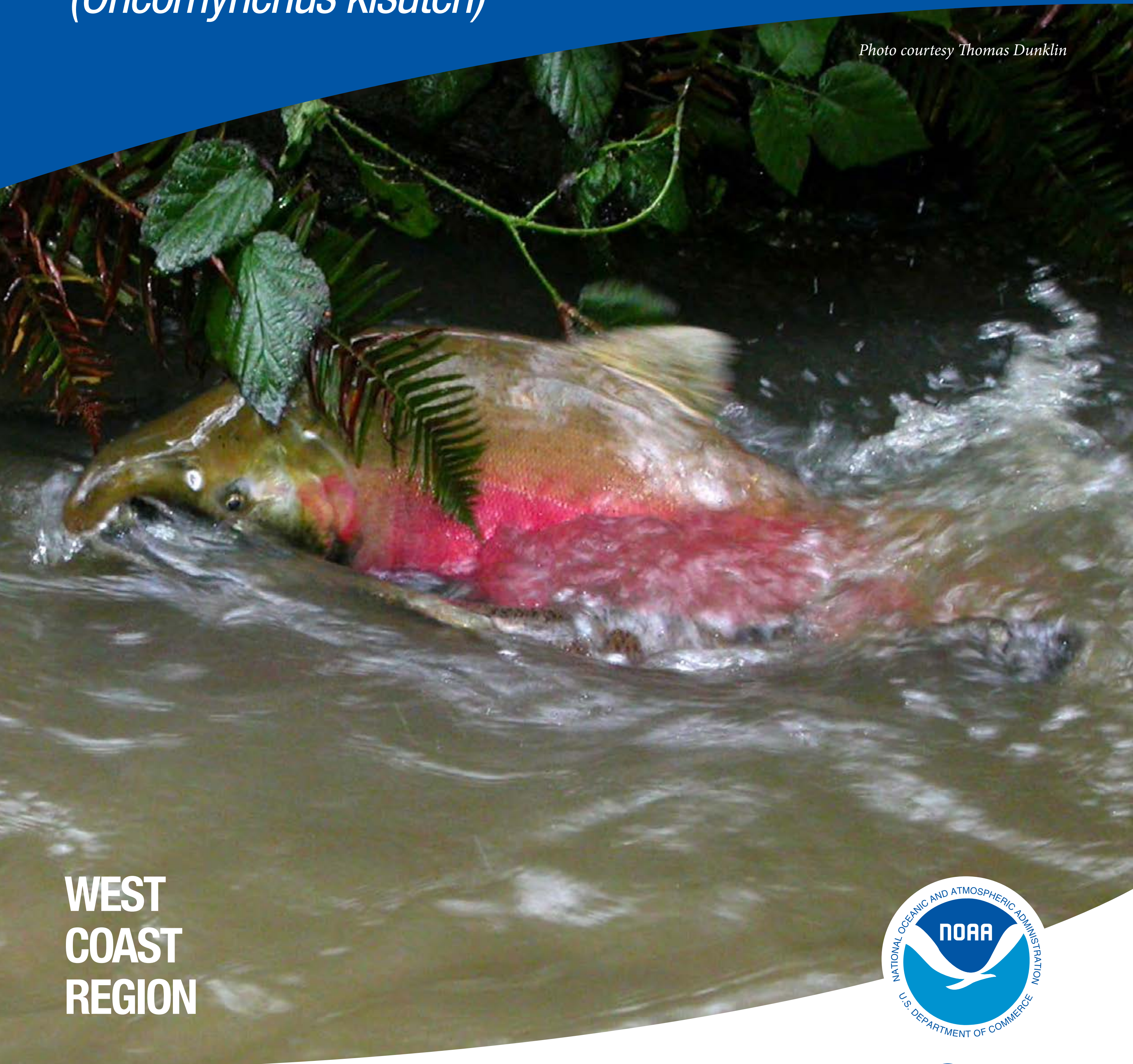
Final Recovery Plan for the Southern Oregon/ Northern California Coast Evolutionarily Significant Unit of Coho Salmon *(Oncorhynchus kisutch)*

2014



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Need for Recovery

Thousands of coho salmon once returned to spawn in the rivers and streams of Northern California and Southern Oregon. Not long ago, these watersheds provided conditions that supported robust and resilient populations of coho salmon that could persist under dynamic environmental conditions. The combined effects of fish harvest, hatcheries, hydropower operations, and habitat alterations caused by land management led to declines in these populations. The National Marine Fisheries Service's (NMFS) evaluation of declining coho salmon abundance and productivity, as well as range reductions and diminished life-history diversity, supported the decision to list the Southern Oregon/Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU) of coho salmon as a threatened species under the Endangered Species Act (ESA) in 1997, a decision that was reaffirmed in 2005.

Recovery can only be achieved through coordinated efforts to build strong conservation partnerships. Conservation partners may be individuals, groups, and government or non-government organizations including NMFS, industry, or tribes who have an interest in the recovery of SONCC coho salmon. The ESA envisions recovery plans as the central organizing tool for guiding each species' recovery process. The recovery plan is a road map to recovery – it lays out where we need to go and how best to get there. The SONCC Coho Salmon ESU recovery plan (Plan) was developed to provide a roadmap to recovery of this species which conservation partners can follow together. Specifically, the Plan is designed to guide implementation of prioritized actions needed to conserve and recover the species by providing an informed, strategic, and voluntary approach to recovery that is based on the best available science. Use of a recovery plan ensures that recovery efforts target limited resources effectively and efficiently. The Plan also provides recovery targets to work toward, as well as criteria by which progress toward recovery will be tracked.

Current Species Status (Chapter 2)

The SONCC Coho Salmon ESU includes all naturally spawned populations of coho salmon in coastal streams between Cape Blanco, Oregon and Punta Gorda, California, as well as coho salmon produced by three artificial propagation programs: Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery. An ESU is comprised of groups of populations with geographic and evolutionary similarities that are considered a "species" under the ESA. NMFS originally listed the SONCC coho salmon ESU as threatened under the ESA in 1997 (62 FR 24588, May 6, 1997). In 2005, following a reassessment of its status and after applying NMFS' hatchery listing policy, NMFS reaffirmed its status as threatened and also added several hatchery programs to the listed ESU (70 FR 37160, June 28, 2005).

NMFS issued guidelines in 1990 (55 FR 24296, June 15, 1990) for assigning listing and recovery priorities. Three criteria are assessed to determine NMFS' species' priority for recovery plan development, implementation, and resource allocation: 1) magnitude of threat; 2) recovery potential; and 3) existing conflict with activities such as construction and development. The recovery priority number for the SONCC coho salmon ESU is 1, as reported in the 2011-2012

Biennial Report to Congress on the Recovery Program for Threatened and Endangered Species (NMFS 2013).

In 2006, NMFS modeled the historic population structure of the SONCC coho salmon ESU (Williams et al. 2006; Chapter 2, this volume). Each population is described in terms of its modeled capacity to support rearing juvenile coho salmon, based on the intrinsic ability of the habitat to support this life stage. This capacity is described as Intrinsic Potential or IP. Williams et al. (2006) calculated the number of kilometers of IP for each population. The role each population played in the historic function of the ESU is primarily based on how much IP it contains. Populations with more than 34 IP-km are described as independent because, due to their size, they are not dependent on strays from nearby populations to persist over time. Populations with from 5 to 34 IP-km are described as dependent because they are too small to persist without immigration from independent populations. NMFS grouped populations with similar geologic and genetic features into seven diversity strata (Williams et al. 2006). Williams et al. (2006) originally described 45 populations in the SONCC coho salmon ESU (Williams et al. 2006), but this recovery plan describes 40 populations, due to the recalculation of the amount of IP in some populations and exclusion of populations with less than 5 IP-km. Figure ES-1 shows the SONCC coho salmon ESU, including all 40 populations and seven diversity strata.

Populations with extremely low numbers of spawning adults can suffer from depensatory effects, which are problems with successful reproduction such as spawners being too scarce to find each other. The number of spawners needed to avoid depensatory effects is called the depensation threshold. Based on the amount of IP-km in each population, this recovery plan describes the extinction risk of each independent population. An independent population with spawner numbers below the depensation threshold is at high risk of extinction. Currently, over three quarters of SONCC coho salmon independent populations are at high risk of extinction (Figure ES-2). In a recovered ESU, these populations would be at moderate or low risk of extinction.

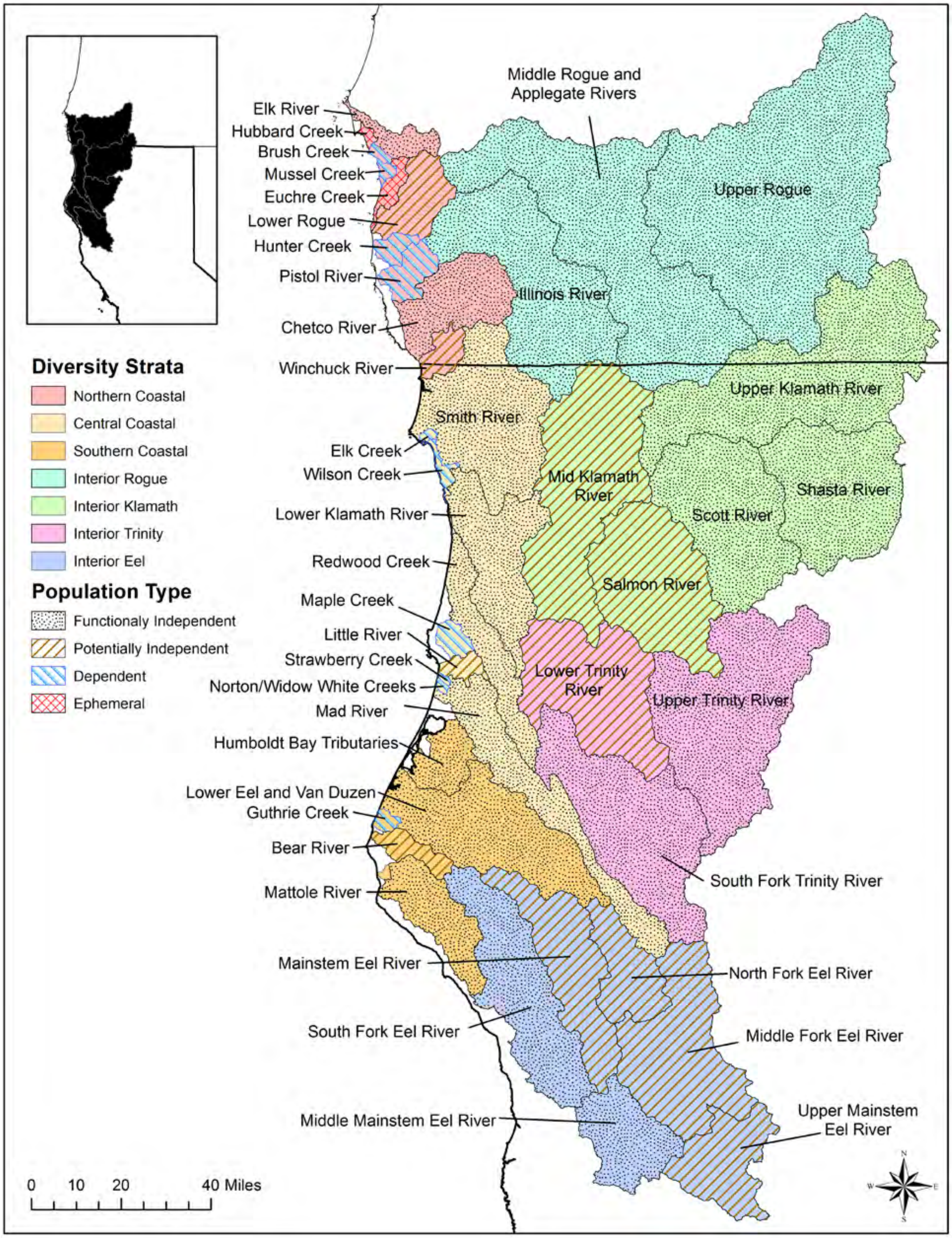

Figure ES-1. Populations and diversity strata of the SONCC coho salmon ESU.

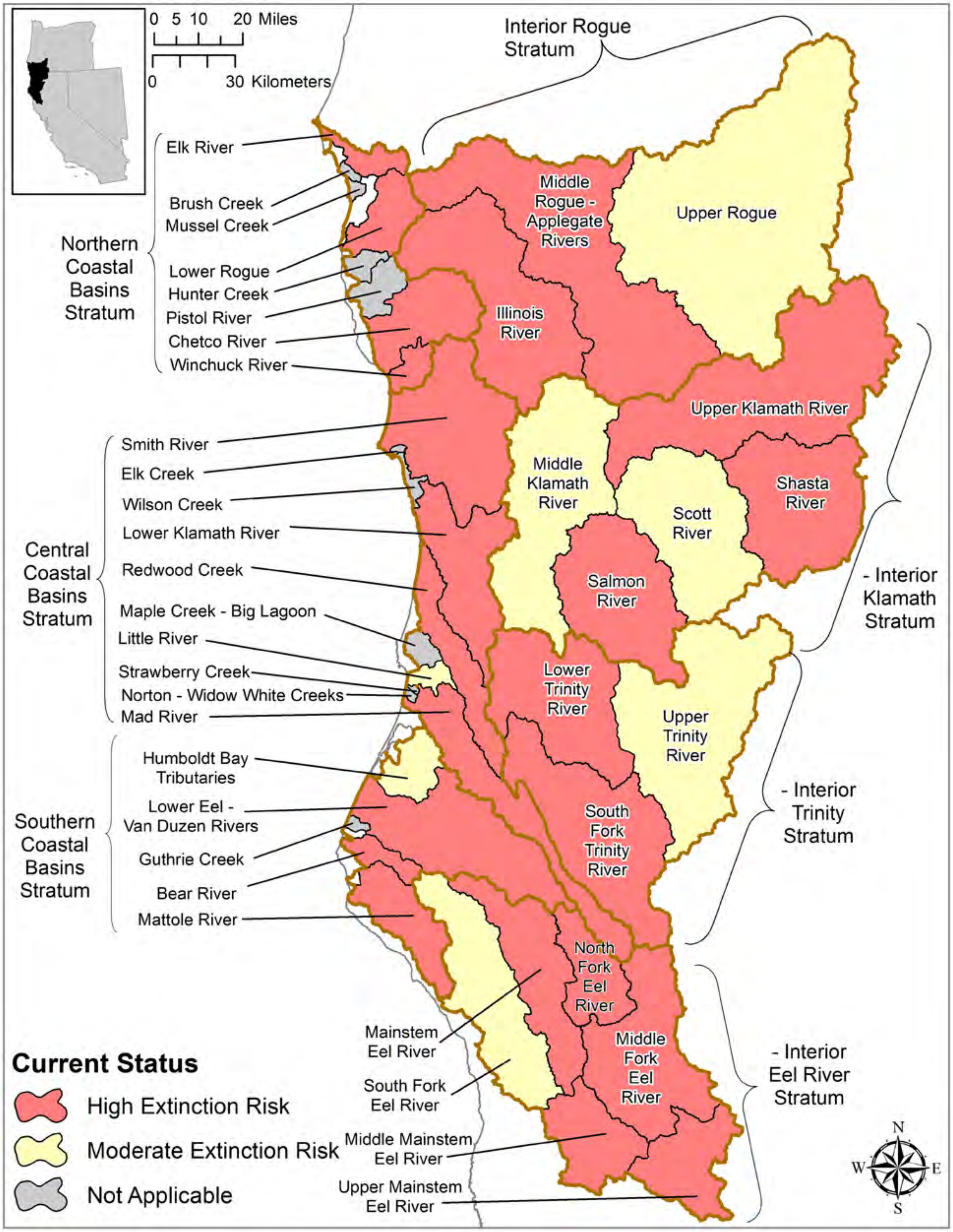

Figure ES-2. Current extinction risk of independent populations in the SONCC coho salmon ESU.

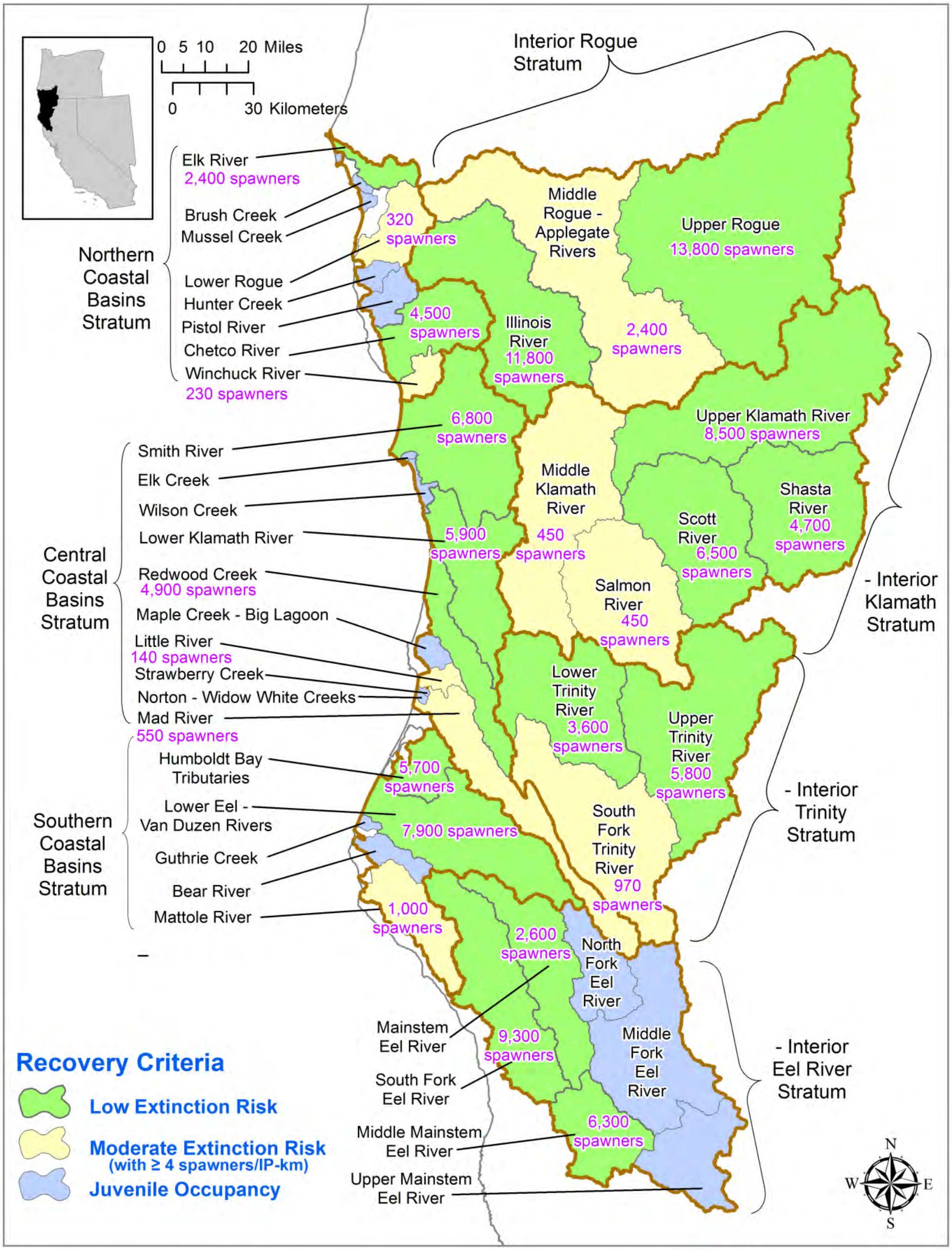

Figure ES-3. Minimum target extinction risk and recovery criteria for each population.

Stresses and Threats (Chapters 3 and 7 to 46)

Stresses are the physical, biological, or chemical conditions and associated ecological processes that that may impede SONCC coho salmon recovery. These are the factors that the fish feel, such as disease, limited habitat access, insufficient instream flows, impaired water quality, and insufficient amount and quality of habitat. Threats are those activities or impacts that cause or contribute to stresses such as hydropower, diversions, land management, invasive species, fish harvest, timber harvest, and hatcheries. The Plan includes recovery actions to restore various aspects of coho salmon habitat, and SONCC coho salmon recovery also depends on ongoing efforts to change past and current practices that diminish salmon habitat.

Chapter 3 describes the stresses and threats that NMFS believes are currently limiting populations from producing enough adults to avoid a high risk of extinction. Chapters 7 to 46 rank these stresses and threats for each population, and contain tables that describe the actions needed to reduce these stresses and threats. Chapters 7 to 46 also describe the key limiting stresses and threats for each population. Key limiting stresses and threats are those stresses and threats that are the most pressing factors limiting recovery of populations. Recovery actions to address key limiting stresses and threats often have a higher priority than those to address other stresses and threats. The key limiting stresses and threats for each population are shown in Table ES-1.

The lack of floodplain and channel structure is a key limiting stress in nearly all coastal populations and about half of interior populations. Good floodplain structure is present when the river retains areas off the main channel such as ponds and old oxbows. These areas are particularly important for coho salmon as they provide refuge from high winter flows. Good channel structure is present when there are sufficient pools and instream structure, such as complex wood jams. In coastal populations, the most common key limiting threat (52% of populations) is channelization, which results in straightening and simplification of the stream channel and reduction of off-channel habitat. In a third of all populations and 63% of interior populations, the amount of water in streams and rivers is insufficient for coho salmon needs, making altered hydrologic function another prevalent key limiting stress. In 35% of all populations and 71% of interior populations, dams and diversions are a key limiting threat, as they lead to a reduction in the amount of water in streams and rivers.

Table ES-1. SONCC coho salmon ESU populations and their key limiting stresses and threats.

Stratum	Populations	Key Limiting Stresses		Key Limiting Threats	
Northern Coastal Basin	Elk River	Structure	Water Quality	Agriculture	Channelization
	Brush Creek	Structure	Riparian	Roads	Timber Harvest
	Mussel Creek	Structure	Riparian	Timber Harvest	Channelization
	Lower Rogue River	Structure	Water Quality	Roads	Development
	Hunter Creek	Structure	Riparian	Roads	Timber Harvest
	Pistol Creek	Structure	Riparian	Roads	Timber Harvest
	Chetco River	Structure	Riparian	Channelization	Development
	Winchuck River	Structure	Water Quality	Channelization	Development
Central Coastal Basin	Smith River	Structure	Estuary	Channelization	Agriculture
	Elk Creek	Structure	Riparian	Channelization	Development
	Wilson Creek	Structure	Riparian	Roads	Timber Harvest
	Lower Klamath River	Structure	Sediment	Channelization	Agriculture
	Redwood Creek	Structure	Estuary	Channelization	Roads
	Maple Creek/Big Lagoon	Structure	Sediment	Roads	Timber Harvest
	Little River	Structure	Sediment	Roads	Agriculture
	Strawberry Creek	Estuary	Barriers	Barriers	Channelization
	Norton/Widow White Creek	Structure	Riparian	Channelization	Roads
	Mad River	Structure	Sediment	Roads	Mining
Southern Coastal Basin	Humboldt Bay tributaries	Structure	Estuary	Channelization	Roads
	Lower Eel/Van Duzen Rivers	Structure	Estuary	Channelization	Dam/Diversion
	Guthrie Creek	Structure	Sediment	Timber Harvest	Agriculture
	Bear River	Structure	Riparian	Roads	Timber Harvest
	Mattole River	Structure	Hydro Function	Dam/Diversion	Development
Interior Rogue River	Illinois River	Structure	Hydro Function	Dam/Diversion	Roads
	Middle Rogue/Applegate Rivers	Structure	Hydro Function	Dam/Diversion	Development
	Upper Rogue River	Structure	Hydro Function	Agriculture	Development
Interior Klamath	Middle Klamath River	Structure	Water Quality	Dams/Diversion	Fire
	Upper Klamath River	Hydro Function	Barriers	Dam/Diversion	Roads
	Shasta River	Hydro Function	Water Quality	Dam/Diversion	Agriculture
	Scott River	Hydro Function	Riparian	Dam/Diversion	Agriculture
	Salmon River	Structure	Riparian	Fire	Climate Change
Interior Trinity	Lower Trinity River	Structure	Hydro Function	Channelization	Hatcheries
	South Fork Trinity River	Hydro Function	Water Quality	Dam/Diversion	Roads
	Upper Trinity River	Hydro Function	Hatchery Effects	Dam/Diversion	Hatcheries
Interior Eel	Mainstem Eel River	Structure	Water Quality	Dam/Diversion	Invasive Species
	Middle Mainstem Eel River	Hydro Function	Sediment	Dam/Diversion	Roads
	Upper Mainstem Eel River	Hydro Function	Barriers	Dam/Diversion	Roads
	Middle Fork Eel River	Structure	Water Quality	Channelization	Roads
	South Fork Eel River	Structure	Hydro Function	Dam/Diversion	Roads
	North Fork Eel River	Water Quality	Sediment	Roads	Fire

Recovery Strategy (Chapters 4 and 6)

The goal of this Plan is to recover the SONCC coho salmon ESU to the point where the species no longer needs the protections afforded by the Federal ESA and can be removed from the ESA list of threatened and endangered species. A recovered SONCC coho salmon ESU will be naturally self-sustaining, and the factors that caused it to be listed will be sufficiently reduced to allow it to persist over time.

The strategy to recover SONCC coho salmon is to carry out recovery actions to restore habitat and reduce stresses and threats, so that populations will rebuild to the levels needed to play their respective roles in recovery, as described in Figure ES-3. These levels are associated with target minimum extinction risks, also shown in Figure ES-3.

Each population must play a role in rebuilding to a recovered ESU. These roles are described in Williams et al. (2008). A certain number of independent populations must be at low risk of extinction to achieve recovery. These populations are called "Core populations" in this plan. A subset of remaining independent populations must be at moderate risk of extinction (and recover to hundreds to low thousands of fish). These populations are called "Non-Core 1 populations". The remaining populations don't need a minimum number of fish, instead they must have sufficient habitat occupied by juvenile fish. These populations are called "Dependent" and "Non-Core 2" populations. Figure ES-4 shows the role of each population.

In 2008, NMFS developed an assessment framework to track the SONCC coho salmon ESU's progress toward recovery (Williams et al. 2008 and Chapters 2 and 4 of this plan). The framework describes a needed configuration of populations with different numbers of spawning adults in various populations such that populations will play different roles in recovery (i.e., when describing core, non-core, dependent) but does not identify which independent populations will be core and which will be non-core. This recovery plan describes which populations will be core and non-core, and identifies the number of spawning adults needed and the needed spatial distribution of juvenile fish for each population. The number of spawning adults needed is based on the population's role in recovery and on the amount of modeled IP-km in each population.

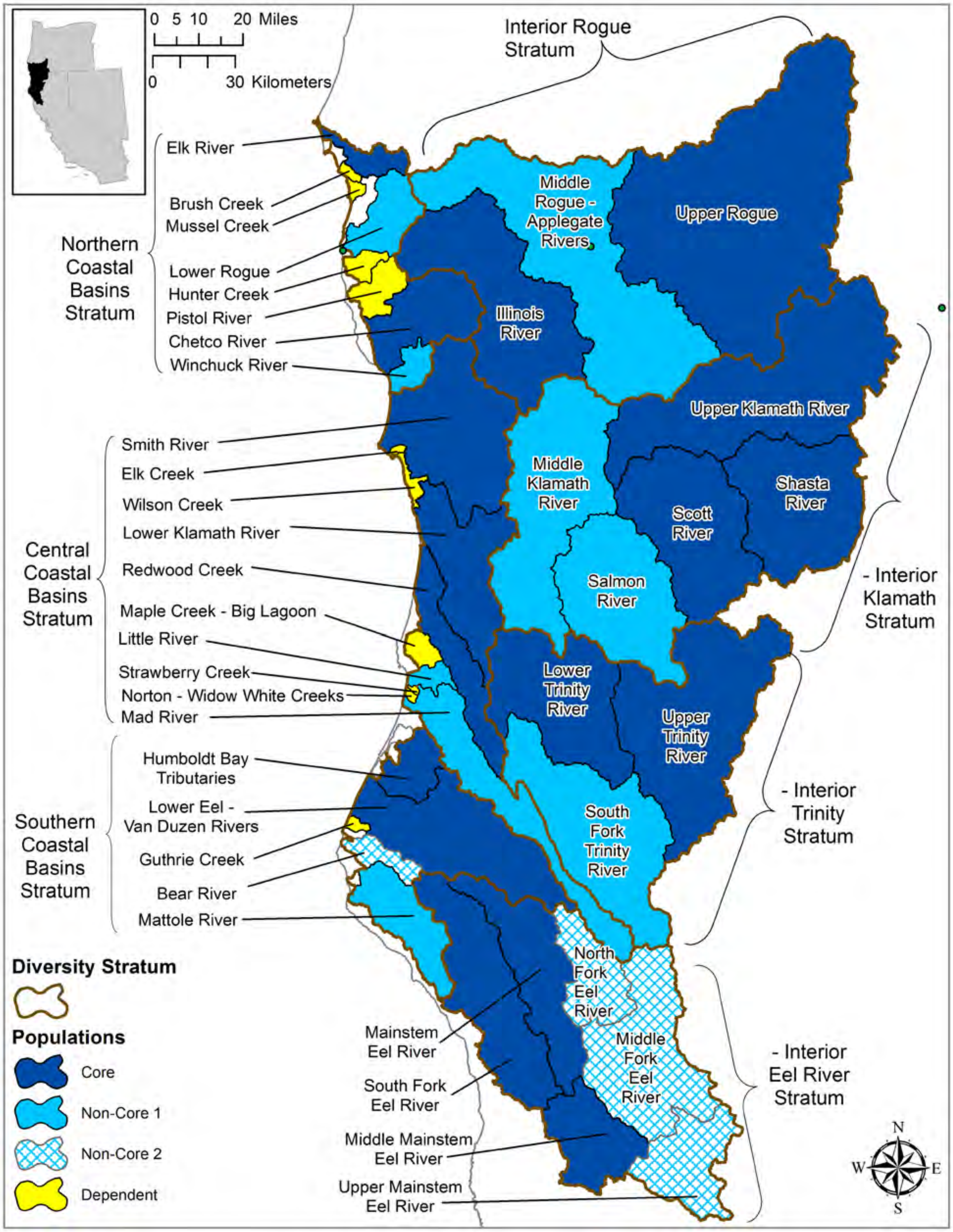

Figure ES-4. The role of each population in the recovery of the SONCC coho salmon ESU.

Table ES-2 shows the recovery objectives and criteria for each population type. There are recovery objectives for four biological parameters of each population: spawner abundance, productivity (growth rate), spatial structure, and diversity (Table ES-2). The Plan's recovery criteria, explained in Chapter 4 and shown in Table ES-2, describe how progress toward each recovery objective will be measured.

Table ES-2. Recovery objectives and criteria by Viable Salmonid Population parameter.

VSP Parameter	Population Role	Biological Recovery Objective	Biological Recovery Criteria[1]
Abundance	Core	Achieve a low risk of extinction[2]	The geometric mean of wild adults over 12 years meets or exceeds the "low risk threshold" of spawners for each core population[2,3,4]
	Non-Core 1	Achieve a moderate or low risk of extinction[2]	The annual number of wild adults is greater than or equal to four spawners per IP-km for each non-core population[2]
Productivity	Core and Non-Core 1	Population growth rate is not negative	Slope of regression of the geometric mean of wild adults over the time series ≥ zero[4]
Spatial Structure	Core and Non-Core 1	Ensure populations are widely distributed	Annual within-population juvenile distribution ≥ 80%[4] of habitat[5,6] (outside of a temperature mask[7])
	Non-Core 2 and Dependent	Achieve inter- and intra-stratum connectivity	≥ 80% of accessible habitat[4] is occupied in years[8] following spawning of cohorts that experienced high marine survival[9]
Diversity	Core and Non-Core 1	Achieve low or moderate hatchery impacts on wild fish	Proportion of hatchery-origin adults (pHOS) < 0.05
	Core and Non-Core 1	Achieve life-history diversity	Variation is present in migration timing, age structure, size and behavior. The variation in these parameters[10] is retained.

[1] All applicable criteria must be met for each population in order for the ESU to be viable.
[2] See Table 4-2 for specific spawner abundance requirements needed to meet this objective.
[3] In the Shasta River, Upper Trinity River, and Upper Rogue River populations, IP above some anthropogenic dams was excluded from the spawner target, so the low-risk threshold for these populations is based on the IP downstream of those dams.
[4] Assess for at least 12 years, striving for a coefficient of variation (CV) of 15% or less at the population level (Crawford and Rumsey 2011).
[5] Based on available rearing habitat within the watershed (Wainwright et al. 2008). For purposes of these biological recovery criteria, "available" means accessible. 80% of habitat occupied relates to a truth value of +1.0,(true: juveniles occupy a high proportion of the available rearing habitat within the watershed (p. 56, Wainwright et al. 2008).
[6] The average for each of the three year classes over the 12 year period used for delisting evaluation must each meet this criterion. Strive to detect a 15% change in distribution with 80% certainty (Crawford and Rumsey 2011).
[7] Williams et al. (2008) identified a threshold air temperature, above which juvenile coho salmon generally do not occur, and identified areas with air temperatures over this threshold. These areas are considered to be within the temperature mask.
[8] If young-of-year are sampled, sampling would occur the spring following spawning of the cohorts experiencing high marine survival. If 1+ juveniles are sampled, sampling would occur approximately 1.5 years after spawning of the cohorts experiencing high marine survival, but before outmigration to the estuary and ocean.
[9] High marine survival is defined as 10.2% for wild fish and 8% for hatchery fish; Sharr et al. 2000. If marine survival is not high, then this criterion does not apply.
[10] This variation is documented in the population profiles in Chapters 7 to 46 of this plan.

Recovery Actions

Chapters 5 and 7 to 46 include over 4,000 recovery action steps and their respective priorities. Recovery actions are designed to address acute issues by reducing threats, and to restore processes which create and maintain good coho salmon habitat by reducing stresses. Recovery actions include removal of or establishment of passage at dams; reducing unpermitted diversions; ensuring sufficient water quantity and quality; restoring in-channel habitat and upslope ecological function; and creating suitable estuarine nurseries. In addition, managing fisheries, reducing detrimental effects of land use activities; decreasing disease and non-native predator species, and operating hatcheries consistent with recovery goals are essential. Each recovery action is assigned a priority. The priority of each action is based on whether it will prevent a significant decline in the population or habitat, whether it addresses a key limiting stress or threat, whether it would help a population at high risk of extinction, and whether it would benefit coho salmon immediately.

Monitoring & Adaptive Management (Chapter 5)

Monitoring is necessary to assess the recovery of SONCC coho salmon by determining if specific recovery criteria are met, and to evaluate whether changes in the recovery strategy are necessary. The Plan identifies acceptable sampling standards and the necessary data to be collected over time, including measuring the abundance and distribution of coho salmon in each population. The adaptive management element offers a feedback loop for continuous scientific evaluation of the foundational scientific framework, monitoring, and recovery action aspects of the Plan so that new information can suggest whether to add or discontinue actions or strategies. Web-based recovery action implementation tracking tools are under development.

Benefits of Recovery

Achieving delisting of SONCC coho salmon by implementation of the recovery actions identified in the Plan is estimated to cost approximately $5 billion over the amount of time needed to recover the species (just over 100 years). Approximately $1.6 billion of that total cost is associated with monitoring actions required to meet delisting criteria. While a significant investment, the recovery of SONCC coho salmon will concurrently result in a wide array of economic, societal and ecosystem benefits. The largest economic returns resulting from recovered coho salmon populations are associated with sport and commercial fishing. For example, the California commercial and recreational salmon fisheries are estimated to generate a total of $118-279 million[1] in income annually, and provide roughly two to three thousand jobs. These figures will increase as salmon runs increase, providing both economic gains and more commercial and recreational fishing opportunities. With a revived sport and commercial fishery, these substantial economic gains and the creation of jobs would be realized across the SONCC coho salmon range, most notably for river communities and coastal counties.

[1] Employment impacts of CA salmon fishery closures in 2008 and 2009. University of the Pacific. Available at: http://forecast.pacific.edu/BFC%20salmon%20jobs.pdf

The economy will also be stimulated through the employment of workers needed to implement recovery projects. Habitat restoration projects stimulate job creation at a level comparable to traditional infrastructure investments such as mass transit, roads, or water projects[2]. Every dollar invested in watershed restoration projects travels through the state's economy. Design, implementation, and maintenance of habitat restoration projects require hiring consultants, contractors, employees, and field crews, and purchasing equipment, goods and services. People hired to carry out such projects spend their wages on goods and services in their local communities. In Oregon, 90% of investments in habitat restoration have been shown to stay in the state[2].

Many of the actions identified in this plan are designed to improve watershed-wide processes which benefit many native species of plants and animals (including other state and federally protected species) by restoring ecosystem functions. In addition, restoration of habitat provides substantial benefits for human communities such as: improving and protecting the quality of important surface and ground water supplies; reducing damage from flooding resulting from floodplain development; and controlling invasive exotic animal and plant species which can threaten water supplies and increase flooding risk. Restoring and maintaining healthy watersheds also enhances important human uses of aquatic habitats, including outdoor recreation, ecological education, field based research, aesthetic benefits, and the preservation of tribal and cultural heritage.

Summary

The Plan provides a comprehensive roadmap for the recovery of SONCC coho salmon to be followed by conservation partners. Recovery will require implementation of actions that conserve and restore the key biological, ecological, and landscape processes that support the ecosystems upon which coho salmon populations depend. The Plan identifies specific recovery actions that protect or restore coho salmon or their habitat and outlines a monitoring and evaluation program to guide its adaptive management elements so that the most effective means of achieving recovery will be utilized. Biological recovery goals, objectives and measurable criteria, and web-based management tools, will provide for a mechanism to track recovery progress. Salmon recovery is best viewed as an opportunity to diversify and strengthen the economy while enhancing the quality of life for present and future generations.

[2] The Economic Impacts of Forest and Watershed Restoration in Oregon, Available at: http://www.oregon.gov/OWEB/MONITOR/job_creation_local_economies.shtml

1. Background

1.1 Introduction

Populations of coho salmon (*Oncorhynchus kisutch*) once ranged across the western part of North America from the coastal river basins of Alaska to interior areas of Washington and probably inhabited most coastal streams in Washington, Oregon, and northern and central California (62 FR 24588, May 6, 1997). These populations were sufficiently large that they were able to withstand changing environmental conditions. Fisheries for these and other salmonids supported vibrant communities across the Pacific Northwest. Salmon were a critical part of healthy ecosystems in rivers and the ocean.

Part of the range of coho salmon occurs in the Southern Oregon/Northern California Coast (SONCC) Recovery Domain, which encompasses the rivers from Punta Gorda, California to Cape Blanco, Oregon. The coho salmon which occupy this area make up the SONCC coho salmon Evolutionarily Significant Unit (ESU). An ESU is a salmon stock that is considered a distinct population and hence a “species” under the Endangered Species Act. An ESU must meet two criteria: it must be substantially reproductively isolated from other nonspecific population units, and it must represent an important component of the evolutionary legacy of the species (57 FR 58612, November 20, 1991).

In the late 1990s, the populations that make up the SONCC Coho Salmon ESU were small, poorly distributed, and subject to factors that threatened their continued existence. Consequently, the ESU was listed as threatened under the Endangered Species Act (ESA) in 1997 (62 FR 24588, May 6, 1997), a finding that was reaffirmed in 2005 (70 FR 37160, June 28, 2005). A “threatened” species is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (ESA Section 3(20)). An “endangered” species is one that is in danger of extinction throughout all or a significant portion of its range (ESA Section 3(6)). The status of the species has continued to worsen since listing (Good et al. 2005, Williams et al. 2011), despite fishing prohibitions and habitat improvements.

The ESU continues to face challenges, as shown in the Rogue River. The Rogue River has the longest time series of coho salmon adult abundance information in the ESU, and its populations are among those in the best condition. Nonetheless, coho salmon returns there are a small fraction of what they once were. The Rogue River is the only river in the ESU with data on coho abundance in the 1800s. Based on extrapolations from cannery pack data, up to 114,000 adult coho salmon returned to the Rogue River in the late 1800s even after heavy fishing pressure had occurred for years (Meengs and Lackey 2005). Figure 1-1 shows the estimated number of adult coho salmon spawners that returned to the Rogue River from 1980 to 2010, based on counts at Huntley Park (Oregon State University (OSU) 2010), as well as the recovery target for all populations in the Rogue River as presented in this recovery plan. The number of adults has been consistently below that needed for the Rogue River to play its role in recovery of the SONCC coho salmon ESU.

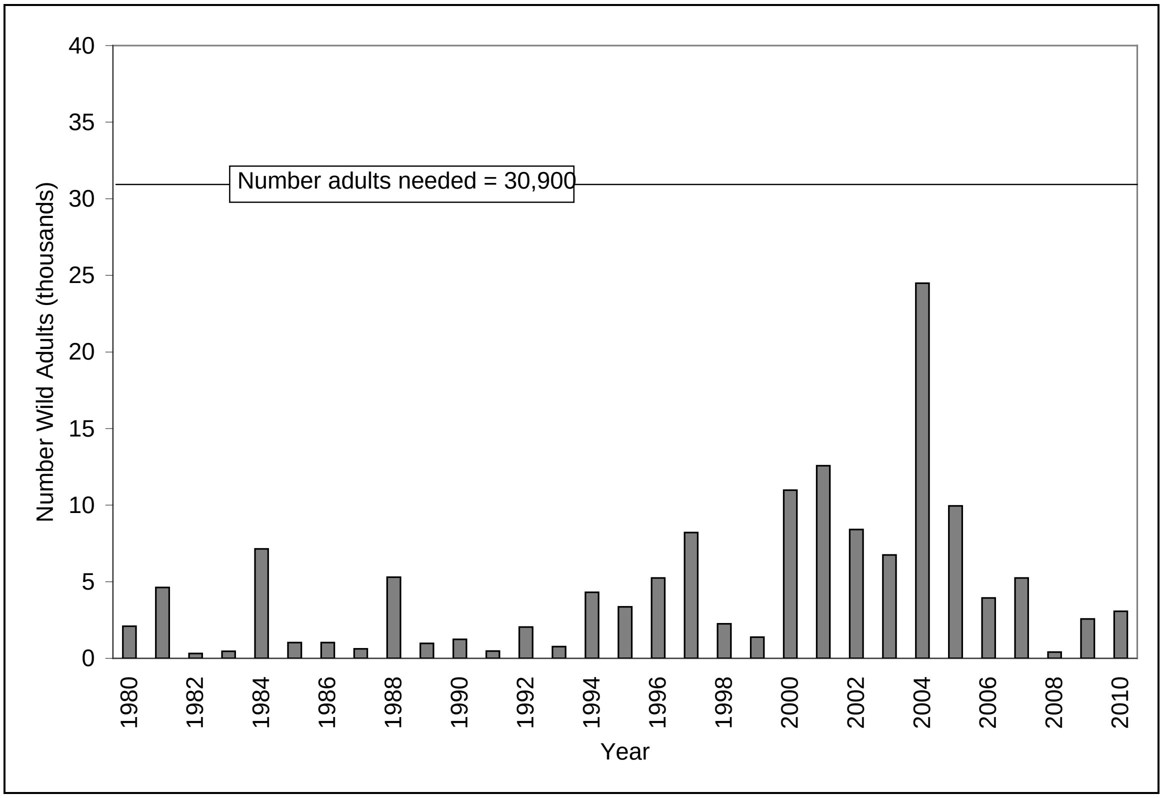

Figure 1-1. Estimates of the run size of wild Rogue basin coho salmon past Huntley Park, 1980-2010 (Oregon Department of Fish and Wildlife [ODFW] 2012), compared to number needed from Rogue River for ESU recovery.

1.2 What is a recovery plan?

"Recovery" is the process by which listed species and their ecosystems are restored and their future is safeguarded to the point that protections under the ESA are no longer needed (NMFS 2010). When a species is listed under the ESA, a recovery plan generally must be prepared (ESA Section 4(f)(1)). The ESA envisions recovery plans as the central organizing tool for guiding each species' recovery process. The recovery plan is a road map to recovery – it lays out where we need to go and how best to get there. The plan organizes, coordinates, and prioritizes the many possible actions that may be taken to achieve recovery of a species. Use of a recovery plan ensures that recovery efforts target limited resources effectively and efficiently.

Recovery plans are guidance documents. No agency or entity is required by the ESA to implement a recovery plan. However, recovery plans describe how Federal agencies can best meet their responsibilities under the ESA. Specifically, section 7(a)(1) of the ESA calls on all Federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species…" In addition to outlining strictly proactive measures to achieve the species' recovery, plans provide context and a framework for implementation of other provisions of the ESA with respect to a particular species, such as section (7)(a)(2) consultations on Federal agency activities, development of Habitat Conservation Plans or Safe Harbor agreements under Section 10, or special rules for threatened species under section 4(d).

1.3 Achieving Recovery

Federal agencies have neither the funds nor the authority to bring about all the actions necessary to sufficiently improve the condition of this species. Partnerships are a critical component of SONCC coho salmon recovery: partnerships between private landowners, tribes, and local, state, and federal government agencies; between non-governmental organizations and landowners; and between federal, state, and local agencies. A recovered ESU can provide ecosystem, recreation, and economic benefits to communities. All of these entities have a common interest in bringing healthy coho salmon populations and their ecosystems back to California's north coast and Oregon's south coast. The states of California and Oregon have been proactive in determining the recovery needs of coho salmon.

1.3.1 Oregon Plan for Salmon and Steelhead

The Oregon Coastal Salmon Restoration Initiative (OCSRI) is a planning process which began in 1995 with the following mission: "To restore our coastal salmon populations and fisheries to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits." In 1997, the State of Oregon released the Oregon Plan, a conservation plan designed to restore salmon to a level at which they can once again be a part of people's lives (State of Oregon 1997). The Oregon Plan included the following goals:

- Goal 1: An infrastructure will exist to provide long-term continuity in leadership, direction, and oversight of salmon restoration.
- Goal 2: Opportunities will exist for a wide range of natural resource uses that are consistent with salmon restoration.
- Goal 3: Achievement of overall OCSRI goals will be based to the greatest extent on existing laws and environmental protections, rather than new ones.
- Goal 4: An adequate funding base will be established and maintained to support the OCSRI.
- Goal 5: Oregon's expectations for sustainability of interrelated natural resources will more accurately reflect a scientific understanding of the physical and biological constraints of the ecosystem.
- Goal 6: Sufficient freshwater and estuarine habitat will be available to support healthy populations of anadromous salmonids throughout coastal river basins.
- Goal 7: Populations of salmonids in coastal river basins will achieve levels of natural production consistent with overall restoration goals.
- Goal 8: A science-based system will support evaluation of progress of the OCSRI Conservation Plan and will provide a basis for making appropriate future changes to management programs.

Report of Oregon Expert Panel

ODFW (2008b) convened a panel of fisheries and watershed scientists as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. The panel identified limiting factors and threats affecting each SONCC coho salmon population in Oregon by considering the impacts across the entire life cycle. The results of the expert panel deliberations are described in each Oregon population profile.

1.3.2 Recovery Strategy for California Coho Salmon

Coho salmon north of San Francisco were listed as threatened under the California Endangered Species Act in 2002. In 2004, the California Fish and Game Commission approved the Recovery Strategy for California Coho Salmon (CDFG 2004a). The plan identified six goals to achieve delisting:

- Goal I: Maintain and improve the number of key populations and increase the number of populations and cohorts of coho salmon.
- Goal II: Maintain and increase the number of spawning adults.
- Goal III: Maintain the range, and maintain and increase distribution of coho salmon.
- Goal IV: Maintain existing habitat essential for coho salmon.
- Goal V: Enhance and restore habitat within the range of coho salmon.
- Goal VI: Reach and maintain coho salmon population levels to allow for the resumption of Tribal, recreational, and commercial fisheries for coho salmon in California.

1.4 Listing of Species

The SONCC coho salmon ESU was listed as threatened in 1997, and this status was reaffirmed in 2005 (62 FR 24588, May 6, 1997 and 70 FR 37160, June 28, 2005). This ESU includes all naturally spawned coho salmon populations between Punta Gorda, California and Cape Blanco, Oregon as well as three artificial propagation programs: The Cole Rivers Hatchery (ODFW stock #52), Trinity River Hatchery, and Iron Gate Hatchery coho hatchery programs. The decision to list the SONCC coho salmon ESU was largely based on information regarding decreased abundance, reduced distribution, and degraded habitat. There are far fewer streams and rivers supporting coho salmon in this ESU now compared to historical conditions, and numerous basin-specific extirpations of coho salmon have been documented (Brown et al. 1994, NMFS 1996, CDFG 2004a, Good et al. 2005, Gustafson et al. 2007). At the time of listing, the major factors in the decline of the species were thought to originate from long-standing, human-induced actions (e.g., habitat degradation, harvest, water diversions, and artificial propagation), combined with natural environmental variability (62 FR 24588, May 6, 1997).

The SONCC coho salmon ESU is made up of 45 ephemeral, dependent, and independent populations (Williams et al. 2006). Five of these populations are not part of the recovery strategy described in this plan. Three were excluded due to reductions in IP (see Appendix A), and two were determined to be too small to persist and therefore were excluded from further consideration.

According to Section 4(a)(1) of the ESA and NMFS listing regulations (50 Code of Federal Regulations [CFR] Part 424), a species may be found to be endangered or threatened based on any one or a combination of five factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or human-made factors affecting its continued existence. The effect of these factors on SONCC coho salmon was considered when the species was listed. The descriptions of each of the factors that follow summarize the final rule from the listing of the SONCC coho salmon ESU (62 FR 24588, May 6, 1997). Chapter 3, as well as Chapters 7 to 46, describes the state of current stresses and threats.

1.4.1 Factor A: Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The habitat factors for the decline of SONCC coho salmon are as follows: Channel morphology changes, substrate changes, loss of instream roughness, loss of estuarine habitat, loss of wetlands, loss/degradation of riparian areas, declines in water quality (e.g., elevated water temperatures, reduced dissolved oxygen, altered biological communities, toxics, elevated pH, and altered stream fertility), altered streamflows, fish passage impediments, elimination of habitat, and direct take (62 FR 24588, May 6, 1997). The major activities responsible for the decline of coho salmon were identified as follows: logging, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation (62 FR 24588, May 6, 1997).

1.4.2 Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overfishing in non-tribal fisheries was identified as a significant factor in the decline of coho salmon (62 FR 24588, May 6, 1997). Significant overfishing occurred from the time marine survival turned poor for many stocks (ca. 1976) until the mid-1990s when harvest was substantially curtailed. This overfishing compromised escapement levels. The contribution of recreational fisheries to the decline was unknown at the time of listing. Tribal harvest was not considered to be a major factor for the decline of coho salmon in either the Klamath River basin or Trinity River basin (62 FR 24588, May 6, 1997). Collection for scientific research and educational programs was believed to have little or no impact on coho salmon populations in the SONCC coho salmon ESU at the time of listing (62 FR 24588, May 6, 1997).

1.4.3 Factor C: Disease or Predation

At the time of listing, disease and predation were not believed to be major factors contributing to the overall decline of coho salmon, although it was recognized that they may have had substantial impacts in local areas (62 FR 24588, May 6, 1997).

1.4.4 Factor D: Inadequacy of Existing Regulatory Mechanisms

Habitat Management

Federal lands owned by the U.S. Forest Service (in California and Oregon) and Bureau of Land Management (in California) are managed under the Northwest Forest Plan. The Northwest Forest Plan has important benefits for coho salmon, but its overall effectiveness in conserving SONCC coho salmon is limited by the extent of federal lands and the fact that Federal land ownership is often not uniformly distributed. Federal lands are often located in the upper reaches of watersheds or river basins, upstream of much of the most suitable coho salmon rearing habitat. In addition, in some areas Federal lands are distributed in a checkerboard fashion, which results in fragmented landscapes.

NMFS determined California's forest practice rules (CFPRs), which regulate timber harvest, contained provisions that can be protective of coho salmon if fully implemented, but found the ability of these rules to protect coho salmon could be improved (62 FR 24588, May 6, 1997). In particular, the CFPRs did not adequately address large woody debris recruitment, streamside tree retention to maintain bank stability, and canopy retention standards that assure stream temperatures are properly functioning for all life stages of coho salmon. NMFS was not able to assess the adequacy of the T&I rules due to the lack of published documentation that the rules are functioning to protect coho salmon (62 FR 24588, May 6, 1997). In 2010, California's Anadromous Salmonid Protection (ASP) rules replaced its Threatened or Impaired Watershed Rules, which had originally been adopted in July 2000. The ASP rules are described in Chapter 3.

NMFS (62 FR 24588, May 6, 1997) determined that Oregon's Forest Practices Act (OFPA) did not have implementing rules that adequately protect coho salmon habitat. NMFS (62 FR 24588, May 6, 1997) determined that there was a low probability that adequate LWD recruitment could be achieved under the requirements of the OFPA. The OFPA was also found to not adequately consider and manage timber harvest and road construction on sensitive, unstable slopes subject to mass wasting, nor did it address cumulative effects. In particular, the OFPA was found to not provide adequate protection for the production and introduction of large woody debris (LWD) to medium, small, and non-fish bearing streams (62 FR 24588, May 6, 1997).

The Army Corps of Engineers (ACOE) regulates removal and fill activities under section 404 of the Clean Water Act (CWA), and the Oregon Division of State Lands (DSL) manages the state-permitted portion of the removal fill laws. At the time of listing, neither the ACOE nor the DSL had in place any process to address the additive effects of the continued development of waterfront, riverine, coastal, and wetland properties (62 FR 24588, May 6, 1997).

Implementation of the CWA was found to have not been effective in adequately protecting fishery resources, especially with respect to non-point sources of pollution (62 FR 24588, May 6, 1997). Total Maximum Daily Loads (TMDLs) are calculations of the maximum amount of pollutant (e.g., sediment, temperature) that a water body can receive and still safely meet water quality standards. TMDLs are a method for quantitative assessment of environmental problems which affect drinking water, aquatic life, recreation, and other uses of rivers, lakes, and streams. NMFS expected that TMDLs would be able to significantly protect SONCC coho salmon in the long-term, but their effectiveness was as yet unknown because few, if any, TMDLs had been developed for water bodies in the range of SONCC coho salmon at the time of listing (62 FR 24588, May 6, 1997).

At the time of listing, the impacts to fish habitat from agricultural activities had historically not been closely regulated, but Oregon's Department of Agriculture had recently completed guidance for development of Agricultural Water Quality Management Plans. It was unknown whether these agricultural management plans would adequately address salmonid habitat factors (62 FR 24588, May 6, 1997).

Harvest Management

The final rule described fishery regulations implemented in 1994 which are more protective of SONCC coho salmon than were historical regulations (62 FR 24588, May 6, 1997). Specifically, in 1994 the Pacific Fishery Management Council (PFMC) recommended harvest rates below those allowed at that time, and the PFMC recommended prohibiting the retention of coho salmon south of Cape Falcon, Oregon, resulting in the closure of commercial ocean fishing for coho salmon in California in 1994. Oregon began marking all hatchery fish to aid in more accurate estimates of natural returns. Oregon regulations for ocean fisheries within 3 miles of shore had generally conformed to these more protective regulations. In 1995, ocean recreational fishing for coho salmon was closed from Cape Falcon to Horse Mountain.

1.4.5 Factor E: Other Natural or Human-made Factors

NMFS determined that long-term trends in rainfall and marine productivity associated with atmospheric conditions in the North Pacific Ocean likely have a major influence on coho salmon production (62 FR 24588, May 6, 1997). The effects of extended drought on water supplies and water temperatures were recognized as a major concern for California populations of coho salmon. Poor ocean conditions were believed to have played a prominent role in the decline of coho salmon populations in Oregon and California (62 FR 24588, May 6, 1997).

The widespread use of artificial propagation of coho salmon was recognized to have had a significant negative impact on the production of West Coast coho salmon (62 FR 24588, May 6, 1997). Potential problems associated with hatchery programs include: genetic impacts on indigenous, naturally-reproducing populations; disease transmission; predation on wild fish; depletion of wild stock to increase brood stock; and replacement rather than supplementation of wild stocks through competition and continued annual introduction of hatchery fish. Advancement and compression of run timing has also been a common effect of hatchery programs.

1.5 Critical Habitat Designation

Critical habitat for SONCC coho salmon was designated as all accessible reaches of rivers (including estuarine areas and tributaries) between Cape Blanco, Oregon, and Punta Gorda, California (64 FR 24049, May 5, 1999). Critical habitat includes all waterways, substrate, and adjacent riparian zones below longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Tribal lands that were excluded in the critical habitat designation include: Big Lagoon Rancheria, Blue Lake Rancheria, Elk Valley Rancheria, Hoopa Valley Indian Reservation, Karuk Reservation, Laytonville Rancheria, Quartz Valley Reservation, Resighini Rancheria, Round Valley Reservation, Sherwood Valley Rancheria, Smith River Rancheria, and Yurok Reservation.

In the critical habitat designation, NMFS identified five essential habitat types for SONCC coho salmon: (1) spawning areas; (2) adult migration corridors; (3) juvenile summer and winter rearing areas; (4) juvenile migration corridors; and (5) areas for growth and development to adulthood. Spawning and rearing are often located in small headwater streams and side channels. Adult and juvenile migration corridors include these tributaries as well as mainstem reaches and estuarine zones. Growth and development to adulthood occurs primarily in near-and off-shore marine waters, although final maturation takes place in freshwater tributaries when the adults return to spawn (64 FR 24049, May 5, 1999). Within these areas, essential features of coho salmon critical habitat include adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions. In addition, designated freshwater and estuarine critical habitat includes riparian areas that provide the following functions: shade, sediment, nutrient or chemical regulation, stream bank stability, and input of large woody debris or organic matter (64 FR 24049, May 5, 1999).

1.6 ESA Section 4(d) Protective Regulations

Section 9 of the ESA prohibits take of species listed as endangered. Section 4(d) of the ESA provides that, whenever any species is listed as threatened, NMFS shall issue regulations deemed necessary and advisable to provide for the conservation of such species. These protective regulations (commonly referred to as a “4(d) rule”) may prohibit take of threatened species while limiting the prohibition under certain circumstances. The 4(d) rule applies to ocean and inland areas and to any authority, agency, or private individual subject to U.S. jurisdiction. NMFS initially promulgated a 4(d) protective regulation for this ESU in 2000 (65 FR 42422, July 10, 2000) and subsequently amended the regulations which are codified at 50 CFR § 223.203. This protective regulation generally prohibits the take of any SONCC coho salmon with an intact adipose fin, with limits on this general prohibition. The limits on the general prohibition of take described in 50 CFR 223.203 are summarized below.

1. Take of threatened salmonids by employees or designees of Federal agencies, CDFW, ODFW, or other governmental entity with co-management authority for the listed salmonids, if this take is necessary to 1. Aid a sick, injured or stranded salmonid, 2. Dispose of a dead salmonid, or 3. Salvage a dead salmonid which may be useful for scientific study.
2. Fishery harvest activities managed in accordance with a NMFS-approved Fishery Management and Evaluation Plan, and implemented in accordance with a letter of concurrence from NMFS.
3. Hatcheries managed under a state or Federal Hatchery and Genetics Management Plan (HGMP) which has been approved by NMFS as meeting specific criteria.
4. Scientific research activities conducted or overseen by employees or contractors of the Oregon Department of Fish and Wildlife (ODFW) or California Department of Fish and Wildlife (CDFW).

5. Habitat restoration activities conducted as part of a watershed conservation plan which has been certified by the states of California or Oregon as consistent with their watershed conservation plan guidelines. NMFS has found these state guidelines to provide for plans that meet specific criteria.
6. Physical diversion of water from a stream or lake, provided that NMFS or its authorized officer has agreed in writing that the diversion facility is screened, maintained, and operated in compliance with applicable criteria.
7. Routine road maintenance activities which contribute to the attainment and maintenance of properly functioning condition (the sustained presence of natural habitat-forming processes that are necessary for the long-term survival of salmonids through the full range of environmental variation).
8. Municipal, residential, commercial, and industrial development (including redevelopment) activities provided that such development occurs pursuant to city, county, or regional government ordinances or plans that NMFS has determined (in writing) are adequately protective of listed species.

1.7 Addition of hatchery stocks to SONCC coho salmon ESU

NMFS established a policy on the role of artificially propagated Pacific salmon and steelhead in listing determinations under the ESA (70 FR 37204, June 28, 2005). Specifically, this policy: (1) establishes criteria for including hatchery stocks in ESUs and DPSs; (2) provides direction for considering hatchery fish in extinction risk assessments of ESUs and DPSs; (3) requires that hatchery fish determined to be part of an ESU be included in any listing of an ESU or DPS; (4) affirms NMFS' commitment to conserving natural salmon and steelhead populations and the ecosystems upon which they depend; and (5) affirms NMFS' commitment to fulfilling trust and treaty obligations with regard to the harvest of some Pacific salmon and steelhead populations, consistent with the conservation and recovery of listed salmon ESUs and steelhead DPSs.

To determine whether a hatchery program is part of an ESU or DPS, NMFS convened the Salmon and Steelhead Hatchery Advisory Group (SSHAG), which divided existing hatchery programs into categories (SSHAG 2003). Using this information and the policy described above, among other things, NMFS completed new status reviews and ESA-listing determinations for 16 ESUs of Pacific salmon, including the SONCC coho salmon ESU (70 FR 37160, June 28, 2005). This listing determination added three artificial propagation programs to the SONCC coho salmon ESU: Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery coho salmon hatchery programs. NMFS determined these artificially propagated stocks were no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU.

1.8 Status reviews

1.8.1 2005 Status Review

In 2004, NMFS convened a biological review team (BRT) to evaluate the status of SONCC coho salmon. The BRT report (Good et al. 2005) concluded that the SONCC Coho Salmon ESU should remain at a threatened status. The BRT found that data did not suggest any marked change, either positive or negative, in the abundance or distribution of coho salmon within the

SONCC coho salmon ESU. They stated that coho salmon populations continued to be depressed relative to historical numbers, and there were strong indications that breeding groups had been lost from a significant percentage of streams within their historical range (Good et al. 2005). The BRT noted that the 2001 broodyear appeared to be one of the strongest perhaps of the last decade, following a number of relatively weak years (Good et al. 2005). Risk factors identified in previous status reviews such as severe declines from historical run sizes, the apparent frequency of local extinctions, long-term trends that were clearly downward, and degraded freshwater habitat and associated reduction in carrying capacity continued to concern the BRT. The BRT noted that several risk factors had been reduced, including termination of hatchery production of coho salmon at Mad River and Rowdy Creek and restrictions on recreational and commercial harvest of coho salmon since 1994 (Good et al. 2005). A new risk identified by the BRT was the introduction of nonnative Sacramento pikeminnow (*Ptychocheilus grandis*) to the Eel River (Good et al. 2005).

1.8.2 2011 Status Review

The most recent status review concluded the ESU remains threatened (NMFS 2011). Monitoring indicates that abundance of coho salmon decreased for many populations in the ESU since the last status review. Population trends are downward. Additionally, a majority of independent populations are well below low-risk abundance targets, and many may also be below the high-risk depensation thresholds established by Williams et al. (2008). None of the seven diversity strata appear to support a single viable population. However, all of the diversity strata are occupied by coho salmon.

In the status review, NMFS expressed concern about these recent declines in abundance of coho salmon across the ESU, regardless of what the contributing factor(s) may have been (e.g., marine survival conditions and drought). The negative short-term trends observed in the limited number of time series were not unexpected given the apparent low marine survival in recent years (<1% for the 2004 to 2006 year classes). However, as population sizes have decreased other factors (e.g., small population dynamics) may be adversely affecting coho salmon populations in spite of the improved ocean conditions that occurred from 2007 to 2009. The declining abundance trends and low spawner abundance for most populations in the ESU underscore the importance of addressing freshwater habitat conditions across the ESU so that all populations are sufficiently resilient to withstand fluctuations in marine survival.

The threats discussed in the five factor analysis were found to be largely unchanged since the last status review with the exception of those associated with natural or manmade factors (NMFS 2011). In particular, threats from poor ocean conditions, drought, climate change, and small population size (depensation and stochastic processes) have or are likely to have increased and may be responsible for the observed declines in abundance. The marine survival of hatchery fish from the Cole Rivers Hatchery on the Rogue River was extremely low for the 2005 and 2006 brood years (i.e., 0.05% and 0.07%, respectively) and the average ocean conditions in 2010 (Peterson et al. 2013) suggest there may be poor marine survival for the 2011 spawning season. Drought conditions occurred for three consecutive years (2007-2009) that decreased instream flows and habitat conditions for juvenile coho salmon and very likely reduced their freshwater survival. Although it is unclear whether significant habitat changes are occurring from climate change, the authors expect a wide range of future detrimental changes to coho salmon habitat.

Lastly, because many coho salmon populations in this ESU are low in abundance, and may well be below their depensation thresholds, their risk of extinction may also be increasing.

1.9 Life-history

Coho salmon is an anadromous fish species that generally exhibits a relatively simple 3-year life cycle. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, and then die. The run and spawning times vary between and within populations. Depending on river temperatures, eggs incubate in ‘‘redds’’ (gravel nests excavated by spawning females) for 1.5 to 4 months before hatching as ‘‘alevins’’ (a larval life stage dependent on food stored in a yolk sac). Once most of the yolk sac is absorbed, the 30 to 35 millimeter fish (then termed “fry”) begin emerging from the gravel in search of shallow stream margins for foraging and safety (NRC 2004). Coho salmon fry typically transition to the juvenile stage by about mid-June when they are about 50 to 60 mm, and both stages are collectively referred to as “young of the year.” Juveniles develop vertical dark bands or “parr marks”, and begin partitioning available instream habitat through aggressive agonistic interactions with other juvenile fish (Quinn 2005). Juveniles rear in fresh water for up to 15 months, then migrate to the ocean as ‘‘smolts’’ in the spring. Coho salmon typically spend 2 growing seasons in the ocean before returning to their natal stream to spawn as 3 year-olds. Some precocious males, called ‘‘jacks,’’ return to spawn after only 6 months at sea.

1.9.1 Spawning and Incubation

Females tend to prepare their redds (gravel nests) and spawn soon after arriving on spawning grounds between November and January with spawning timing varying by watershed within the ESU (Weitkamp et al. 1995). Coho salmon generally choose spawning sites near the head of a riffle, just below a pool where there is abundant small- to medium-size gravel (Shapovalov and Taft 1954). The number of fertilized eggs deposited in each redd is based on each female’s individual fecundity and fertilization success; fecundity ranges between 1,400 to 3,000 eggs (Sandercock 1991). These eggs are dispersed among pockets within the redd (Sandercock 1991). Larger females tend to produce larger and more abundant eggs. Migration distance can also influence egg production, with longer migrations inhibiting egg size and/or quantity (Kinnison et al. 2001). All these differences drive population-specific differences in fecundity and egg size (Beacham 1982, Hjort and Schreck 1982, Taylor and McPhail 1985, Swain and Holtby 1989, Fleming and Gross 1990, Murray et al. 1990).

Once spawning is complete, the female will cover the redd with gravel and guard it until her death (approximately 4 to 15 days; Weitkamp et al. 1995). Ultimately the success of reproduction depends on a number of environmental and biological factors that occur within the redd, the spawning site, and the watershed. Many of these factors are linked to the timing of reproduction.

Embryonic development begins when an egg is fertilized, and developmental rate and incubation period are inversely related to water temperature. In most streams in Oregon and California, incubation takes place between November and April and lasts from 38 to 48 days depending on water temperature (Shapovalov and Taft 1954). Alevins are the larval stage which hatches from the egg and is dependent on food stored in a yolk sac. Alevins remain in the redd after hatching, develop into fry in the redd, then emerge. The time between hatching and fry emergence is dependent on temperature as well as dissolved oxygen levels in the redd; fry can remain in the redd for 4 to 10 weeks. The total emergence period can last between 10 and 47 days. Fry emergence takes place between March and July, with peak emergence in March and May (Shapovalov and Taft 1954, Koski 1966). Fry are approximately 30 mm in length when they emerge, with earlier emergence linked to larger size and greater growth opportunity (Mason and Chapman 1965, Sandercock 1991). The percentage of eggs and alevins that survive to emergence is dependent on stream and riverbed conditions. Winter flooding, with its associated scour and gravel movement, accounts for a high proportion of losses. Low flows, freezing, heavy silt loads, bird and insect predation, and infection can also lead to mortality. Under very harsh conditions, no eggs or alevins will survive. Under average conditions between 15 to 27 percent will survive to emergence (Neave 1949, Crone and Bond 1976) and in favorable conditions between 65 to 85 percent will survive (Shapovalov and Taft 1954). Studies from California and Oregon found average survival to be between 27.1 percent and 74.3 percent (Briggs 1953, Koski 1966).

1.9.2 Rearing and Outmigration

After emergence, fry seek out shallow water along stream margins. Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up streams with as much as 5 percent gradient (Agrawal et al 2005, Leidy et al. 2005). Juveniles have been found in streams as small as 1 to 2 meters wide. Typical juvenile rearing habitat consists of slow moving, complex pool habitat commonly found within small, heavily forested tributary streams (Moyle 2002, Quinn 2005). When rootwads, large woody debris, or other types of cover are present, growth is bolstered (Nielsen 1992). Increased growth is essential for juveniles because larger size confers higher over-wintering survival (Quinn and Peterson 1996).

The dominant life-history pattern is for juvenile coho salmon to feed and rear within the streams of their natal watershed for a year before migrating to the ocean. However, they may spend up to two years rearing in freshwater (Bell and Duffy 2007, Ransom 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988). The occurrence of age-0 "ocean-type" coho salmon migrants to the estuary, stream-estuary ecotone, or lower main-stem reaches has been documented throughout the range of coho salmon and is thought to be an alternative life-history strategy (Chapman et al. 1961; Chapman 1962; Hartman et al. 1982; Murphy et al. 1984; Rodgers et al. 1987, Au 1972, Kahler et al. 2001, Ryall and Levings 1987, Miller and Sadro 2003, Pinnix et al. 2013). Recent studies documenting various coho salmon juvenile life histories (Bennett et al. 2011, Roni et al. 2012, Pinnix et al. 2013, Quinn et al. 2013, Bennett et al. 2014, Jones et al. 2014) suggest coho salmon juveniles may have at least four life-history strategies in some basins (Bennett et al. 2014, Jones et al. 2014; Figure 1-2).

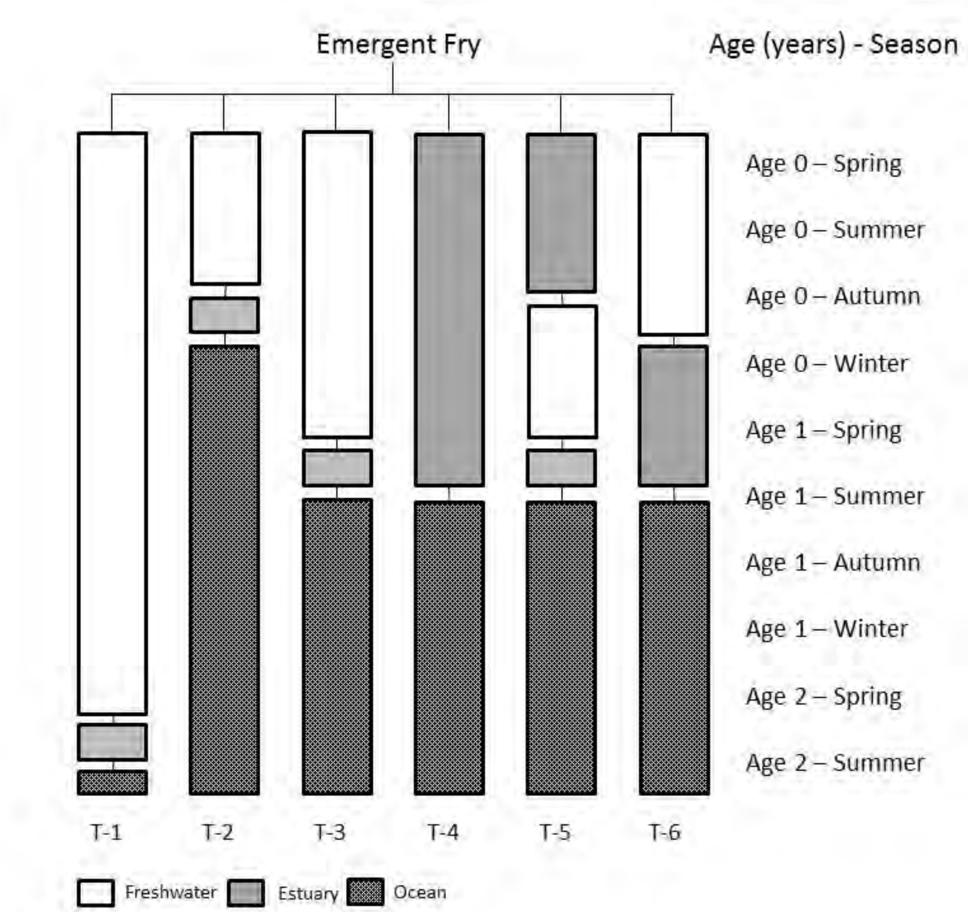

Figure 1-2. Types of life-history strategies of coho salmon juveniles. Figure modified from Jones et al. 2014.

In California and Oregon, some ocean-type coho salmon rear in the estuary during the spring, summer, and fall then return upstream to overwinter (Miller and Sadro 2003, Jones et al. 2014). This primarily occurs in watersheds with adequate estuarine rearing habitat (Merrell and Koski 1978). Extended freshwater residence in California streams has also been documented for age-1+ coho salmon (Bell and Duffy 2007, Ransom 2007). The proportion of a cohort that exhibited extended freshwater rearing ranged from 0 percent to almost 30 percent among Northern California streams and was linked most strongly to peak winter streamflow (Ransom 2007). Coho salmon also use non-natal streams for rearing, and redistribute into riverine ponds following fall rains (Peterson 1982, Ackerman and Cramer 2006, Soto et al. 2008, Hillemeier et al. 2009). For juvenile coho salmon that rear for at least a year in freshwater streams, this habitat offers the opportunity to grow prior to migration to larger rivers and the ocean. While rearing in such environments, coho salmon may grow slowly but experience a relatively low predation risk compared with downstream habitats (Quinn 2005).

Coho salmon fry may move upstream or downstream to rear after emergence. Coho salmon rearing areas include lakes, sloughs, side channels, estuaries, beaver ponds, low-gradient tributaries to large rivers, and large areas of slack water (PFMC 1999). During the rearing period, juveniles set up territories for feeding, especially in pool areas of streams (Hartman

1965). The abundance of coho salmon in streams is limited by the number of suitable territories available; streams with more complex habitat support larger numbers of fry (Scrivener and Andersen 1982, Larkin 1977).

During summer, juvenile coho salmon move into deep pools and areas with dense shade and large woody debris (LWD) for refuge from high water temperatures (Nickelson et al. 1992; Brown et al. 1994). A study of coho salmon occurrence in tributaries of the Mattole River suggested that a MWMT (maximum weekly maximum temperature) greater than 18.1 °C or a MWAT (highest average of mean daily temperature over any seven-day period) greater than 16.8 °C would preclude the occurrence of coho salmon. Lethal temperatures range from 24 to 30 ºC (McCullough 1999), but coho salmon can survive at high daily maximum temperatures if (1) high quality food is abundant, (2) thermal refugia are available, and (3) competitors or predators are few (NRC 2004).

In the winter, juvenile coho salmon avoid being washed out of their habitat by high flows by utilizing flow refugia including smaller tributary streams, intermittent streams, deeper pools, and large woody debris (Tripp and McCart 1983, Skeesick 1970, Narver 1978, Quinn and Peterson 1996, Solazzi et al. 2000). Ebersole et al. (2006 and 2009) found that coho salmon in a Washington stream moved into seasonally dry areas shortly after fall rains, and that these fish as well as those that moved into tributaries had higher survival than those that remained in the mainstem. In the Washington stream, off-channel ponds, large woody debris, and other floodplain habitat were scarce due to past land-use and geology, conditions shared across much of the SONCC coho salmon ESU. Ebersole et al. (2009) found that much of the variation in overwinter survival in this system was associated with winter discharge and the effects of high winter streamflows, emphasizing the need for high flow refugia. Large woody debris and other instream cover are heavily used by coho salmon in systems where these habitat features are more abundant (Nielsen 1992, Hardy et al. 2006), indicating the importance of access to cover while rearing.

The synchrony of arrival timing in coastal waters and the availability of food is especially critical for determining the survival rates of different cohorts (Walters et al. 1978). Many studies have shown that the timing of outmigration can have a large impact on the survival of coho salmon at sea (Pearcy 1992). Spence and Hall (2010) found patterns in outmigration of coho salmon smolts at 54 locations from central California to Kodiak Island, Alaska. They observed latitudinally-associated differences in duration, season, and variability in timing of migration across years, which they attributed to regional differences in the predictability and timing of favorable marine conditions. Spence and Dick (2014) examined short-term probability of migration of four coho salmon populations in the North Pacific (Canada and Oregon) that entered the ocean in different ocean production domains. Two factors, amount of daylight and water temperature, explained migration timing in the farthest northern location, while migration in Oregon sites was tied to numerous environmental factors [amount of daylight, water temperature (absolute and change), flow (absolute and change), and lunar phase] and migration in the southern Canadian site, was influenced by all these factors except lunar phase. There is likely selective pressure on coho salmon smolts to begin smoltification and to enter the ocean at times when ocean conditions will be most favorable, and there is latitudinal variability in how predictable these ocean conditions are due to different ocean production domains (Spence and Dick 2014). The southernmost populations, closest to the SONCC coho salmon ESU, responded to the most environmental cues, suggesting that the timing and predictability of ocean conditions in these areas was less predictable than in areas to the north.

Downstream migration of coho salmon in the SONCC coho salmon ESU begins in the spring sometime between April and May and continues into June. Most smolts measured between 90 and 115 mm fork length. Factors affecting the onset of emigration include the size of the fish, flow conditions, water temperature, dissolved oxygen (DO) levels, day length, and the availability of food (Shapovalov and Taft 1954). Smolt migration timing is affected by anthropogenic activities, including habitat degradation (Moring and Lantz 1975, Scrivener and Andersen 1984, Holtby and Scrivener 1989), and habitat restoration (Johnson et al. 1993, Rodgers et al. 1993). Beeman et al. (2012) documented a positive relationship between flow volume and travel time and survival of juvenile coho salmon in the mainstem Klamath River. The anthropogenic activities listed above may influence migration timing by affecting environmental factors such as temperature (Scrivener and Anderson 1984) and flow (Beeman et al. 2012).

A juvenile’s downstream migration to the ocean is accompanied by a series of internal changes in morphology, physiology, and behavior needed for a transition to saltwater. Travel rates to reach the ocean are determined by flow rates, date, and distance as well as individual based characteristics such as the extent of parr-smolt transformation. Travel rates increase with flow rates and travel distance. Fish migrating later in season also move faster than fish migrating earlier in the year (Dawley et al. 1986). Mortality from downstream migration is positively correlated to the distance traveled and has been linked to predation and hydropower operations in past studies (Quinn 2005).

Once juveniles reach the estuary, they will spend a variable amount of time completing the juvenile-to-smolt transformation. Estuarine residence is dependent on variety of factors, many of which remain unknown for this species of salmon. Growth rates in estuaries are generally higher than in freshwater habitats, and many juvenile coho salmon take advantage of feeding opportunities and time to transition to salt water while in the estuary. Depending on the opportunity and capacity of the estuary, coho salmon on the Oregon and California coast will spend a few days to a few weeks in the estuary (Miller and Sadro 2003, Clements et al. 2012, Pinnix et al. 2013, Jones et al. 2014).

Large smolts have higher ocean survival than small smolts (Bilton et al. 1982, Henderson and Cass 1991, Lum 2003, Quinn 2005, Jokikokko et al. 2006, Muir et al. 2006). In addition, larger smolts produce larger adults (Lum 2003, Henderson and Cass 1991), which have higher fecundity than smaller adults (Weitkamp et al. 1995, Fleming 1996, Heinimaa and Heinimaa 2004). The average size of outmigrating coho salmon is approximately 128 mm with the largest smolts originating from the Trinity River (mean 147 mm) and the smallest originating from Blue Creek on the Klamath River (mean 104 mm). The large sizes of Trinity River smolts likely results from hatchery operations in that basin, which produce larger than average smolts. The range of smolts sizes in the SONCC coho salmon ESU is between 90 and 200 mm (Weitkamp et al. 1995).

SONCC coho salmon have evolved multiple life-history strategies, which encompass a range in timing of outmigration and amount of time spent in the river or estuary by migrating smolts. The earliest outmigration in the SONCC coho salmon ESU occurs in Roach Creek on the Klamath River and Ten Mile Creek on the Eel River (March or earlier). The latest occur in the South Fork of the Eel River (mid-June or later). Because of this, the Eel River has the broadest range of outmigrant timing (March to August; Weitkamp et al. 1995).

1.9.3 Ocean Migration

Early ocean migration patterns of young coho salmon have been described in a number of studies (e.g., Weitkamp et al. 1995, Weitkamp et al. 2004, Van Doornik et al. 2007). By the beginning of their first winter at sea, coho salmon begin to move into feeding grounds. Studies using coded wire tags (CWT) have shown that this dispersal at sea is regionally specific, with coho salmon from northern California and Oregon south of Cape Blanco dispersing locally (Weitkamp and Neely 2002). These fish were recovered primarily in California (65 to 92 percent), with some recoveries in Oregon (7 to 34 percent) and almost none (<1 percent) further north. Compared with other coho salmon populations, the SONCC coho salmon ESU has a comparatively small marine distribution. Coho salmon occur in the upper part of the water column in the open ocean, at observed depths of from about 10 to 25 m (summarized by Quinn 2005).

One potential reason SONCC coho salmon do not move farther north is the productivity associated with upwelling areas off the coast of California, which provide high densities of food (Moyle 2002). When they first enter coastal areas, coho salmon feed primarily on marine invertebrates; as they grow larger, they shift to more piscivorous diets (Shapovalov and Taft 1954). Coho salmon feed opportunistically on a variety of prey including small pelagic fishes, shrimp, crab and crab larvae, and other pelagic invertebrates (Sandercock 1991). Growth associated with feeding opportunities at sea is rapid and most fish can double their length and increase their weight more than tenfold their first summer.

While there are many opportunities for growth at sea, coho salmon experience high predation pressures and steep mortality. Studies of smolt-to-adult survival place estimates between 1 percent and 10 percent with the greatest mortality during the first summer at sea. Factors such as size, physiological condition, migration date, and ocean conditions can all influence mortality, and under optimum conditions survival can be as high as 40 percent (Sandercock 1991). In addition to ocean entry timing as a factor influencing survival (as discussed above), size is also important in minimizing mortality since much of the predation that occurs at sea is size-selective (McGurk 1996, Shapovalov and Taft 1954). Generally, small fish have higher mortality rates than larger fish up until about 100 mm (Koenings et al. 1993). Predation is thought to be an important cause of mortality on smaller fish in their first year at sea and has less of an impact on adult populations.

1.9.4 Maturation

The growth and survival of adult coho salmon is closely linked to marine productivity, which is controlled by complex physical and biological processes that are highly dynamic and vary greatly over space and time. Shifts in salmon abundance due to climatic variation are known to be large and sudden (Beamish et al. 1999). Short and long-term cycles in climate [e.g., El Niño/La Niña and the Pacific Decadal Oscillation] are thought to affect adult coho salmon size, abundance, and distribution at sea, as does inherent year-to-year variation in environmental conditions not associated with climatic cycles. Several studies have related ocean conditions specifically to coho salmon production (Cole 2000), survival (Ryding and Skalski 1999, Koslow et al. 2002), and spatial and temporal patterns of survival and body size (Hobday and Boehlert 2001, Wells et al. 2006). The link between survival and climate could be operating via the availability of nutrients regulating the food supply and hence competition for food (Beamish and Mahnken 2001). For example, the 1983 El Niño event off the Pacific coast of North America resulted in increased adult mortality and decreased average size for Oregon's returning coho salmon. Juvenile coho salmon entering the ocean in the spring of 1983 also had low survival, resulting in low adult returns in 1984 (Johnson 1988). Larger-scale decadal to multi-decadal events also have been shown to affect ocean productivity and coho salmon (Hare and Francis 1995; Mantua et al. 1997; Beamish et al. 1997a; Beamish et al. 1999; Pearcy 1992; Lawson 1993). Although salmon evolved in this variable environment and are well suited to withstand climactic changes, the resiliency of the adult population has been reduced by the loss of life-history diversity, lower population abundance, cohort loss, and fragmentation of the spatial population structure. Changes in the freshwater environment (e.g., loss and degradation of habitat) have also weakened the ability of coho salmon to respond to the natural variability in ocean conditions.

The age composition and size of coho salmon at maturity is influenced by a number of factors including growth rate, sex, origin (either hatchery or wild and population), and genetic makeup (Quinn 2005). Due to variation in these factors, coho salmon exhibit a range of ages and sizes at maturation. The most common life-history strategy for coho salmon in the SONCC coho salmon ESU is a fairly strict 3-year life cycle, with most coho salmon spending approximately 18 months at sea before returning to their natal rearing grounds to spawn (Gilbert 1912, Briggs 1953, Shapovalov and Taft 1954, Loeffel and Wendler 1968, Weitkamp et al. 1995). The most recent data show that the average size of returning adults in Oregon and California is between 56.4 and 64.6 cm (average 62.7). Variations to this life-history do exist and some fish return after only 5 to 7 months at sea. These "jacks" that return early keep runs from being genetically isolated based on a strict 3-year return year. In general, coho salmon that migrate earlier than average and at a size larger than average are believed to produce a higher rate of jack returns (Bilton et al. 1984). Studies have shown highly variable numbers of returning jacks to Oregon and California streams, possibly due to the influence of hatchery fish. Jacks in the Klamath River made up to 97 percent of returns in one year between 1984 and 1987 (average 59 percent) (Hopelain 2001). Other studies have shown the jacking rate ranges from 7 percent to 34 percent (e.g., Murphy 1952).

The size of coho salmon when they reach maturity also exhibits spatial and temporal variability along with the age at maturity. Size is dependent on factors related to growth and genetic heritage with the sex, origin, age, and run timing all influencing the size of a fish when it reaches maturity. In general, coho salmon in later runs tend to be larger than those in earlier runs (Sandercock 1991), coho salmon from mainstem areas are often larger than those spawning in tributaries (Lister et al. 1981), males tend to be larger than females, and older fish are larger than younger fish. Of available data from southern Oregon and northern California streams and rivers, the smallest spawners tend to come from the Rogue River (average 56 cm between 1976 to 1986) and the largest tend to come from Redwood Creek (average 76.1 cm between 1950 to 1951). The range for this area is between 30 and 91 cm (Weitkamp et al. 1995).

One overall trend across the range of coho salmon is the observed decrease in size of mature fish over the past 50 years. Harvest practices, effects of fish culture, declining ocean productivity, and density-dependent effects in the marine and freshwater environments attributable to large numbers of hatchery releases are potential factors leading to this decline. Weitkamp et al. (1995) noted that the rate of this decline are population, or area, specific with the highest rates of decline in Oregon and California being observed in Rogue River spawners (Slope = -1.50). The CA and OR troll data on coho size also supports a regional decline in size (Slope = -0.05). In the few creeks within the SONCC coho salmon ESU with historical and current data for comparison, average declines averaged between 1.1 and 4.2 cm per decade. These declines in adult size have direct implications for individual reproductive success and population viability because smaller spawners have lower fecundity.

1.9.5 Homeward Migration and Spawning

Timing and location of reproduction are two of the most critical adaptations salmon populations make to their environment. Salmon are uniquely evolved in their ability to take advantage of feeding and growth opportunities at sea and optimal spawning conditions in freshwater streams and rivers. Once a salmon starts the process of maturation, it begins a homeward migration to the location in which it was spawned. Once adult coho salmon reach nearshore and estuarine waters they are able to use imprinted chemical cues to help guide them. Imprinting in fry occurs shortly after emergence and is based on stream-specific or population-specific characteristics of their natal stream.

About 95 to 99 percent of all salmon return to their natal stream using these imprinted cues, however a small percentage (the magnitude of which varies temporally and by population) are “strays,” meaning they spawn in streams they were not born in (Quinn 2005). Whether this characteristic of adult coho salmon is genetically, behaviorally, or environmentally influenced is unknown, but ultimately the occurrence of straying contributes to the persistence and distribution of populations and the entire ESU. As a general rule, straying is linked to the stability and degree of specialization of a population or its spawning habitat. Populations occupying “flashy” or steep, unstable coastal streams are more likely to exhibit non-natal rearing as are small coastal streams that require little or no specialization for spawning. Information on straying rates for coho salmon in California is sparse, but Shapovalov and Taft (1954) reported values between 15 percent and 27 percent for Scott and Waddell Creek. Other genetic studies of California coho salmon populations show differences among populations that suggest lower effective straying rates. Fish that do stray are most commonly found in spawning areas near their natal stream (Shapovalov and Taft 1954, Jacobs 1988, Labelle 1992).

Upriver migration of adults to spawning areas normally occurs from October to March for populations in the SONCC coho salmon ESU, with a peak between November and January. For most populations, the duration of spawning migration is at least three months or more. Coho salmon river entry timing is influenced by many environmental and genetic factors, the most important of which is river flow (Shapovalov and Taft 1954, Salo and Bayliff 1958, Sumner 1953, Eames et al. 1981, Lister et al. 1981). Coho salmon generally wait for freshets before entering rivers, so a delay in fall rains delays river entry and, potentially, spawn timing as well. Many of the small coastal streams in California are barred over by sand at their mouths, and coho salmon in these streams have to wait to ascend until the sand barriers are breached by high stream flows that follow heavy winter rains. Once a fish enters a river, if conditions in the stream are unsuitable for entry, fish will often wait (or "hold") in the vicinity of the stream mouth for conditions to change, usually marked by a decreasing temperature and increasing flow. This holding allows coho salmon to reach further into headwater streams where good spawning and rearing conditions may exist.

Because of the influence of environmental drivers, run timing shows considerable spatial and temporal variability. Large river systems are especially diverse in terms of coho salmon run timing. For example coho salmon runs in the Klamath River can last over four months with various populations entering the system from late August to mid-January (Washington Department of Fisheries (WDF) 1951, Leidy and Leidy 1984, WDF et al. 1993, Polos 1994). In terms of large-scale spatial patterns in run timing, Weitkamp et al. (1995) found some regional patterns that define the SONCC coho salmon ESU. Coho populations in southern Oregon and northern California tend to have later run timing than population to the north. There also appears to be a wider range of timing, with some runs starting in late August (Klamath) and most lasting into mid-February.

Once conditions are favorable, adult coho salmon migrate into spawning areas along the coast and in small tributaries of larger rivers. Coho salmon migrate further upstream than chum salmon but not usually as far as Chinook. In general, coho spawning grounds are within 240 km of the coast (Godfrey 1965). Large river systems like the Klamath, Trinity, Eel, and Rogue Rivers historically supported coho salmon in their upper tributaries (Williams et al. 2006). Once adult fish reach the spawning grounds, they can spend days, weeks, or months waiting to spawn. During this time salmon are subject to predation and disease prior to spawning.

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2. Structure, Viability, and Status of the SONCC Coho Salmon ESU

The SONCC coho salmon ESU must meet the criteria described in Chapter 4 for NMFS to determine it has recovered to the extent that the protections of the Federal Endangered Species Act could be removed,. Chapter 2 describes the underpinnings of these population-related criteria. These criteria are based on guidance provided in two NOAA Technical Memoranda, which describe the historical population structure and biological viability criteria, respectively, for the SONCC coho salmon ESU (Williams et al. 2006, Williams et al. 2008).

2.1 Intrinsic Potential

2.1.1 Modeling Intrinsic Potential of Historical Habitats

Spawner abundance serves as an important indicator of viability and extinction risk, and for salmon it is heavily influenced by the extent and quality of available freshwater habitat. An estimate of historical habitat carrying capacity can serve as an indirect means of estimating the number of adults needed to reach viability. Because of degraded current freshwater habitat conditions, which often differ from historical conditions, recovery planners need a method that estimates the extent and capacity of watersheds to support coho salmon prior to the major anthropogenic impacts to habitat which began in the mid-1800s. Williams et al. (2006) characterized the historical extent and carrying capacity of SONCC coho salmon streams by using a GIS-based model. This "IP" model "…predicts the potential for a stream reach to exhibit habitat characteristics suitable for rearing juvenile coho salmon, as a function of the underlying geomorphic and hydrologic characteristics of the landscape (Williams et al. 2006)." The IP model provides recovery planners with a framework to develop a recovery strategy for the SONCC coho salmon ESU.

To account for differences in habitat suitability across the landscape, three habitat components were modeled to serve as predictors of historical habitat suitability (Figure 2-1): stream gradient, valley constraint, and average annual discharge (based on catchment area and localized precipitation data). For each stream reach (50-200 m) in the SONCC coho salmon ESU, each of the three attributes was scored from zero to one and the geometric mean of the scores was calculated. A score of one indicates reaches with the most intrinsic potential to support rearing juvenile coho salmon, and a score of zero indicates areas with no such potential. For example, a narrow and steep stream reach with little predicted flow has low potential to support quality rearing habitat and would likely score close to zero, while a low-gradient stream with a bigger floodplain and more predicted flow has more potential to support quality rearing habitat and would score closer to one. The IP score for each reach in a population area was multiplied by its respective reach length and the values for each reach in a population were added to identify the total integrated IP in kilometers (km) for that population (Figure 2-2). The number of IP-km in a population was used to classify each population (Williams et al. 2006) and to calculate spawner abundance targets (Williams et al. 2008).

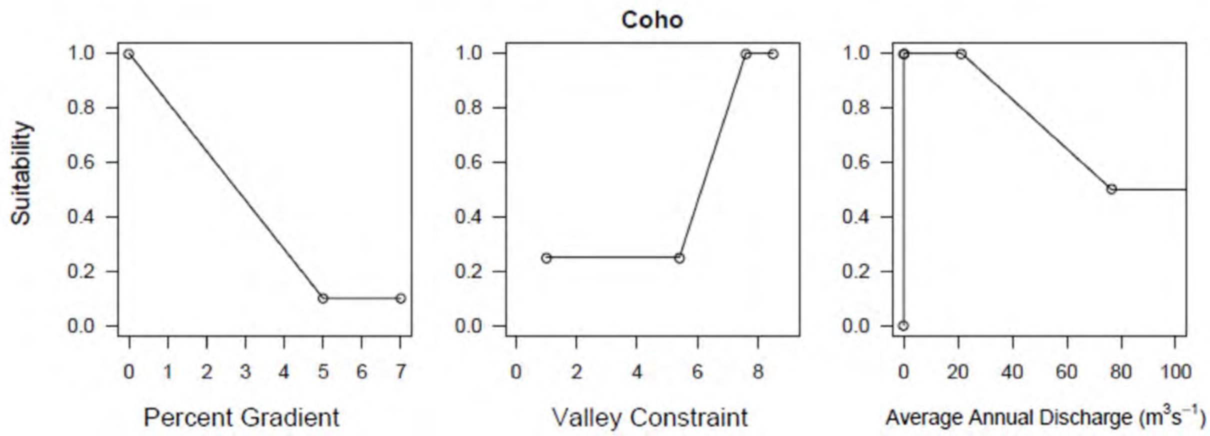
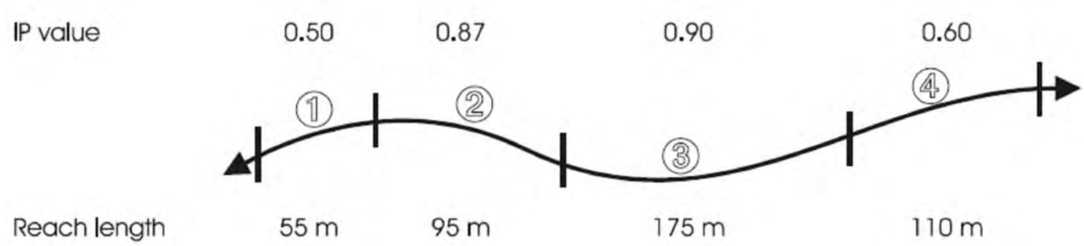


Figure 2-1. Suitability curves for each of the three IP components (Gradient, Valley Constraint, and Discharge). Source: Agrawal et al. 2005.



No.	Reach length (m)	IP value	Integrated IP (IP m)
1	55	0.50	27.5
2	95	0.87	82.65
3	175	0.90	157.50
4	110	0.60	66.00
Total	435	-	333.65

Figure 2-2. Calculation of integrated intrinsic potential (IP) from reach-specific IP values. Source: Williams et al. 2006.

Summer water temperatures in the interior portions of some large drainages in the ESU (i.e., Rogue, Klamath, Trinity, and Eel rivers) can approach or exceed the tolerable limits for juvenile coho salmon (Eaton et al. 1995). Where this occurs, temperature might preclude coho salmon from using areas that, based on geomorphic and hydrologic characteristics, would otherwise be suitable. Comprehensive data on water temperatures were not available for the ESU, and the available water temperature data was likely influenced by land-use practices that altered temperature regimes in comparison to historical conditions. Therefore, to identify areas where temperature might limit the distribution of coho salmon, Williams et al. (2006) combined information on the historical distribution of coho salmon and mean August air temperature to identify a threshold temperature above which juvenile coho salmon generally do not occur. This analysis found that coho salmon were rarely reported as present in watersheds where the lowest mean August air temperature in the basin exceeded 21.5 °C (Agrawal et al. 2005); this temperature is comparable to the maximum tolerable water temperature for coho salmon reported by Eaton et al. (1995). Therefore, a 21.5 °C threshold (i.e., temperature mask was used to modify results from the IP model by identifying IP-km in areas where coho salmon are likely to be excluded by warm temperature, and excluding these IP-kms from calculation of spawner targets.

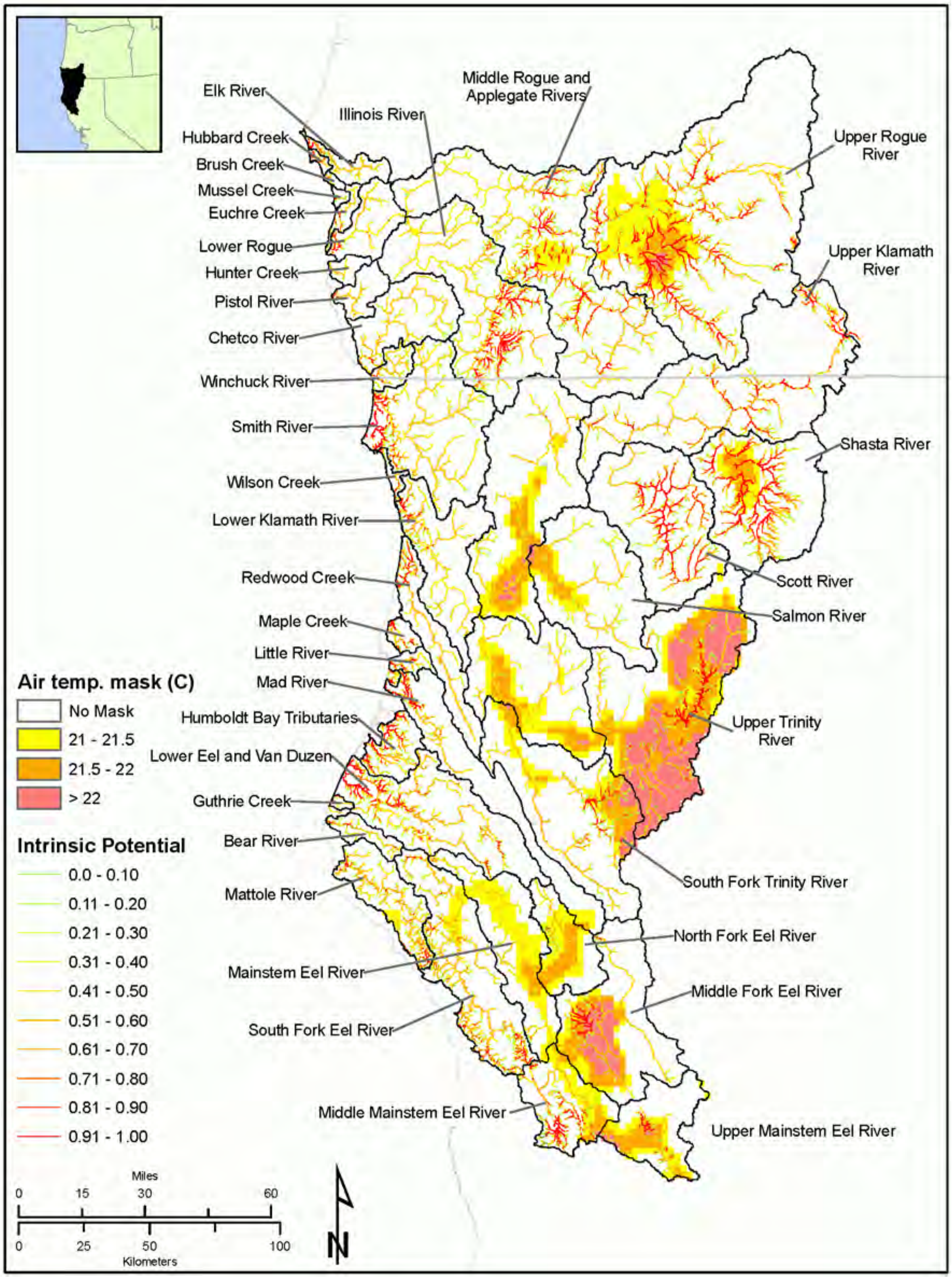


Figure 2-3. Intrinsic Potential for coho salmon across the SONCC Coho Salmon ESU, including areas where coho salmon are likely to be excluded by warm temperature indicated by temperature mask (from Williams et al. 2006).

2.1.2 IP Model Assumptions and Uncertainty

Williams et al.'s (2006) use of the IP model to identify potentially suitable coho salmon habitat rests on two assumptions. The first assumption is that the suitability curves (Figure 2-1), which translate geomorphic and hydrologic characteristics into IP, apply to watersheds in the SONCC Coho Salmon ESU as they do for the Oregon Coast Range where the model was originally developed. Williams et al. (2006) lacked local data from which to develop region-specific suitability curves and therefore "…assumed that either the suitability curves based on data from the Oregon Coast Range applied to watersheds in southern Oregon and northern California, or that the relationship between watershed characteristics and habitat potential throughout the SONCC Coho Salmon ESU differed from that observed in Oregon in a uniform and consistent way." An extensive literature search provided no basis for choosing alternative suitability curves for the SONCC coho salmon ESU (Agrawal et al. 2005).

The second assumption was that differences in geomorphic structure and processes between the Oregon Coast Range and the SONCC Coho Salmon ESU, although present, do not require modification of the IP components (gradient, discharge, valley-width constraint) (Williams et al. 2006). One of the most substantial differences among coastal watersheds in Oregon and California could be the amount and timing of precipitation, especially as one moves south along the coast (Williams et al. 2006). Williams et al. (2006) attempted to account for this variation by estimating regional models for mean annual discharge as a function of catchment area and mean annual precipitation (Agrawal et al. 2005). The relationships estimated for coastal watersheds north of Cape Mendocino were almost identical to that reported for coastal Oregon watersheds. Following an extensive literature search, Williams et al. (2006) found little to suggest the need to modify the IP components calculated for the Oregon Coast Range before using them for the SONCC Coho Salmon ESU.

NMFS is aware that the modeling approach used to estimate historical capacity of a stream reach may result in estimates that can be biased (i.e., can under- or over-estimate historical capacity). Recently updated coho salmon distribution datasets (Garwood 2012 and Bowers 2013) report documented coho salmon presence extending upstream of IP habitat in several populations. For example, coho salmon are distributed in the lower 8.4 miles of Bluff Creek in the Middle Klamath, none of which was identified as IP. Conversely, habitat believed to be unsuitable for coho salmon due to geologic conditions was modeled as IP habitat (and subsequently removed, see Appendix A) in the Big Springs Complex of the Shasta River (Appendix A). Recent research in Oregon (Steel et al. 2012, Flitcroft et al. 2013a) identified IP as a significant predictor of coho distribution for areas that support a large number of fish. The IP model as a whole provides the best available scientific information on the historical population structure of the ESU and on appropriate targets for a recovered SONCC coho salmon ESU.

IP-based viability criteria are ***not*** estimates of historical abundance. Rather, the criteria describe the number of spawners that are likely to lead to viable populations in terms of abundance and spatial structure. Comparisons of historical abundance estimates and IP model-driven density-based abundance targets for coastal watersheds in Oregon and the South Fork Eel River in California suggest that the methods used in Williams et al. (2006) do not overestimate the historical carrying capacities of coho salmon populations. In all instances, the target abundance is between 3% and 12% of the estimated historical abundance. As ESU- and population-specific research and monitoring occur, changes to the model and the resulting population thresholds could be warranted (Williams et al. 2008), and the recovery plan will be updated with the best available information.

NMFS acknowledges there is uncertainty regarding the IP model's ability to predict the potential of habitat to support rearing SONCC coho salmon. Several co-managers and members of the public have expressed concern that the IP model likely over-estimates the potential of particular streams, and that the use of the IP model to develop spawner targets in particular populations is not appropriate. The IP model and associated habitat suitability curves, temperature mask, and spawner density criteria provide an initial framework for recovery planners that can be adjusted or replaced as the best available information relevant to SONCC coho salmon habitat utilization and viability parameters improves over time. For example, if new research demonstrates SONCC coho salmon can tolerate higher temperatures than current information suggests, NMFS may update the temperature mask. Additionally, if new information suggests spatial structure and diversity needs of SONCC coho salmon can be realized at lower spawner densities than this Plan currently requires, NMFS may update the spawner density criteria.

IP habitat should not be confused or associated with modeled critical habitat. IP habitat is identified using a coarse-scale model which is one of many tools one can use to estimate the current or historical extent of anadromy. Although a useful tool to visualize the estimated historical range of SONCC coho salmon, other approaches can be used to provide greater insight into the possible presence of migration barriers. The IP model depends on appropriate and accurate Digital Elevation Models (DEM) which are subject to improvement (i.e., finer resolution) or refinement/corrections (e.g., a road crossing with culvert may appear as a natural barrier in DEM). Modeled IP habitat lacks the precision needed to determine whether a specific reach meets the description of designated critical habitat for the SONCC coho salmon ESU "to include all river reaches accessible to listed coho salmon between Cape Blanco, Oregon and Punta Gorda, California" (50 CFR 226.210(b)). Therefore, alterations to the extent of modeled IP habitat for use in this Plan, such as removal of IP habitat above a probable natural barrier, would not necessarily modify designated critical habitat for the SONCC coho salmon ESU.

Oregon Department of Fish and Wildlife concerns with recovery framework

The Oregon Department of Fish and Wildlife (ODFW) has concerns that the methods used to produce Williams et al. (2006) may overestimate the extent of historical coho production in the populations within the Northern Coastal and Interior Rogue diversity strata. Further, ODFW believes these methods may have led to inaccurate characterizations of historical populations as larger than they likely were. Finally, ODFW believes the low-risk targets for core populations may not need to be achieved if the other 3 VSP criteria are being met. This has been identified as a critical research need in Chapter 5 and NMFS intends to work with partners to reevaluate the population structure, and associated recovery criteria, within the Northern Coastal and Interior Rogue diversity strata as part of a conservation planning process. ODFW is in general agreement with NMFS on the recovery actions needed for Oregon populations, including a recovery action (present in all populations) that calls for refinement of the methods used to delineate populations and set population targets.

2.2 Historical Structure and Function of the ESU

2.2.1 Classifying Populations

Williams et al. (2006) describes the population structure of SONCC coho salmon based on the location and amount of potential coho salmon habitat and identifies all the populations in the ESU and their demographic characteristics. A population is defined as a group of fish of the same species that spawns in a particular location at a particular season and does not interbreed substantially with fish from any other group (McElhany et al. 2000). An integral element of determining the historical population structure for the ESU was estimating the distribution of potential juvenile rearing habitat within each basin. This was accomplished using both historical records and the IP model (Williams et al. 2008).

Watersheds across the ESU vary greatly in size. Large basins, such as the Klamath River watershed, support multiple populations because they contain several large rivers or streams which vary in terms of their environmental conditions and each support populations. Small watersheds probably did not historically support viable populations, but are not necessarily a part of a larger population. In the development of the historical population structure, Williams et al. (2006) recognized the full range of coho salmon habitat in the SONCC coho salmon ESU.

Williams et al. (2006) adopted a population classification system based on two factors: self-recruitment and viability-in-isolation. Self-recruitment reflects the proportion of a population's spawners that are native (not strays), and is a function of the size of the population, the size of potential donor populations, and the distance between populations. Viability-in-isolation is based on the probability of extinction for a population in complete isolation from all other populations. A population that has a low (<5%) probability of extinction over 100 years would be viable-in-isolation. Viability-in-isolation is assessed as a function of population size using IP-km as a proxy.

Williams et al. (2006) treated self-recruitment and viability-in-isolation as two axes, resulting in four types of historical populations depending on the estimated values of these two factors (Figure 2-4).

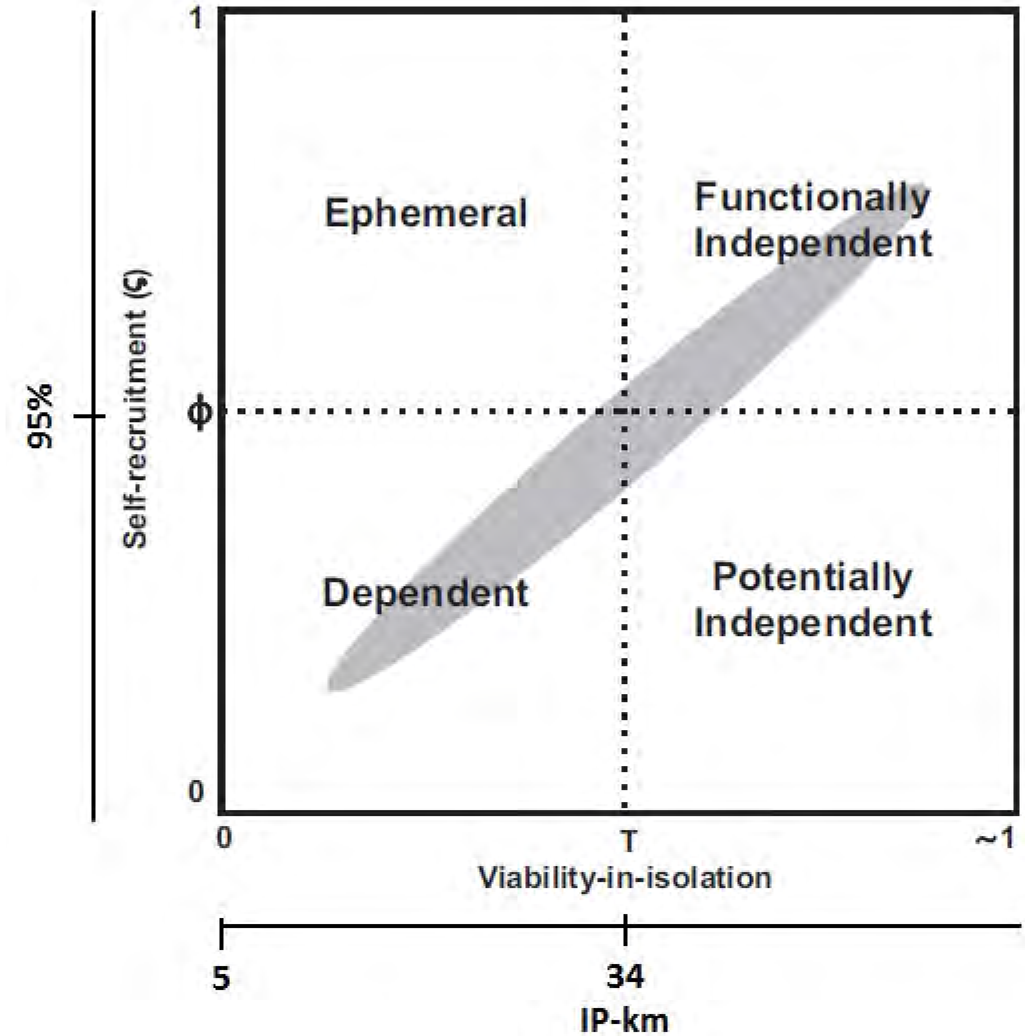


Figure 2-4. Population type as a function of viability-in-isolation and self-recruitment. Figure modified from Williams et al. (2006).

Those populations that are viable-in-isolation are potentially or functionally independent populations. Those which are not viable-in-isolation are either dependent or ephemeral. The boundary between independent and dependent populations is determined by the habitat capacity [estimated using IP-km]), below which there is a low likelihood of a population persisting without migrants from other populations. Populations that have at least 5 but less than 34 IP-km have relatively lower viability-in-isolation and are designated as dependent if they have less than 95 percent fidelity (0.95 self-recruitment) or ephemeral if they have more than 95 percent fidelity. Basins with less than 5 IP-km are not recognized as populations. Independent populations that have 95 percent fidelity (0.95 self-recruitment) are designated as functionally independent, while populations that have less than 95 percent fidelity are potentially independent. Williams et al. (2006) describes in detail the values assigned to each population.

Although Williams et al. (2006) recognized 45 populations in the ESU, due to subsequent modifications to the IP-km for several populations, and exclusion of populations that are too small to be dependent, this recovery plan considers 40 populations. Modifications to IP are described in Appendix A.

The type of each population is as follows:

Functionally Independent Populations are those with a high likelihood of persisting in isolation over a 100-year time scale and are not substantially altered by exchanges of individuals with other populations.

Potentially Independent Populations have a high likelihood of persisting in isolation over a 100-year time scale, but are too strongly influenced by immigration from other populations to exhibit independent dynamics.

Dependent Populations have a substantial likelihood of going extinct within a 100-year time period in isolation, yet receive sufficient immigration to alter their dynamics and extinction risk, and presumably increase persistence or occupancy.

Ephemeral Populations[3] do not have a high likelihood of sustaining themselves over a 100-year time period in isolation, and do not receive sufficient immigration to affect this likelihood. Habitats that support such populations are expected to be occupied only rarely. This type of population is not included in this recovery plan and is not considered further.

Dependent populations, although not expected to persist in the long-term (100 years) without strays from other populations, serve at least two roles within an ESU (Williams et al. 2006). If an independent population is extirpated, dependent populations can provide a nearby source of colonists to repopulate the area. Dependent populations are also critically important for bridging spatial gaps to allow dispersal of spawners between independent populations, and so increase connectivity.

2.2.2 Grouping Populations into Diversity Strata

Williams et al. (2006) separated populations into seven diversity strata. Populations in each diversity stratum likely exhibit genotypic and phenotypic similarity to each other due to exposure to similar environmental conditions, common evolutionary history, and location relative to each other (Table 2-1; Williams et al. 2006). Figure 2-5 shows the historical structure and function of the SONCC coho salmon ESU as described in Williams et al. (2006).

[3] Ephemeral populations were not considered when developing the recovery strategy for SONCC coho salmon described in this recovery plan and will not be discussed further.

Table 2-1. Arrangement of historical populations of the SONCC coho salmon ESU. Population types are functionally independent (F), potentially independent (P), and dependent (D).

Diversity Stratum	Population Type	Population Unit
Northern Coastal Basins	F	Elk River
	P	Lower Rogue River
	F	Chetco River
	P	Winchuck River
	D	Brush Creek
	D	Mussel Creek
	D	Hunter Creek
	D	Pistol River
Central Coastal Basins	F	Smith River
	F	Lower Klamath River
	F	Redwood Creek
	D	Maple Creek/Big Lagoon
	P	Little River
	F	Mad River
	D	Elk Creek
	D	Wilson Creek
	D	Strawberry Creek
	D	Norton/Widow White
Southern Coastal Basins	F	Humboldt Bay Tributaries
	F	Low. Eel/Van Duzen Rivers
	P	Bear River
	F	Mattole River
	D	Guthrie Creek
Interior Rogue River	F	Illinois River
	F	Mid. Rogue/Applegate Rivers
	F	Upper Rogue River
Interior Klamath River	P	Middle Klamath River
	F	Upper Klamath River
	P	Salmon River
	F	Scott River
	F	Shasta River
Interior Trinity River	F	South Fork Trinity River
	P	Lower Trinity River
	F	Upper Trinity River
Interior Eel River	F	South Fork Eel River
	P	Mainstem Eel River
	P	North Fork Eel River
	P	Mid. Fork Eel River
	F	Mid. Mainstem Eel River
	P	Upper Mainstem Eel River

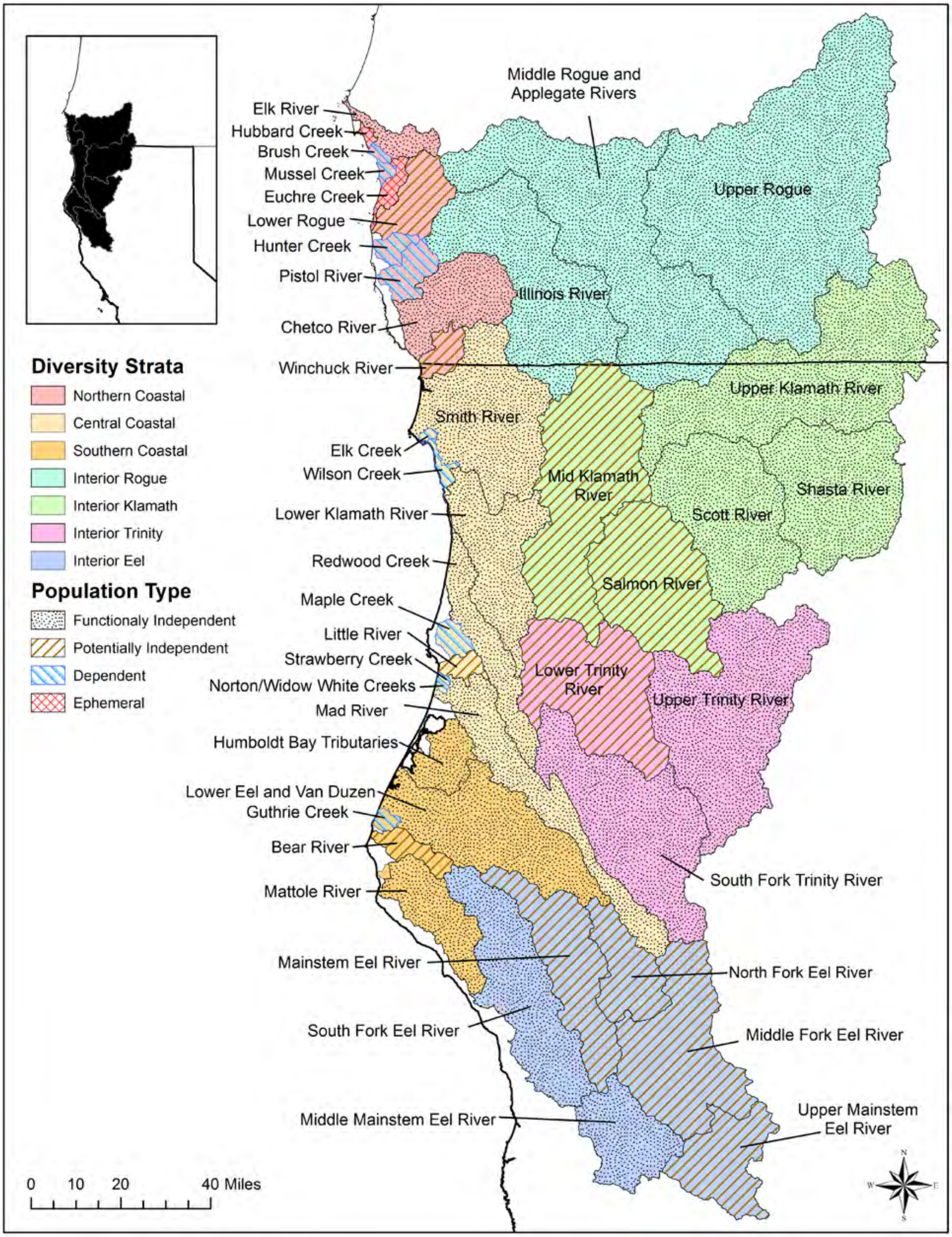


Figure 2-5. Historical population structure of the SONCC coho salmon ESU, as described in Williams et al. (2006).

2.3 Viability Criteria

Viability is the likelihood that a population will sustain itself over a 100-year time frame (McElhany et al. 2000). Viability criteria are the means by which a viable ESU is defined, and by which extinction risk is evaluated. Viability criteria are used to develop the delisting criteria described in Chapter 4.

2.3.1 ESU

The viability of an ESU depends on several factors, including the number and status of populations, spatial distribution of populations, the characteristics of large-scale catastrophic risk, and the collective diversity of the populations and their habitat (Lindley et al. 2007). In order for the SONCC coho salmon ESU to be viable, in each diversity stratum at least 50 percent of the independent populations (i.e., Functionally Independent or Potentially Independent) must be viable, and the abundance of these viable independent populations collectively must make up at least 50 percent of the total abundance modeled for all of the independent populations in that stratum (Williams et al. 2008). The independent populations that are chosen to meet the population viability criteria are called “core.” NMFS’ rationale for its choice of core populations is explained in Appendix C and is based on NMFS’ assessment of which populations are most likely to achieve those criteria most quickly. Many recovery scenarios with different core populations could result in a recovered ESU. Based on new information about population status or habitat conditions, NMFS’ designation of core and non-core populations may change to achieve recovery more quickly or efficiently. Although not all populations are required to be viable, the ESU viability criteria are intended to ensure representation of the diversity throughout the ESU, buffer the ESU against potential catastrophic risks, and provide sufficient connectivity among populations to maintain long-term demographic and genetic processes.

The ESU viability criteria incorporate the principles of representation, redundancy, and connectivity (Table 2-2). Representation relates to the genetic and life-history diversity of the ESU, which is needed to conserve its adaptive capacity. Redundancy addresses the need to have a sufficient number of populations so the ESU can withstand catastrophic events (Williams et al. 2008). Connectivity refers to the dispersal capacity of populations to maintain long-term demographic and genetic processes. The overarching goal of these rules was to determine an appropriate number and arrangement of populations that allow populations to track changes in environmental conditions (Williams et al. 2008).

Table 2-2. ESU viability criteria for SONCC coho salmon. Source: Williams et al. 2008.

ESU Viability Characteristic	Criteria
Representation	1. All diversity strata should be represented by viable populations
Redundancy and Connectivity	2. a) At least fifty percent of historically independent populations in each diversity stratum should be demonstrated to be at low risk of extinction according to the population viability criteria. AND 2. b) Total aggregate abundance of the populations selected to satisfy 2a must meet or exceed 50% of the aggregate viable population abundance predicted for the stratum based on the spawner density. 3. All dependent and independent populations not expected to meet low-risk threshold within a stratum should exhibit occupancy indicating sufficient immigration is occurring from the "core populations". 4. The distribution of extant populations, both dependent and independent, needs to maintain connectivity across the stratum as well as with adjacent strata.

Williams et al. (2008) writes about Criterion 3 (Table 2-2): "We propose that recovery planners place a high priority on populations that are remnants of historically independent populations **with a minimum standard that most historically independent populations should be at no greater than moderate risk of extinction (i.e., not at high risk) when evaluated as independent populations** [Emphasis added]". This recommendation would require a higher standard for occupancy than just presence of individuals. It should be recognized that these independent populations no longer fulfill their historical role within the ESU, but they can play a critical role in connectivity and have the potential for representing critical components of the evolutionary legacy of the ESU."

The depensation threshold is the number of spawning adults below which a population is subject to depensatory effects such as not being able to find a mate, or having all adults eaten by predators before they can reproduce. To meet Williams' recommendation above, most non-core independent populations would be at moderate (not high) risk of extinction in a recovered ESU and so would consistently have more spawners than the depensation threshold (Table 2-3). These populations are called "Non-Core 1". "Non-Core 2" populations were identified in response to the requirement that "most" (not all) independent populations should be at moderate risk of extinction, which allows that some independent populations do not need to be either at moderate risk or low risk. For some independent populations, there is little to no documentation of coho salmon presence in the last century, and prospects are low for the population to recover to numbers at least four spawners per IP-km. These populations are categorized as Non-Core 2 populations, and so have a lower threshold (juvenile occupancy) than if they were Non-Core 1 populations. This threshold is the same as for dependent populations: these populations should exhibit occupancy patterns that indicate sufficient emigration is occurring from the core populations, in order to maintain connectivity within and among diversity strata (Table 2-2).

2.3.2 Population

Williams et al. (2008) builds on the Viable Salmonid Population (VSP) concept (McElhany et al. 2000) to establish viability criteria at the population and ESU level. The population viability criteria represent an extension of an approach developed by Allendorf et al. (1997), and include metrics related to population abundance (effective population size), population decline, catastrophic decline, spawner density, hatchery influence, and population viability assessment. Populations that fail to satisfy several viability metrics are likely at greater risk than those that fail to satisfy a single metric. A viable population must have a low extinction risk for all the population metrics (Table 2-3). For a population to be at moderate risk of extinction, it must meet the moderate risk description for each of the criteria shown in Table 2-3. To align with the ESU viability criteria described in Table 2-2, NMFS identified four population categories with different targets based on their role in meeting these criteria. Core populations are those needed to meet Criteria 2a and 2b in Table 2-2. These populations must be at low risk of extinction, or viable, in order to delist. Non-Core 1 populations are those independent populations needed to meet Criterion 3, and should be at no greater than moderate risk of extinction for the ESU to be viable. Non-Core 2 populations are those independent populations that may be at higher than moderate risk of extinction in a recovered ESU, because there is no evidence they supported coho salmon, or because the amount of IP habitat in them is very low. Non-Core 2 and Dependent populations must meet Criterion 3 for the ESU to be viable. Non-Core 2 populations and dependent populations have no target extinction risk.

Table 2-3. Viability criteria used to assess extinction risk for SONCC coho salmon populations. For a given population, the highest risk score for any category determines the population's overall extinction risk. Source: Williams et al. 2006.

Criterion	Extinction risk		
	High	Moderate	Low
	- any One of -	- any One of -	- all of -
Effective population size[a]	$N_e \leq 50$	$50 < N_e < 500$	$N_e \geq 500$
- or -	*- or -*	*- or -*	*- or -*
Population size per generation[b]	Ng ≤250	$250 < N_g < 2500$	$N_g \geq 2500$
- or -	*- or -*	*- or -*	*- or -*
Population size per year[b]	*Average* $N_a \leq 83$	*83 < Average* $N_a < 830$	*Average* $N_a \geq 830$
Population decline[c]	Precipitous decline[d]	Chronic decline or depression[e]	No decline apparent or probable
Catastrophic decline	Order of magnitude decline within one generation	Smaller but significant decline[f]	Not apparent
Spawner density (adults/IP-km)	N_a/*IP-km* ≤ 1	1 < N_a/*IP-km* ≥ MRSD[g]	N_a/*IP-km* ≥ MRSD[g]
Hatchery influence			Hatchery fraction <5%
	-in addition to above-		
Extinction risk from PVA	≥20% within 20 years	≥5% within 100 years but <20% within 20 years	<5% within 100 years[h]

[a] The effective population size (N_e) is the number of breeding individuals in an idealized population that would give rise to the same variance in gene frequency under random genetic drift or the same rate of inbreeding as the population under consideration (Wright 1931).
[b] The generation time for coho salmon is approximately three years, therefore the number of spawners per generation $N_g = 3 N_a$ where N_a is the annual number of spawners.
[c] The population decline criteria require the calculation of two parameters, N_a and the population trend (*T*). Williams et al. (2008) recommends using the geometric mean of the most recent four generations (i.e., 12 years) to estimate annual population abundance, so N_a is equal to the geometric mean of 12 years of spawner abundance.
[d] Population has declined within the last two generations or is projected to decline within the next two generations (if current trends continue) to annual run size of $N_a \leq 500$ spawners (historically small but stable populations not included) or $N_a > 500$ but declining at a rate of ≥10% per year over the last two-to-four generations.[e] Annual spawner abundance N_a has declined to ≤500 spawners, but now stable **or** number of adult spawners (N_a) > 500 but continued downward trend is evident.
[f] Annual spawner abundance decline in one generation < 90% but biologically significant (e.g., loss of year class).
[g] MRSD, or minimum required spawner density, is the number adults divided by the amount of IP-km in a population. For high extinction risk, the MRSD is the same number as the depensation threshold.
[h] For populations to be considered at low-risk of extinction, all criteria must be satisfied (i.e., not just a PVA). A population viability analysis (PVA) can also be included for consideration, but must estimate an extinction risk <5% within 100 years *and* all other criteria must be met. If discrepancies exist between PVA results and other criteria, results need to be thoroughly examined and potential limitations of either approach carefully identified and examined.

The risks of small population size

Population size is extremely important to recovery of species because the time-to-extinction decreases as the population size decreases (Caughley 1994, Fagan and Holmes 2006). This longstanding theoretical prediction and empirically observed phenomenon of small populations (Fagan and Holmes 2006) highlights the importance of keeping currently healthy salmonid populations from reaching low abundance levels. In addition, it adds urgency to recovery efforts for those populations that are depressed. The effects of stochastic pressure due to small population size are discussed in the 2011 status review for SONCC coho salmon (Ly and Ruddy 2011).

Extinction is theorized to occur in stages. In the first phase of extinction, population instability occurs with population abundance fluctuating with a higher than normal amplitude. Anadromous salmonid populations are known to have large swings in abundance that are usually linked to variations in ocean productivity (Northcote and Atagi 1997; also see Chapter 3). This makes identifying the instability stage difficult for fisheries managers because they rarely have sufficient population abundance data with which to distinguish between population instability and natural population variability. In the decline phase there is a sustained period in which death rates exceed birth rates within one or more populations (Figure 2-6). Depending on the robustness of the data and length of the dataset, the decline in the phase may or may not be evident by examining the trend in abundance over time. The collapse phase is characterized by reductions in the number or extent of occurrence of a species. The extent of the occurrence of a species may erode from the edges (i.e., range contraction) or from gaps closer to the center of its range (i.e., fragmentation; Ewers and Didham 2005). In the terminal phase (Figure 2-6), a population is not likely to increase in abundance over any time interval before extinction (Fagan and Holmes 2006). Any increases in abundance are likely to be very short-lived (Fagan and Holmes 2006) and the reproductive success of the population depends on the success of a small number of individuals (Caughley 1994, Fagan and Holmes 2006). The longer a population stays in the small dynamics phase (Figure 2-6), the more likely it will go extinct.

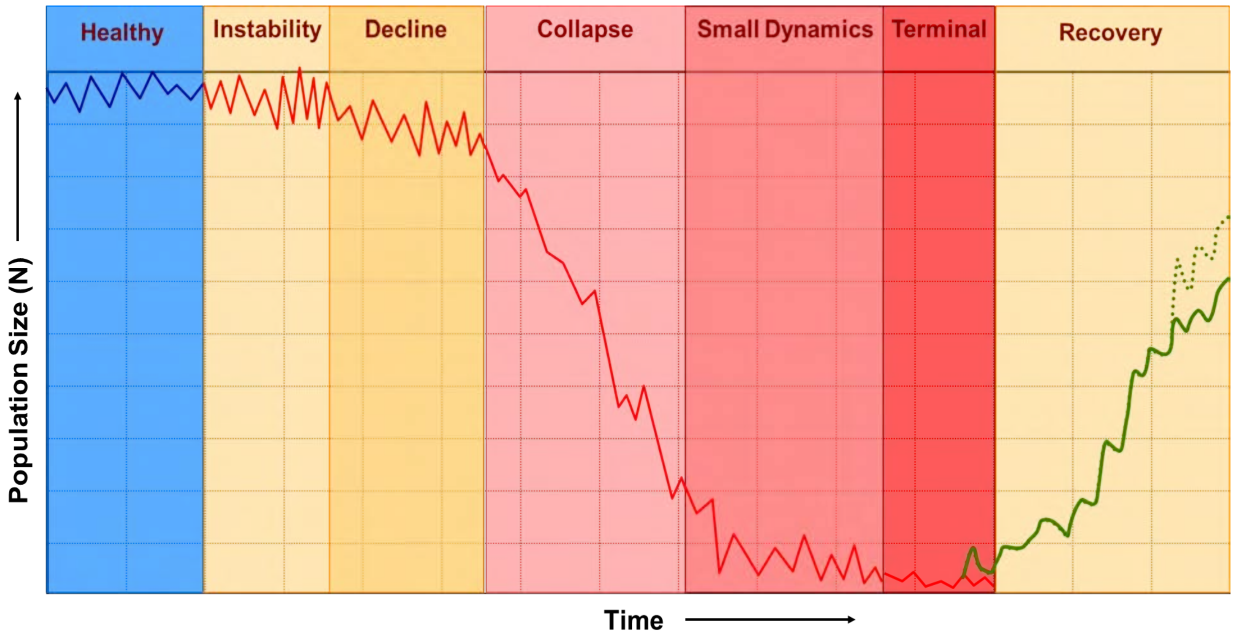


Figure 2-6. Conceptual diagram of the demographic extinction process. Diagram shows the size of a population over time through different stages. In the terminal phase, two possible trajectories for the population are extinction or recovery. Figure adapted from C. Johnson, pers. comm., 2010.

For Snake River coho salmon, which were monitored for 20 years preceding their extinction, the population size at which the final decline began (terminal phase) was 404 individuals (Fagan and Holmes 2006). After the population reached 233, there were no increases in the population in subsequent years, with a final population size preceding extinction of 6 individuals (Fagan and Holmes 2006).

In terms of recovery of small populations (those with fewer individuals than the depensation threshold) of anadromous salmonids, it is important to recognize that these populations are subject to random environmental and demographic changes. This is unlike large populations which are, in general, only subject to environmental stochasticity (Lande 1993). Because small populations can be affected by more than one form of stochasticity, they have a much greater probability of extinction than large populations (Lande 1993, Caughley 1994, Melbourne and Hastings 2008). Once a population enters the small population dynamics phase it is equally important, if not more so (Melbourne and Hastings 2008), to recognize and consider that the population is at a substantial risk of extinction resulting from the demographic factors originating from within the population.

Depensation Threshold

Population size provides an indication of the type of extinction risk that a population faces. For instance, smaller populations are at a greater risk of extinction than large populations because the processes that affect populations operate differently in small populations than in large populations (McElhany et al. 2000). One risk of low population size is the population effects of depensation. Depensatory effects occur when populations are reduced to very low densities and individual growth rates decrease as a result of a variety of mechanisms [e.g., failure to find mates and therefore reduced probability of fertilization and failure to saturate predator populations (Liermann and Hilborn 2001)]. Depensation, and its resultant effects, results in negative feedback that accelerates a decline toward extinction (Williams et al. 2008).

The depensation threshold is the number of spawners below which a population is subject to depensatory effects. Williams et al. (2008) defined the depensation threshold as 1 spawner per IP-km. A population below the depensation threshold is at high risk of extinction (Table 2-3). The depensation threshold for each independent population is shown in Table 2-6. In order for the ESU to be viable, all independent populations which aren't extirpated must not be at high risk of extinction, and so their spawner numbers must be greater than the depensation threshold.

2.4 Current Status of the ESU

In order to determine the current risk of extinction of the SONCC coho salmon ESU, NMFS utilized the population viability criteria (Table 2-3) and the concept of Viable Salmonid Populations (VSP) to evaluating populations described by McElhany et al. (2000). A viable salmonid population is defined as one that has a negligible risk of extinction over 100 years. Viable salmonid populations are described in terms of four parameters: abundance, population productivity, spatial structure, and diversity. These parameters are predictors of extinction risk, and reflect general biological and ecological processes that are critical to the growth and survival of salmon (McElhany et al. 2000). In a recovered ESU, viability criteria for all four parameters would be met.

The productivity of a population (i.e., production over the entire life cycle) can reflect conditions (e.g., environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany et al. 2000). In general, declining productivity equates to declining population abundance.

Understanding the spatial structure of a population is important because the population structure can affect evolutionary processes and, therefore, alter the ability of a population to adapt to spatial or temporal changes in the species' environment (McElhany et al. 2000). Spatial structure and the distribution of appropriate amounts and types of habitat (and ecological processes) should be considered the foundation of population and ESU viability.

Diversity, both genetic and behavioral, is critical to success in a changing environment. Salmonids express variation in a suite of traits, such as anadromy, morphology, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, and physiology and molecular genetic characteristics. The more diverse these traits (or the more these traits are not restricted), the more diverse a population is, and the more likely that individuals, and therefore the species, would survive and reproduce in the face of environmental variation (McElhany et al. 2000). However, when this diversity is reduced due to loss of entire life-history strategies or to loss of habitat used by fish exhibiting variation in life-history traits, the species is in all probability less able to survive and reproduce given environmental variation.

Because some of the parameters are related or overlap, the evaluation is at times necessarily repetitive. Viable ESUs are defined by some combination of multiple populations, at least some of which exceed “viable” thresholds, and that have appropriate geographic distribution, protection from catastrophic events, and diversity of life histories and other genetic expression. The following subsection provides the evaluation of the risk of extinction for SONCC coho salmon based the four VSP parameters. For more information on the status of specific populations, refer to Chapters 7 to 46. The upcoming status review for SONCC coho salmon may not consider all the time series data presented here, because at least 9 to 12 years of time series data are needed for rigorous application of the criteria described in Williams et al. (2008) in the status review (Williams et al. 2011).

2.4.1 Population Abundance

Quantitative population-level estimates of adult spawner abundance spanning more than 9 years are scarce for SONCC coho salmon. New data since publication of the previous status review (Williams et al. 2011) consists of continuation of a few time series of adult abundance, expansion of efforts in coastal basins of Oregon to include SONCC coho salmon populations, and continuation and addition of several “population unit” scale monitoring efforts in California. The following text summarizes the available data for adult coho salmon abundance in the SONCC coho salmon ESU. Although long-term data are scarce, the available monitoring data indicate that spawner abundance has generally declined for populations in this ESU.

Unless otherwise noted, Figure 2-7 to Figure 2-16 show the observed or estimated number wild adult coho salmon populations of the SONCC coho salmon ESU. The data from Redwood Creek, the Smith River, Freshwater Creek, and Bogus Creek do not reflect escapement to the entire watershed. In some cases, one year class appears to be stronger or weaker than the others (i.e., the Scott River, the Shasta River, and Redwood Creek’s Prairie Creek). The Huntley Park seine estimates provide the best overall assessment of naturally produced coho salmon spawner abundance in the Rogue River basin (Oregon Department of Fish and Wildlife [ODFW] 2005a). Four independent populations contribute to this count (Lower Rogue River, Illinois River, Middle Rogue and Applegate rivers, and Upper Rogue River).

For the high-risk threshold related to depensation, Williams et al. (2008)’s viability criteria are based on an estimate of average spawner density in the three consecutive years of lowest abundance within the last four generations (i.e., 12 years). For this analysis, the average spawner density was obtained by dividing the number of spawners by the amount of IP-km, as the depensation threshold is set at 1 spawner per IP-km. A ratio less than one indicates the population is at high risk of extinction for this parameter, while a ratio greater than one indicates the population is at moderate risk of extinction for this parameter. Among those locations described above, where the number of adults has been observed or estimated for a watershed, this ratio is less than one for the Little River (0.76, Figure 2-9) and the Shasta River (0.15, Figure 2-12). The ratio of the average abundance of the lowest three year classes over the amount of IP-km is greater than one for the Upper Rogue River (2.67, Figure 2-15), the Rogue River (from

Huntley Park; 1.36, Figure 2-16), Upper Trinity River (3.10, Figure 2-11), and Scott River (1.45, Figure 2-13).

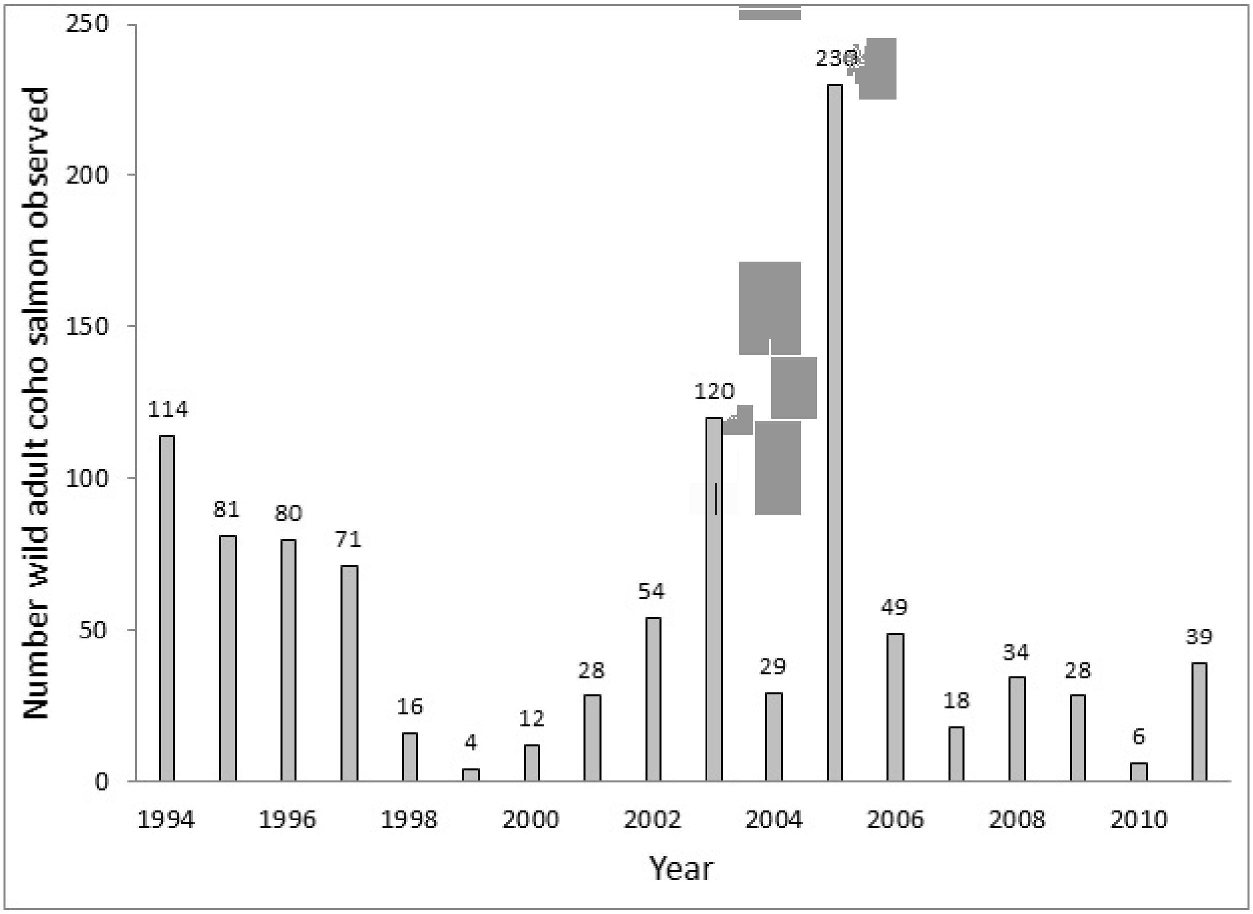


Figure 2-7. Number of wild adult coho salmon observed in Mill Creek, a tributary of the Smith River basin, 1994 through 2011. Slope of LN-transformed values = -0.046, 95% C.I = -0.148, 0.055 (Data source: Larson 2012).

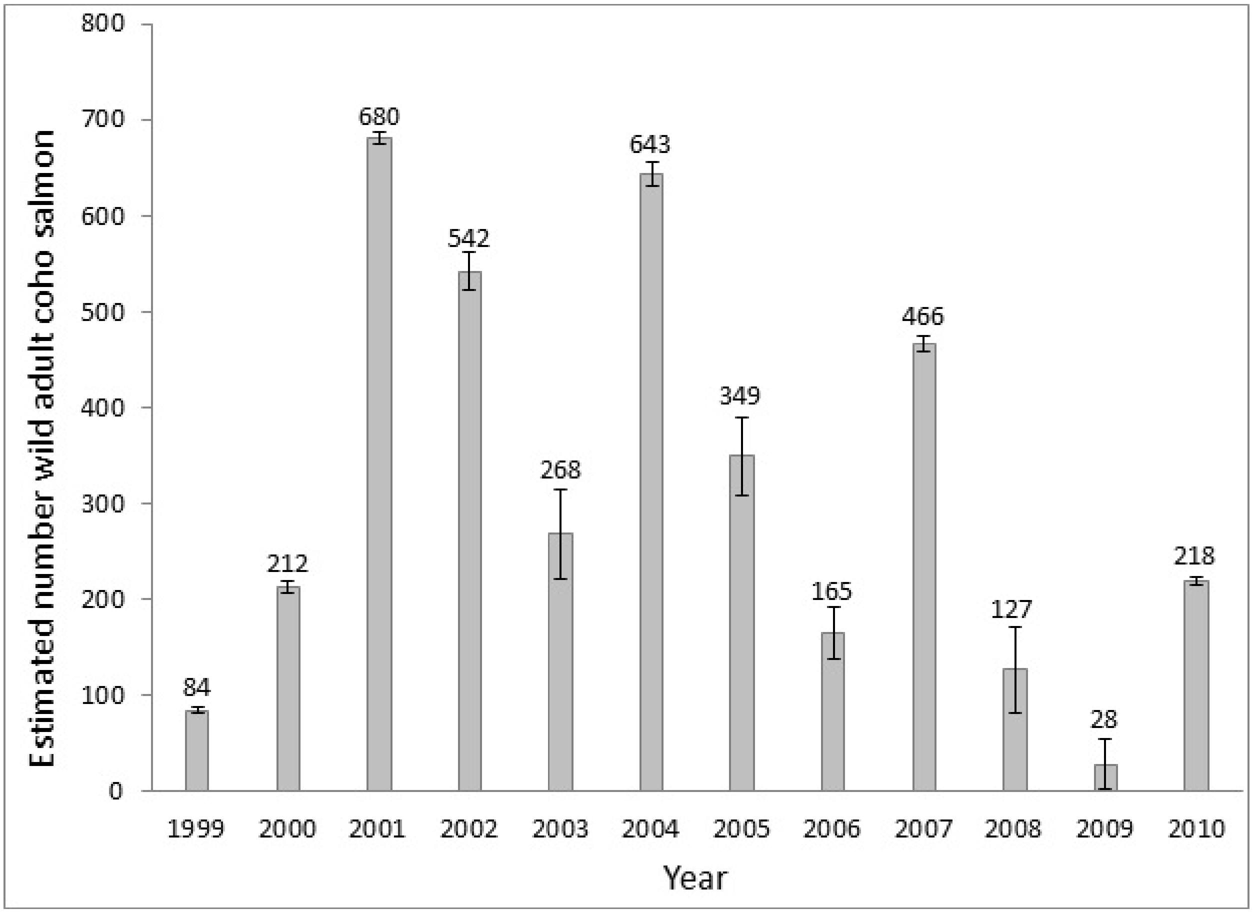


Figure 2-8. Estimated number adult coho salmon in Prairie Creek, a tributary to Redwood Creek (Humboldt County, California). Slope of LN-transformed values = -0.014, 95% C.I. = -0.181, 0.152 (Data source: Duffy 2011).

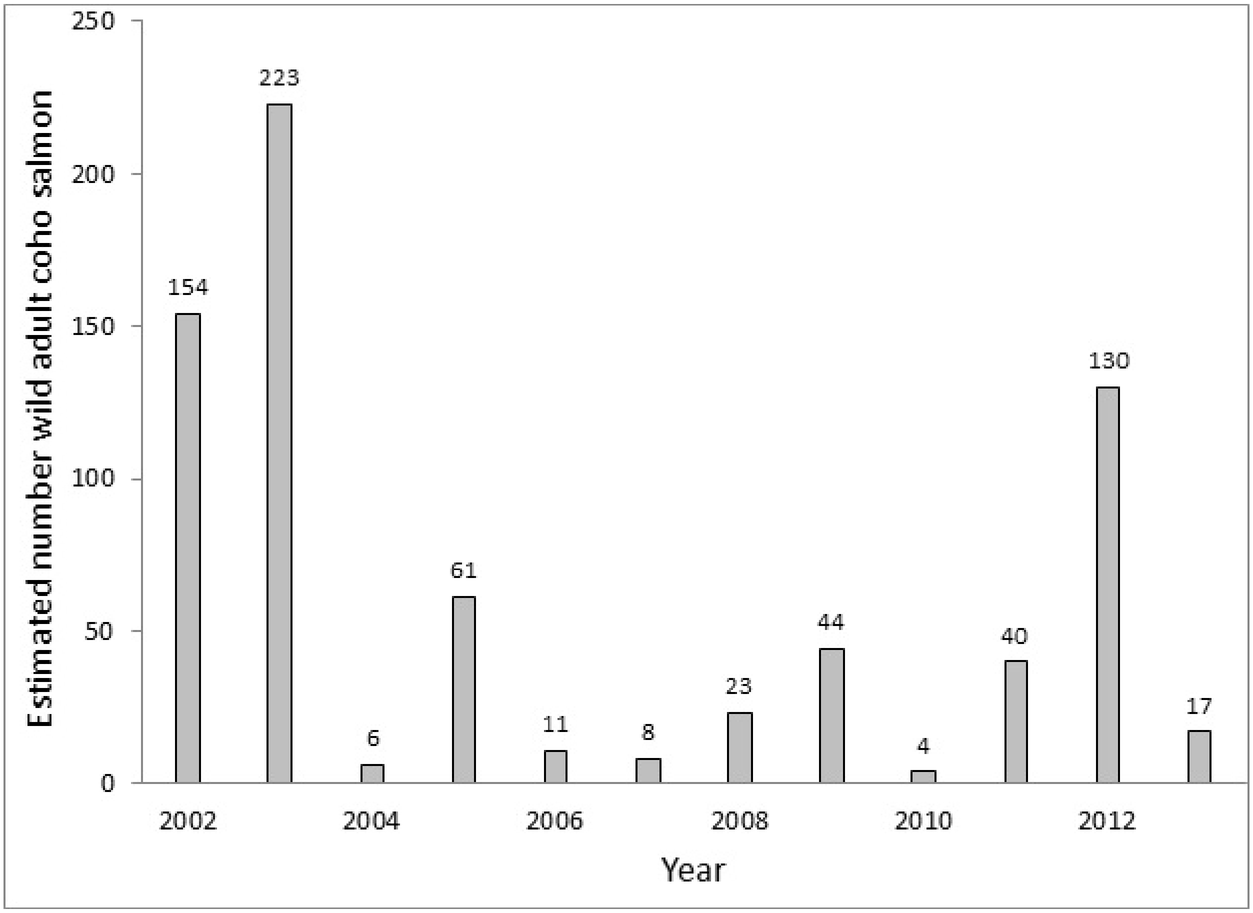


Figure 2-9. Estimated number wild adult coho salmon in the Little River. Slope of LN-transformed values = 0.44, 95% C.I. = -0.135, 0.223 (Data source: Bourque, R., pers. comm. 2013).

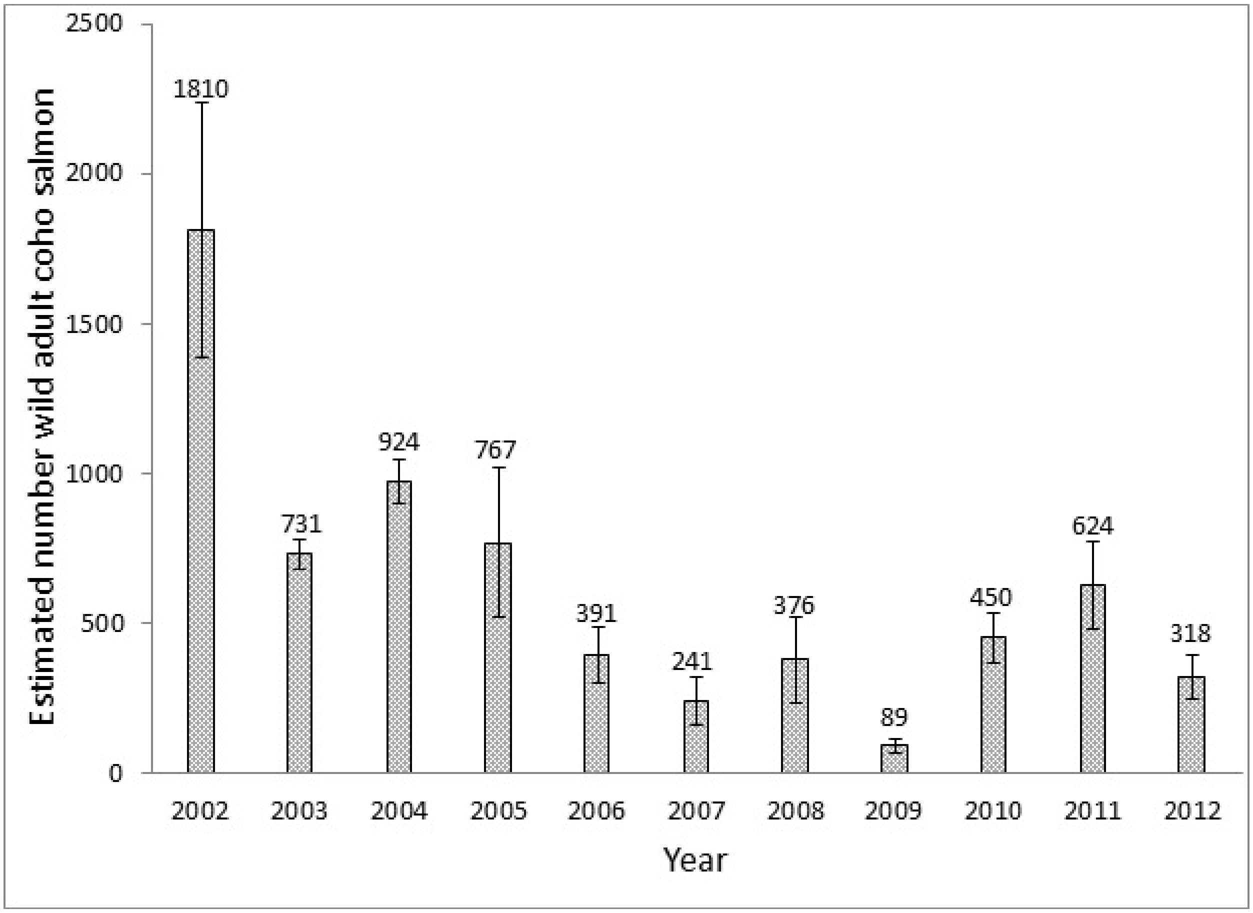


Figure 2-10. Escapement estimates for adult coho salmon in Freshwater Creek, a tributary to Humboldt Bay. Slope of LN-transformed values = -0.145, 95% C.I. = -0.280, -0.011. (Data source: Moore and Ricker 2012).

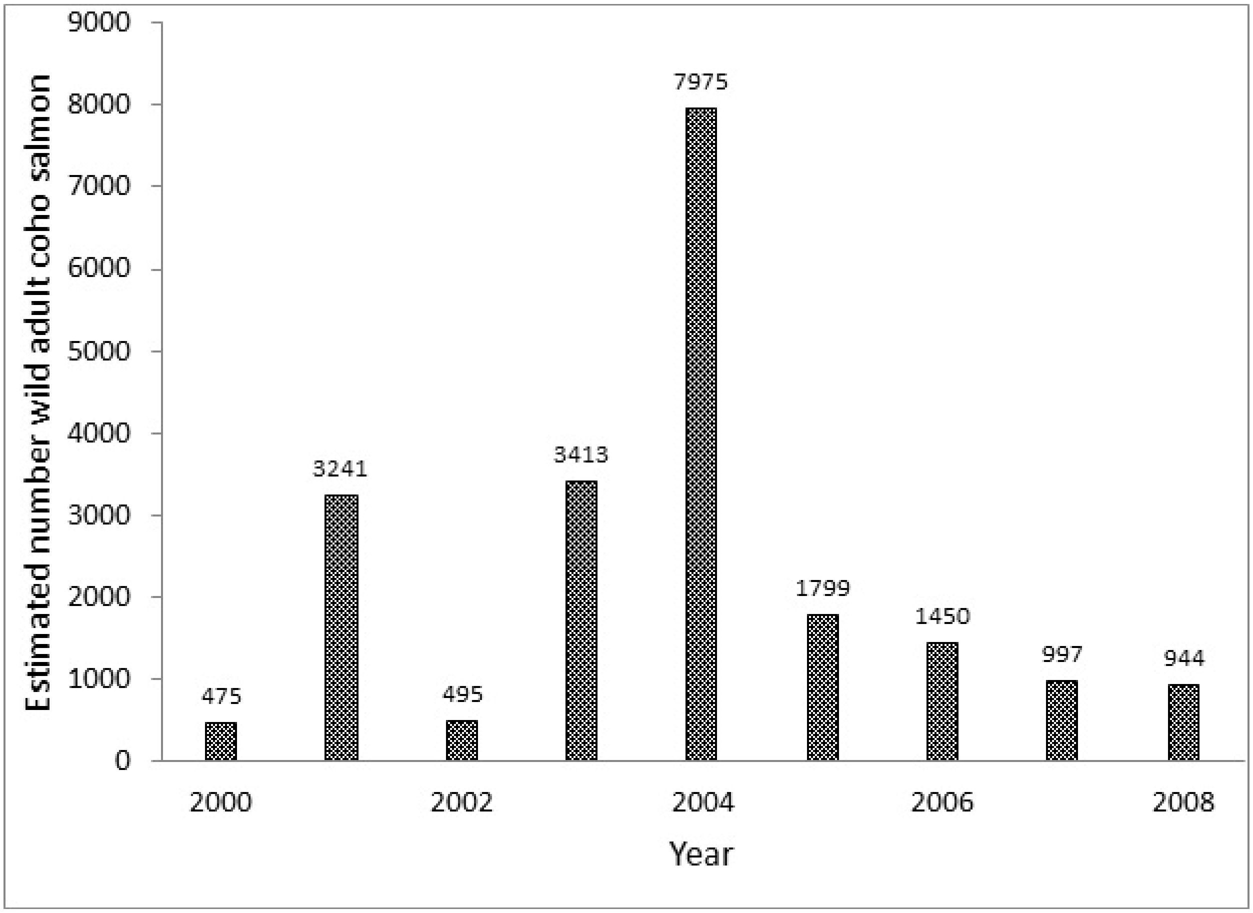


Figure 2-11. Estimated number wild adult coho salmon upstream of Willow Creek weir in the Trinity River. Slope of LN-transformed values = 0.012, 95% C.I. = -0.28, 0.30. Data source: CDFG 2009.

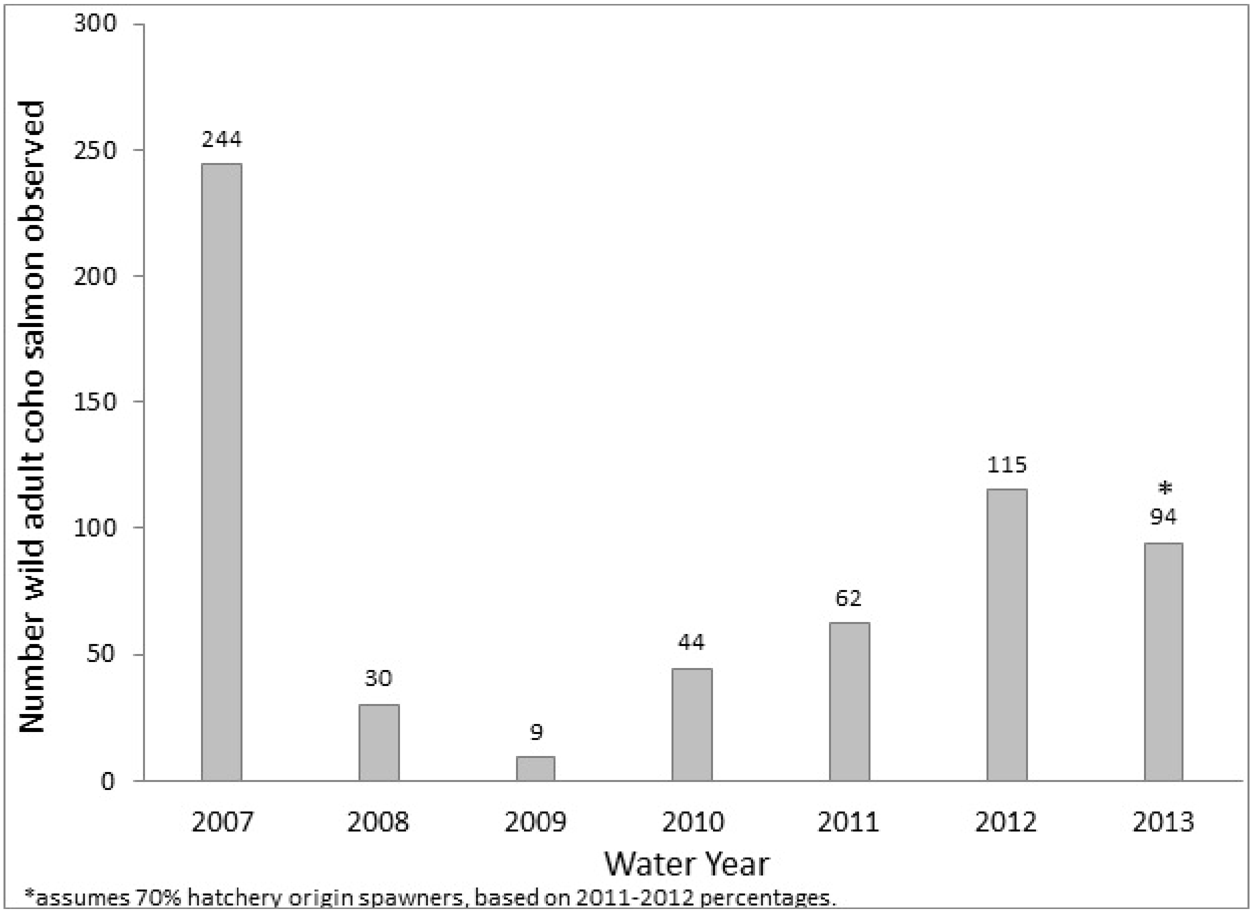


Figure 2-12. Estimated number wild coho salmon observed at video weir on the Shasta River Does not include hatchery origin fish on spawning grounds. Slope of LN-transformed values = 0.063, 95% C.I. = -0.542, 0.667. (Data source: 2007-2012 Chesney and Knechtle 2013a, 2013 Knechtle, M. pers. comm. 2014).

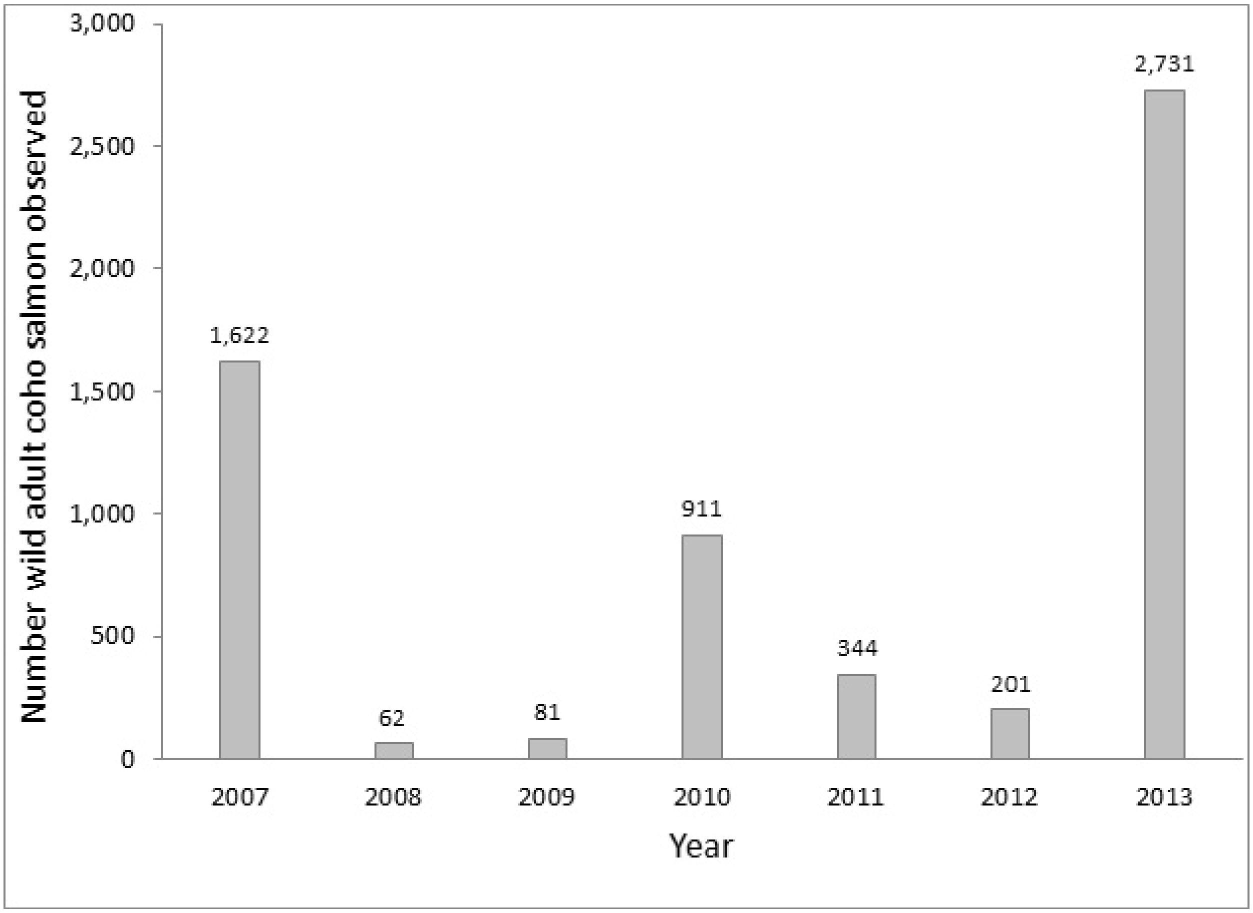


Figure 2-13. Number wild adult coho salmon observed at the Scott River fish counting facility at River Mile 18, 2007 to 2013. Does not include hatchery origin fish on spawning grounds. Slope of LN-transformed values = 0.191, 95% C.I. = -0.556, 0.939. (Data source: 2007-2012 data Knechtle and Chesney 2013a, 2013 data pers. comm. M. Knechtle, CDFW, 2014).

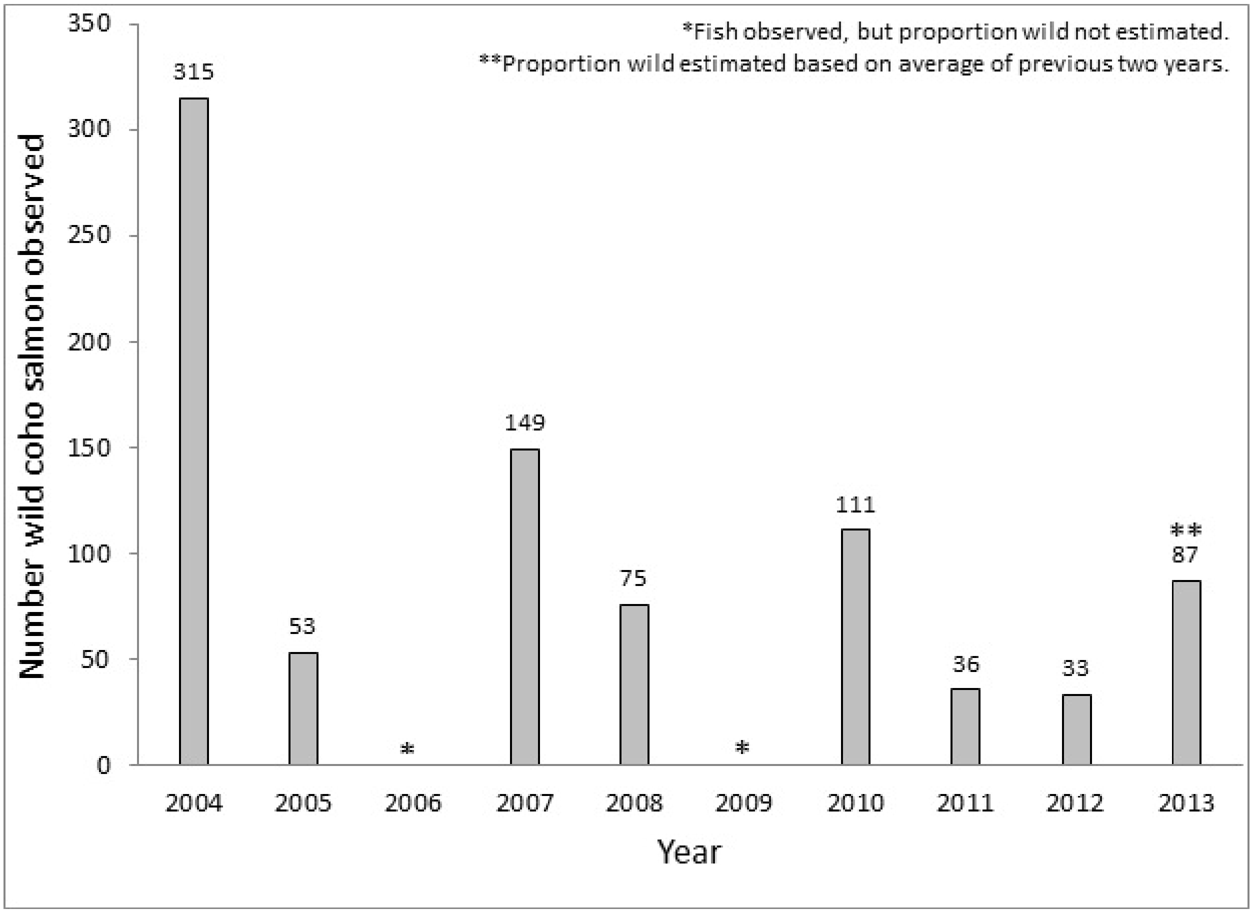


Figure 2-14. Number wild adult coho salmon observed in Bogus Creek, a tributary of the Upper Klamath River. Does not include hatchery origin fish on spawning grounds. Slope of LN-transformed values = -0.13, 95% C.I. = -0.329, 0.066. (Data source: 2007-2012 data Knechtle and Chesney 2013b, 2013 data pers. comm. M. Knechtle, CDFW, 2014).

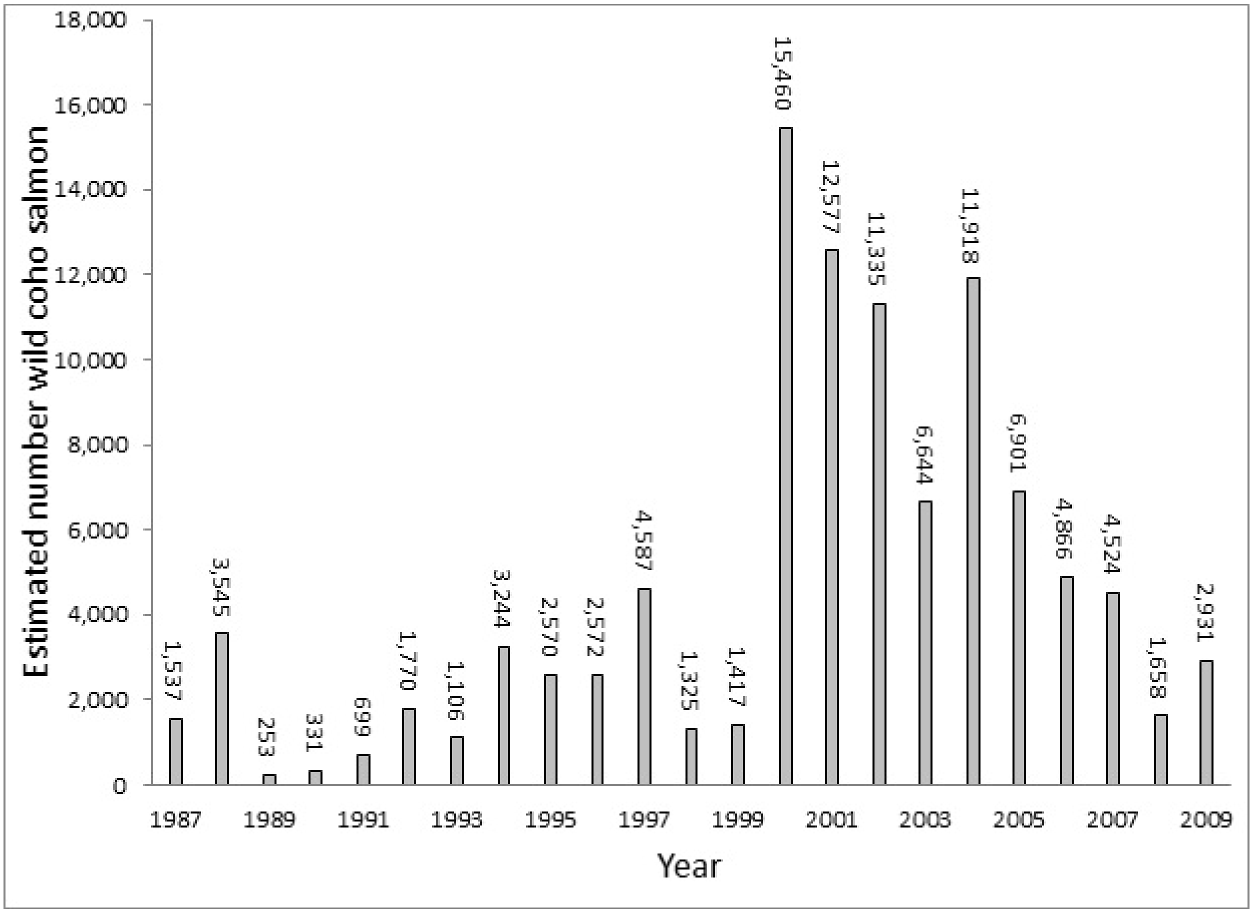


Figure 2-15. Number adult wild coho salmon observed at Gold Ray Dam on the Upper Rogue River. Slope of LN-transformed values = 0.094, 95% C.I. = 0.035, 0.154. Data source: ODFW 2010.

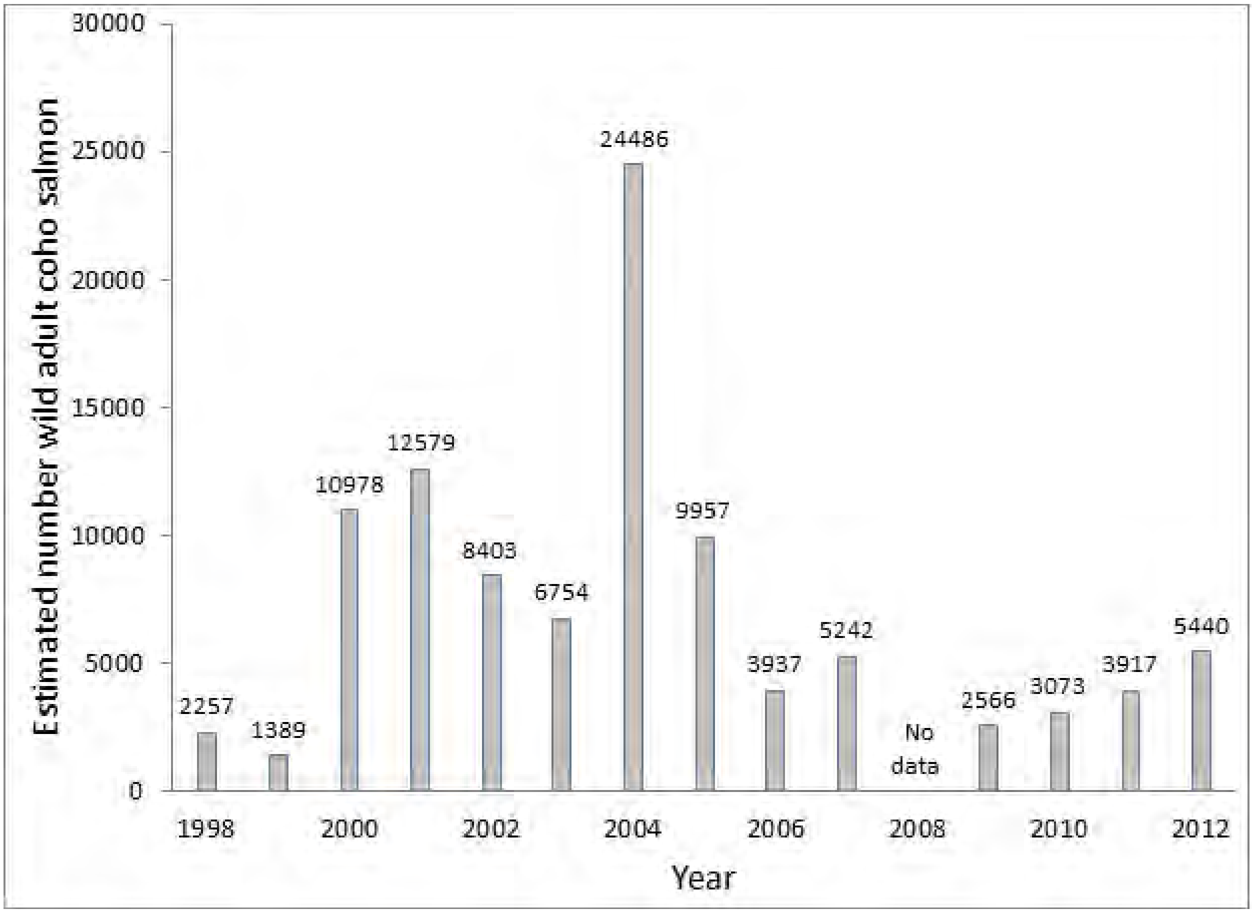


Figure 2-16. Estimated number of wild adult coho salmon in the Rogue River basin. (Huntley Park sampling), 1998 to 2012[4]. Slope of LN-transformed values = -0.023, 95% C.I. = -0.1469, 0.100 (Data source: ODFW 2012).

Though population-level estimates of abundance for most independent populations are lacking, the best available data indicate that none of the seven diversity strata appears to support a single viable population (one at low risk of extinction) as defined by in the viability criteria (Table 2-3). In fact, most of the 30 independent populations in the ESU are at high risk of extinction for abundance because they are below or likely below their depensation threshold (Table 2-6).

Populations that are below depensation have increased likelihood of being extirpated. Coho salmon spawners in the Eel River watershed, which historically supported significant spawners (e.g., 50,000 to 100,000 per year; Yoshiyama and Moyle 2010), have declined in number. Yoshiyama and Moyle (2010) concluded that coho salmon populations in the Eel River basin appear to be headed for extirpation by 2025. One of the four independent populations in this basin has already been extirpated (i.e., Middle Fork Eel River; Moyle et al. 2008, Yoshiyama and Moyle 2010) and one population contains critically low numbers (i.e., Upper Mainstem Eel

[4] 2008 data were excluded from consideration because the extremely low numbers were not consistent with that seen upstream at Gold Ray Dam, suggesting other reasons (sampling issues, data errors, etc.) for the dramatic drop in fish numbers from 2007 to 2008.

River, with only a total of seven adult coho salmon counted at the Van Arsdale Fish Station in over six decades; Jahn, J., pers. comm. 2010). Although long term spawner data are not available, both NMFS and CDFW believe the Lower Eel/Van Duzen River (Chapter 26), Middle Mainstem Eel River population (Chapter 44) and Mainstem Eel River population (Chapter 42) are very likely below the depensation threshold, and thus are at a high risk of extinction (rationale provided in referenced chapters). The only population in the Eel River basin that is likely to be above its depensation threshold is the South Fork Eel River (Chapter 41), which has also declined from historical numbers in the tens of thousands before 1950 (Taylor 1978; Figure 2-17).

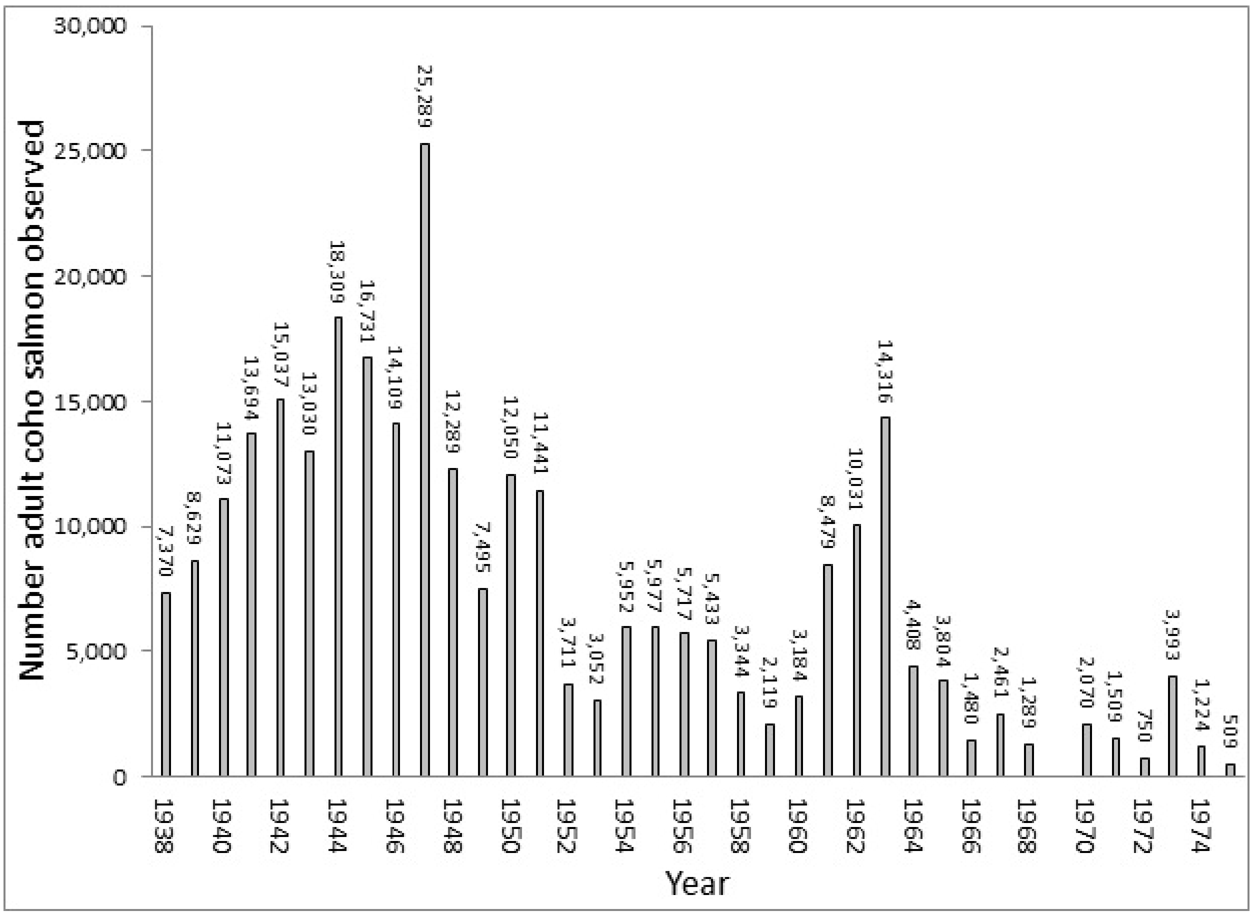


Figure 2-17. Fish counts at Benbow Fish Station, in the South Fork Eel River. Data are from 1938 to 1975 (excluding 1969). Counts may contain hatchery-origin fish. Data source: Taylor 1978.

In addition to the Eel River basin, two other independent populations south of the Eel River basin, the Bear River and Mattole River populations, have similar trajectories. The Bear River population is likely extirpated or severely depressed. Despite multiple surveys over years, no coho salmon have been found in the Bear River watershed (Bliesner et al. 2006, Ricker 2002). In 1996 and 2000, the California Department of Fish and Game (CDFG) surveyed most tributaries of the Bear River, and did not find any coho salmon (CDFG 2004a). In addition, CDFG sampled the mainstem and South Fork Bear River between 2001 and 2003 and found no coho salmon (Jong et al. 2008). In the Mattole River, surveys of live fish and carcasses since 1994 indicate the population is severely depressed and well below the depensation threshold of 250 spawners. Recent spawner surveys in the Mattole River resulted in only three and nine coho salmon for 2009 and 2010, respectively. These low numbers, along with a recent decline since 2005, indicate that the Mattole River population is at a high risk of extinction.

2.4.2 Productivity

The productivity of a population (i.e., production over the entire life cycle) can reflect conditions (e.g., environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape, habitats in which it exists, and its response to those habitats (McElhany et al. 2000). In general, declining productivity equates to declining population abundance.

Available data show that the 95% confidence intervals for the slope of the regression line include zero for many populations (Figure 2-7 to Figure 2-16), indicating that whether the slope is negative or positive cannot be determined. However, there is 95% confidence that the slope of the regression line is negative, indicating a decreasing trend, for Mill Creek in the Smith River and Freshwater Creek in Humboldt Bay Tributaries. In contrast, there is 95% confidence that the slope of the regression line is positive, indicating an increasing trend, at Gold Ray Dam in the Upper Rogue River.

2.4.3 Spatial Structure

The viability report for the SONCC coho salmon ESU explicitly described spatial structure and concluded data were insufficient to set specific population spatial structure targets (Williams et al. 2008). In the absence of such targets, McElhany et al. (2000) suggested the following: "As a default, historical spatial processes should be preserved because we assume that the historical population structure was sustainable but we do not know whether a novel spatial structure will be", where "historical" means "before the recent or severe declines that have been observed in many populations (McElhany et al. 2000)."

An ESU persists in places where it is able to track environmental changes, and becomes extinct if it fails to keep up with the shifting distribution of suitable habitat (Thomas 1994, Williams et al. 2008). If freshwater habitat shrinks due to climate change (Battin et al. 2007) or habitat degradation, certain areas such as inland rivers and streams could become inhospitable to coho salmon, which would change the spatial structure of the SONCC coho salmon ESU, having implications for the risk of species extinction.

Available data are inadequate to determine whether the spatial distribution of SONCC coho salmon has changed since 2005. In 2005, Good et al. (2005) noted that they had strong indications that breeding groups have been lost from a significant percentage of streams within their historical range. Relatively low levels of observed presence in historically occupied coho salmon streams (32 to 56 percent from 1986 to 2000) indicate continued low abundance in the California portion of the SONCC coho salmon ESU. The relatively high occupancy rate of historical streams observed in brood year 2001 suggests that much habitat remains accessible to coho salmon (70 FR 37160, June 28, 2005). Brown et al. (1994) found survey information on 115 streams within the SONCC coho salmon ESU, of which 73 (64 percent) still supported coho salmon runs while 42 (36 percent) did not. The streams Brown et al. (1994) identified as lacking coho salmon runs were all tributaries of the Klamath River and Eel River basins. CDFG (2002b) reported a decline in SONCC coho salmon occupancy, with the percent reduction dependent on the data sets used. All the assessments based on fish presence described above were affected by the often poor hydrologic conditions present in the survey years.

Although there is considerable year-to-year variation in estimated occupancy rates, it appears that there has been no dramatic change in the percent of coho salmon streams occupied from the late 1980s and early 1990s to 2000 (Good et al. 2005). However, the number of streams and rivers currently supporting coho salmon in this ESU has been greatly reduced from historical levels, and watershed-specific extirpations of coho salmon have been documented (Brown et al. 1994, CDFG 2004a, Good et al. 2005, Moyle et al. 2008, Yoshiyama and Moyle 2010). In summary, recent information for SONCC coho salmon indicates that their distribution within the ESU has been reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which they are now absent (NMFS 2001). However, extant populations can still be found in all major river basins within the ESU (70 FR 37160; June 28, 2005).

The spatial structure of each population was not quantified for this plan because data are insufficient. The current spatial structure of each population is described in Chapters 7 to 46.

2.4.4 Diversity

The primary factors affecting the genetic and life-history diversity of SONCC coho salmon appear to be low population abundance and the influence of hatcheries and out-of-basin introductions. Although the operation of a hatchery tends to increase the abundance of returning adults (70 FR 37160; June 28, 2005), the reproductive success of hatchery-born salmonids spawning in the wild can be less than that of naturally produced fish (Araki et al. 2007a). As a result, the higher the proportion of hatchery-born spawners, the lower the overall productivity of the population, as demonstrated by Chilcote (2003). Williams et al. (2008) considered a population to be at least at a moderate risk of extinction if the contribution of hatchery coho salmon spawning in the wild exceeds 5 percent. Populations have a lower risk of extinction if no or negligible ecological or genetic effects resulting from past or current hatchery operations can be demonstrated. Because the main stocks in the SONCC coho salmon ESU (i.e., Rogue River, Klamath River, and Trinity River) remain heavily influenced by hatcheries and have little natural production in mainstem rivers (Weitkamp et al. 1995; Good et al. 2005), some of these populations are at high risk of extinction relative to the genetic diversity parameter. The extent of hatcheries in the ESU, and a discussion of their effects, is described in Chapters 3 and 7 to 46. Table 2-4 shows those populations with hatchery stress and threat ranks of high (greater than 10 percent and less than 30 percent hatchery-origin adults) and very high (greater than 30 percent hatchery-origin adults).

Table 2-4. Populations with hatchery effects rated as a high or very high stress and threat. Table shows % hatchery spawners, and source.

Population	Stress and Threat Rank	Average Percentage Hatchery Origin Adults
Upper Klamath River	Very High	47% at Bogus Creek from 2004 to 2012, excluding 2006 and 2009; Knechtle and Chesney (2013b)
Shasta River	High	16% in 2001, 2003, 2004; Ackerman and Cramer (2006). 23% from 2001 to 2004; Ackerman et al. (2006). 43% from 2007 to 2012; Chesney and Knechtle (2013)
Lower Trinity River	Very High	85-97% from 1997 to 2002; Sinnen et al. 2009. 60-100% from 1998 to 1999; Dutra and Thomas (1999)
South Fork Trinity River	Very High	36% in 1985; Jong and Mills (1992)
Upper Trinity River	Very High	97%, USFWS and HVT (1999)

Some populations are extirpated or nearly extirpated (i.e., Middle Fork Eel, Bear River, Upper Mainstem Eel) and some brood years have low abundance or may be absent in some areas (e.g., Shasta River, Scott River, Mattole River, Mainstem Eel River), which further restricts the diversity present in the ESU. The ESU's current genetic variability and variation in life-history likely contribute significantly to long-term risk of extinction. Given the recent trends in abundance across the ESU, the genetic and life-history diversity of populations is likely very low and is inadequate to contribute to a viable ESU.

2.4.5 Oregon Assessment

The Oregon Department of Fish and Wildlife assessed the status of the Rogue Coho Species Management Unit (SMU), which includes the Upper Rogue, Middle Rogue, and Illinois River populations (ODFW 2005a) using five interim criteria defined in their Native Fish Conservation Policy. These criteria were designed to identify cases of significant near-term conservation risks. The Rogue Coho SMU was found Not At Risk because all three populations met all six criteria (Table 2-5). The criteria used by ODFW and NMFS to assess the status of the ESU were different, leading to different results. In addition, the NMFS assessment included all populations within the ESU, while the ODFW assessment was limited to the three interior Rogue populations within the Rogue Coho SMU.

Table 2-5. Interim criteria and standards. As defined in the Native Fish Conservation Policy risk assessment of Oregon salmon and steelhead SMUs (ODFW 2005a).

Attribute	Criteria
Existing populations	At least 80% of historical populations are still in existence (i.e., not extinct) *and* not at risk of extinction in the near future.
Habitat use distribution	Naturally produced members of a population occupy at least 50% of the historically-used (pre-development) habitat in at least three of the last five years for at least 80% of existing populations.
Abundance	Number of naturally-produced fish is greater than 25% of average levels in at least three of the last five years for at least 80% of existing populations.
Productivity	Population replacement rate for at least 80% of existing populations is at least 1.2 naturally-produced adult offspring per parent in three of the last five years when total abundance was less than average returns of naturally produced fish.
Reproductive independence	90% or more of spawners are naturally produced in at least three of the last five years for at least 80% of existing populations.
Hybridization	Hybridization with non-native species is rare or nonexistent in three of the last five years for at least 80% of existing populations.

2.4.6 Summary

Though population-level estimates of abundance for most independent populations are lacking, the best available data indicate that none of the seven diversity strata appears to support a single viable population as defined by the SONCC coho salmon technical recovery team's viability criteria (low extinction risk; Williams et al. 2008). Further, 24 out of 31 independent populations are at high risk of extinction and 6 are at moderate risk of extinction (Table 2-6).

Based on the above discussion of the population viability parameters, and qualitative viability criteria presented in Williams et al. (2008), NMFS concludes that the SONCC coho salmon ESU is currently not viable and is at high risk of extinction.

The decline in abundance from historical levels, and the poor status of population viability metrics in general, are the main factors behind the extinction risk faced by SONCC coho salmon. The primary causes of the decline are likely long-standing human-caused conditions (e.g., harvest and habitat degradation), which exacerbated the impacts of adverse environmental conditions (e.g., drought and poor ocean conditions) (60 FR 38011; July 25, 1995). The demographic response to impaired habitat has been a reduction in the number of fish and their range, which has made them less resilient to environmental stresses such as poor ocean conditions. The stresses and threats that contribute to the current status of SONCC coho salmon are described in Chapter 3.

Table 2-6. SONCC coho salmon ESU core and non-core 1 populations and their current risk of extinction.

Stratum	Population	Extinction Risk	Depensation Threshold (1*IP-km)	Extinction Risk Criteria Used[1]
Northern Coastal Basin	Elk River	High	63	Spawner density
	Lower Rogue River	High	81	Population decline
	Chetco River	High	135	Spawner density
	Winchuck River	High	57	Spawner density
Interior Rogue River	Illinois River	High	590	Population decline
	Middle Rogue/Applegate Rivers	High	603	Population decline
	Upper Rogue River	Moderate	689	Spawner density
Central Coastal Basin	Smith River	High	325	Spawner density
	Lower Klamath River	High	205	Spawner density
	Redwood Creek	High	151	Spawner density
	Little River	Moderate	34	Spawner density
	Mad River	High	136	Spawner density
Interior Klamath	Middle Klamath River	Moderate	113	Spawner density
	Upper Klamath River	High	425	Spawner density
	Shasta River	High	144	Spawner density
	Scott River	Moderate	250	Spawner density
	Salmon River	High	114	Spawner density
Interior Trinity	Lower Trinity River	High	112	Spawner density
	South Fork Trinity River	High	242	Spawner density
	Upper Trinity River	Moderate	365	Spawner density
South Coastal Basin	Humboldt Bay tributaries	Moderate	191	Spawner density
	Lower Eel/Van Duzen Rivers	High	394	Spawner density
	Mattole River	High	250	Spawner density
Interior Eel	Mainstem Eel River	High	68	Spawner density
	Middle Mainstem Eel River	High	232	Spawner density
	South Fork Eel River	Moderate	464	Spawner density

[1]As described in Williams et al. (2008) and Table 2-3.

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3. Stresses and Threats

Stresses are the physical, biological, or chemical conditions and associated ecological processes that may be impeding SONCC coho salmon recovery. General categories of stresses include water quality, competition, disease, access to habitat, instream flows, insufficient quality and quantity of physical habitat, and predation. Threats are activities or impacts that cause or contribute to the stresses that limit recovery of the species, including: water diversions, hydropower impacts, land management, invasive species, fish harvest management, and hatchery management.

When the SONCC coho salmon ESU was listed under the Endangered Species Act (ESA) in 1997, NMFS identified the factors which led to the decline of the species (62 FR 24588, May 6, 1997), and the stresses and threats associated with those factors. These factors, called "listing factors", are described in Chapter 1. Table 3-1, Table 3-2, and Table 3-3 describe the stresses and threats associated with each listing factor. Each population's stresses and threats are assessed in the population profiles (Chapters 7 to 46). This chapter describes the stresses and threats associated with each listing factor, the causes of those stresses and threats, and what can be done to address them. In addition, this chapter describes the listing factor "Inadequacy of existing regulatory mechanisms", which contributes to all stresses and threats.

NMFS assessed the viability of individual populations within the SONCC coho salmon ESU and the current condition of their habitats using five steps: (1) identify conservation targets; (2) assess population viability; (3) identify potential threats and stresses; (4) compile available literature, data and best professional knowledge on the condition of the landscape; and (5) determine the severity and impact of stresses and threats affecting each population. This methodology is detailed in Appendix B.

The timeframe for assessment of stresses and threats is over the next ten years[5] under current circumstances and management (Appendix B). In addition to those stresses identified at the time of listing, additional stresses currently affecting SONCC coho salmon were identified and ranked using the Conservation Action Planning (CAP) workbook (explained in Appendix B) for each life stage of coho salmon.

[5] The effects of climate change are expected to take at least 50 years to manifest.

Table 3-1. Relationship between listing factors, stresses and threats for SONCC coho salmon.

Threat	Listing Factor				
	Habitat Destruction, Modification or Curtailment	Over-Utilization for Commercial, Recreational, Scientific, or Educational Purposes	Disease and Predation	Inadequate Regulatory Mechanisms	Other Natural and Man-made Factors
Roads	X			X	
Timber Harvest	X			X	
Channelization/Diking	X			X	
Agricultural Practices	X		X	X	
Dams/Diversions	X		X	X	
Mining/Gravel Extraction	X		X	X	
Urbanization	X		X	X	
Fishing and Collecting		X		X	
Climate Change	X		X	X	X
Hatcheries				X	X
Fire	X			X	
Invasive/Non-native Alien Species	X		X	X	

Table 3-2. Matrix of interrelated threats and stresses in the SONCC coho salmon ESU.

Threats	**Stresses**									
	Adverse Hatchery-Related Effects	Impaired Water Quality	Degraded Riparian Forest Conditions	Increased Disease/ Predation/ Competition	Altered Sediment Supply	Lack of Floodplain/ Channel Structure	Altered Hydrologic Function	Barriers	Adverse Fishery and Collecting-Related Effects	Impaired Estuary/ Mainstem function
Climate Change		X	X	X	X	X	X			X
Roads		X	X		X	X	X	X		X
Channelization/Diking		X	X		X	X	X			X
Agricultural Practices		X	X		X	X	X	X		X
Timber Harvest		X	X		X	X	X	X		X
Urban/Residential/ Industrial Development		X	X		X	X	X	X		X
High Severity Fire		X	X		X		X			
Mining/Gravel Extraction		X	X		X	X	X	X		X
Dams/Diversions		X	X	X	X	X	X	X		X
Fishing and Collecting									X	
Invasive/Non-Native/Alien Species				X						X
Hatcheries	X			X						

Table 3-3. Comparison of threats at the time of listing to current stresses and threats described in recovery plan.

Threat or Stress Assessed in Plan	Threats Identified at Time of Listing												
	Logging	Road Building	Grazing and Mining	Urbanization	Stream Channelization	Dams	Wetland Loss	Beaver Trapping	Water Withdrawals	Unscreened Diversions	Over Fishing (non-tribal)	Natural Factors	Artificial Propagation
Threats													
Roads	X	X		X	X		X						
Timber Harvest	X	X					X						
Channelization/Diking			X		X								
Agricultural Practices			X			X		X	X	X			
Dams/Diversions			X			X	X	X					
Mining/Gravel Extraction			X		X								
Urbanization				X			X	X					
Fishing and Collecting											X		X
Climate Change												X	
Hatcheries											X		X
Fire				X									
Invasive/Non Native Species				X		X							
Stresses													
Adverse Hatchery Related Effects													X
Impaired Water Quality	X	X	X	X		X	X	X	X	X			
Degraded Riparian Forest	X	X	X	X	X		X	X					
Increased Disease/Predation/Competition				X		X			X				X
Altered Sediment Supply	X	X	X	X	X	X	X					X	
Lack of Floodplain and Channel Structure		X	X	X	X		X	X					
Altered Hydrologic Function	X	X	X	X	X	X	X	X					
Barriers			X	X	X	X			X				
Impaired Estuary/Mainstem Function	X	X	X	X	X	X	X	X	X			X	
Adverse Fishery and Collecting Related Effects											X		X

In addition to the CAP assessment process, NMFS used the best available science regarding the impacts of predicted shifts in climate, effects from fishing and collecting activities, and estuary and mainstem condition on the ability of the species' to recover. Additional categories (either stresses or threats) were created for Climate Change, Impaired Estuary/Mainstem Function, and Fishing and Collecting.

3.1 Stresses

In each population profile we summarize and rank the stresses and threats (Chapters 7 to 46). Each of these population profiles includes a summary table of the stress rankings by coho salmon life stage, the overall stress ranking, and a narrative discussing the effects on the population. In addition to the stresses identified during listing, we performed a stress ranking and assessment for Impaired Estuary/Mainstem Function and Adverse Fishery- and Collection-Related Activities. Whenever available, empirical data were used in the stress assessment. Where empirical information was not available, NMFS staff relied on best professional judgment to assign a severity ranking to each stress by life stage. Refer to Appendix B for more detailed information on the methodologies used to rank stresses. The stresses assessed in this plan are listed in Table 3-4.

In the following subsection we summarize the stresses existing within the SONCC coho salmon ESU, with a brief description of the effects to coho salmon and their habitat associated with each stress. In addition, each population profile (Chapters 7 to 46) provides a detailed description of each stress at the population level, and the recovery strategy and actions recommended to achieve viability by reducing the severity of each stress as needed.

Table 3-4. Summary of stress severity ranking by population. Stress ranking represent CAP results as follows: L = Low, M = Medium, H = High, VH = Very High. See Appendix B for definition of severity rankings. See Chapters 7 to 46 for detail about any particular population's ranking.

	Stresses										
Population	Adverse Hatchery Related Effects	Impaired Water Quality	Degraded Riparian Forest	Increased Disease/ Predation / Competition	Altered Sediment Supply	Lack of Floodplain and Channel Structure	Altered Hydrologic Function	Barriers	Impaired Estuary/ Mainstem Function	Adverse Fishery- and Collection-Related Effects	Total High or Very High
Elk River	L	H[1]	H	L	M	VH[1]	H	M	M	L	4
Lower Rogue River	M	VH[1]	H	L	H	VH[1]	M	M	VH	L	5
Chetco River	L	H	VH[1]	NA	M	VH[1]	H	L	H	L	5
Winchuck River	L	VH[1]	H	NA	H	VH[1]	H	M	H	L	6
Brush Creek	L	L	VH[1]	NA	M	VH[1]	H	L	L	L	3
Mussel Creek	L	M	VH[1]	NA	H	VH[1]	H	L	H	L	5
Hunter Creek	L	H	VH[1]	NA	H	VH[1]	M	L	H	L	5
Pistol River	L	H	VH[1]	NA	VH	VH[1]	H	L	H	L	6
Smith River	M	H	M	L	M	H[1]	L	H	H[1]	M	4
Lower Klamath River	M	M	H	M	VH[1]	VH[1]	H	M	H	L	5
Redwood Creek	L	VH	H	M	H	VH[1]	M	L	VH[1]	L	5
Maple Creek/Big Lagoon	L	L	M	L	VH[1]	VH[1]	M	L	VH	L	3
Little River	L	M	H	NA	VH[1]	H[1]	M	M	M	L	3
Mad River	M	VH	H	M	VH[1]	VH[1]	M	M	VH	L	5
Elk Creek	L	M	H[1]	NA	M	H[1]	M	L	M	L	2
Wilson Creek	L	L	H[1]	NA	H	H[1]	M	L	M	L	3
Strawberry Creek	L	M	M	NA	H	M	M	H[1]	H[1]	L	3
Norton/Widow White Creek	L	M	VH[1]	NA	M	H[1]	M	M	L	L	2
Humboldt Bay Tributaries	L	H	H	L	VH	VH[1]	M	H	H[1]	L	6

	Stresses										
Population	Adverse Hatchery Related Effects	Impaired Water Quality	Degraded Riparian Forest	Increased Disease/ Predation / Competition	Altered Sediment Supply	Lack of Floodplain and Channel Structure	Altered Hydrologic Function	Barriers	Impaired Estuary/ Mainstem Function	Adverse Fishery- and Collection-Related Effects	Total High or Very High
Low. Eel/Van Duzen rivers	L	H	H	H	VH	H[1]	M	L	H[1]	L	6
Bear River	L	VH	VH[1]	NA	VH	VH[1]	L	L	H	L	5
Mattole River	L	H	H	NA	H	VH[1]	VH[1]	L	H	L	6
Guthrie Creek	L	M	M	NA	H[1]	H[1]	L	L	M	L	2
Illinois River	M	H	VH[1]	M	H	H	VH[1]	H	VH	L	7
Mid. Rogue/Applegate rivers	M	VH	VH[1]	H	H	VH	VH[1]	H	VH	L	8
Upper Rogue River	M	VH[1]	VH	H	VH	VH	VH[1]	H	VH	L	8
Middle Klamath River	M	H[1]	M	H	H	H[1]	H	H	H	L	7
Upper Klamath River	VH	H	H	H	H	VH	H[1]	VH[1]	H	L	9
Salmon River	M	M	H[1]	M	M	H[1]	L	L	M	L	2
Scott River	M	VH	VH[1]	M	VH	H	VH[1]	L	VH	L	6
Shasta River	H	VH[1]	H	VH	M	H	VH[1]	H	VH	L	8
South Fork Trinity River	VH	H[1]	H	L	H[1]	H	H	H	M	L	6
Lower Trinity River	VH	M	M	M	H	VH[1]	H[1]	M	M	L	4
Upper Trinity River	VH[1]	M	M	H	M	H	VH[1]	VH	M	L	5
South Fork Eel River	L	H	H	H	VH	VH[1]	H[1]	H	H	L	8
Mainstem Eel River	L	H[1]	H	H	VH	VH[1]	H	M	H	L	7
Mid. Fork Eel River	L	H[1]	H	H	H	H[1]	M	M	H	L	6
Mid. Mainstem Eel River	L	H	H	H	VH[1]	H	VH[1]	M	H	L	7
Upper Mainstem Eel River	L	VH	H	H	H	H	H[1]	VH[1]	H	L	5
North Fork Eel River	L	H[1]	H	H	VH[1]	H	H	M	H	L	7

[1]Identified as a key limiting stress.

3.1.1 Adverse Hatchery-Related Effects

Three artificial propagation programs are part of the SONCC coho salmon ESU: the Cole Rivers Hatchery (Rogue River), Trinity River Hatchery ,and Iron Gate Hatchery (Klamath River) coho salmon programs (70 FR 37160, June 28, 2005). Annual coho salmon production goals at these hatcheries are 200,000, 500,000, and 75,000 respectively. These hatcheries produce not only coho salmon, but also Chinook salmon and steelhead for release into the wild. Together, these hatcheries release approximately 14,215,000 hatchery salmonids into SONCC coho salmon ESU rivers annually. In addition to the three hatcheries, the Mad River and Rowdy Creek hatcheries in California and the Elk River Hatchery in Oregon are located within the ESU and produce steelhead and Chinook salmon that can prey on or compete with natural SONCC ESU coho salmon.

Table 3-5. Production levels at hatcheries throughout the SONCC coho salmon ESU.

State	Hatchery	Coho Salmon Production	Chinook Salmon Production	Steelhead Production
Oregon	Cole Rivers[1]	200,000 (released into Rogue River)	1.6 million (spring-run released into Rogue River)	220,000 (summer- run released into Rogue River)
				132,000 (winter-run released into Rogue River)
				132,000 (winter-run released into Applegate River)
	Elk River[2]	Not Applicable	325,000 fall-run smolts into Elk River	50,000 (winter-run smolts into Chetco River
			200,000 fall-run smolts into Chetco River	
California	Iron Gate[3]	79,710	6,280,978	104,324
	Trinity River[3]	502,617	4,434,995	800,000
	Mad River[4]	Not Applicable	Not Applicable	172,000
	Rowdy Creek	Not Applicable	105,000	100,000

[1] Data from ODFW 2014a
[2] Data from ODFW 2014b
[3] Data from ICF/Jones and Stokes 2010
[4] Data from CDFW 2013

Hatchery fish can affect natural salmon populations through a variety of ecological mechanisms, such as increased competition (Nickelson et al. 1986, NRC 1996, McMichael et al. 1997), predation (Sholes and Hallock 1979, HSRG 2004), genetic dilution (NRC 1996), and disease transmission (Goede 1986, NRC 1996, Coutant 1998, Moffitt et al. 1998). These interactions can occur immediately after release (presmolt or smolt stage) or after most hatchery smolts have emigrated. Effects from these stresses may include, on a population level: decreased spawning and reproductive success, decreased productivity, decreased abundance, changes in diversity and spatial structure, and mortality (Chilcote et al. 1986, Leider et al. 1990, Berejikian 1995, Fleming et al. 1997, McLean et al. 2003, HSRG 2004, Araki et al. 2009, Araki and Schmidt 2010, Williamson et al. 2010, Thériault et al. 2011, Whitcomb et al. 2014). In a recent literature review, 12 studies found negative effects of hatchery rearing on the fitness of hatchery fish, 8 studies found decreased reproductive success of hatchery origin fish, and 4 additional studies reported a decrease in the survival rate of hatchery fish as compared to wild fish (Araki and Schmidt 2010).

Competition

If hatchery fish are released in large numbers relative to natural-origin juveniles in a limiting environment, natural-origin fish may be affected through competition (Nielsen 1994). Competition occurs when the demand for a resource by two or more organisms exceeds the available supply (McMichael et al. 1999). Adverse competitive effects of hatchery salmonids on natural-origin salmonids may include food resource competition, competition for spawning sites, and redd superimposition (NMFS 2002a). Several studies have shown that wild fish may be displaced from preferred feeding and hiding locations by hatchery fish (Abbott et al. 1985, McMichael et al. 1997), which can lead to increased vulnerability to predation and decreased forage ability (McMichael et al. 1999). Ruggerone and Nielsen (2004) found evidence that intraspecific and interspecific competition with hatchery-origin juveniles and smolts in estuaries decreased the survival and growth rate of wild juveniles.

Adverse effects of competition may result from direct interactions, whereby a hatchery-origin fish interferes with natural-origin fish's access to limited resources, or through indirect means, such as the use of a limited resource by hatchery fish, which reduces the amount of resources available for natural-origin fish (SIWG 1984). Newly released hatchery smolts may compete with natural-origin smolts for food and space in areas where they interact during downstream migration (HSRG 2004). Interactions with juvenile hatchery-origin salmonids may lead to behavioral changes in natural-origin salmonids that are detrimental to productivity and survival (Pearsons et al. 1994). Many studies have suggested that hatchery-origin fish are competitively superior (when they are released at a larger size than the natural fish) and can displace natural-origin fish (Nickelson et al. 1986). Natural-origin fish may be competitively displaced by hatchery fish early in life, especially in cases when hatchery fish are more numerous, are of equal or greater size as wild fish, or are released as non-migrants and have taken up residency before natural-origin fry emerge from redds (Nielsen 1994, Pearsons et al. 1994).

Adverse effects from these interactions are dependent on the exposure time between populations, and the quantity and quality of habitat and resources available. The relative size of affected natural-origin fish when compared to hatchery fish, as well as the abundance of hatchery fish encountered, also will determine the degree to which natural-origin fish are displaced (Steward and Bjornn 1990). Large hatchery releases may cause displacement of rearing natural-origin juvenile salmonids from occupied stream areas, leading to abandonment of advantageous feeding stations or premature out-migration (Pearsons et al. 1994). Hatchery origin fish may also alter natural-origin salmonid migratory responses or movement patterns, leading to a decrease in foraging success (Hillman and Mullan 1989, Steward and Bjornn 1990).

In a review of 270 references on ecological effects of hatchery salmonids on natural salmonids, Flagg et al. (2000) found that, except in situations of low wild fish density, increasing release numbers of hatchery fish can negatively impact naturally produced fish. Evident from the review is that competition of hatchery fish with naturally produced fish almost always has the potential to displace wild fish from portions of their habitat (Flagg et al. 2000). Additional data on competition varies, and effects have been shown to be neutral to negative depending on the situation (NMFS 2002a). Any competitive interactions likely diminish as hatchery-produced fish disperse, but resource competition may continue to occur at some unknown, but lower level as natural-origin juvenile salmon and any commingled hatchery juveniles emigrate seaward (USFWS 1994).

Predation

Release of large numbers of hatchery salmonids in freshwater and estuarine areas brings risks to wild salmonids attributable to direct predation (direct consumption) or indirect predation (increases in predation by other predator species due to enhanced attraction) (NMFS 2002a). Studies have shown that hatchery fish can prey on smaller wild fish in some situations (Sholes and Hallock 1979, Hawkins and Tipping 1999, Pearsons et al. 2007, Naman and Sharpe 2010). The spatial and temporal overlap of predator and prey is one of the most influential factors in determining the extent of effects from predation (Naman and Sharpe 2010).

Hatchery-origin fish may prey upon wild juvenile salmonids at several stages of their life stage: when the smolts are newly released, when they have residualized prior to smolting (NMFS 2002a), or in estuarine and marine areas HSRG 2004). In general, natural-origin salmonid populations are most vulnerable to predation when natural-origin populations are depressed and predator abundance is high; in small streams, where migration distances are long; and when environmental conditions favor high visibility (SIWG 1984). Predation by hatchery fish on natural-origin smolts or sub-adults is less likely to occur than predation on fry. Naman and Sharpe (2010) found that there is at minimum a low level of predation occurring in all systems where yearling salmonids are released and overlap with smaller fish.

The potential for adverse effects on natural coho salmon populations is highest in late spring when lower flows and higher water temperatures may increase competition for suitable rearing habitat (CDFG and NMFS 2001). In the Trinity River, predation rates as high as 0.53 percent have been documented (Naman 2008). Naman (2008) found that when hatchery steelhead are released in March and April, natural-origin salmonids are very small, increasing the potential for predation. This study also found that hatchery-origin steelhead were able to consume prey that were up to 45 percent of their body length, and that hatchery-origin steelhead did not appear to be gape limited, meaning their prey was not too big to fit into their mouths (Naman 2008). Although the level of predation may not be as high in other SONCC coho salmon ESU basins with hatcheries, predation of natural coho salmon by hatchery steelhead is likely occurring at some level. Given the small number of wild-born juvenile coho salmon, predation at any level may be having an adverse effect on coho salmon.

Genetic Diversity

Gene flow occurs naturally among salmon and steelhead populations, a process referred to as straying (Quinn 1993, Quinn 1997). Straying occurs when an adult spawns in a stream other than the one it was born in. Natural straying serves a valuable function in preserving diversity through genetic drift and in re-colonization of vacant habitat. However, straying may be considered a risk when it occurs at unnatural levels or from unnatural sources, such as hatchery fish. Hatchery fish may be a threat to natural population productivity, diversity, and natural gene flow when they interbreed with natural-origin fish. Hatchery fish straying is considered a risk if it results in additional and potentially harmful gene-flow.

Hatchery activities can threaten the natural genetic diversity among salmon populations in several different ways. Many hatcheries have historically bred and released salmon that were not native to the drainage into which they were released. When these fish stray and breed with native salmon, the unique genetic attributes of the local salmon populations can be degraded or lost through dilution by the genetic attributes of the out-of-basin fish (Reisenbichler and Rubin 1999, Ford 2002). In addition, the transferring of genes from hatchery fish to wild fish can be problematic because hatchery programs have the potential to significantly alter phenotypic traits (Hard et al. 2000; Kostow 2004) and behavior (Berejikian et al. 1996) of reared fish. Genetic interactions between hatchery and naturally produced stocks can decrease the amount of genetic and phenotypic diversity of a species by homogenizing once disparate traits of hatchery and natural fish. The result can be progeny with lower survival (McGinnity et al. 2003, Kostow 2004) and ultimately, a reduction in the reproductive success of the natural stock (Reisenbichler and McIntyre 1977, Chilcote 2003, Araki et al. 2007b, Williamson et al. 2010, Chilcote et al. 2011, Thériault et al. 2011, Whitcomb et al. 2014), potentially compromising the viability of natural stocks via out breeding depression (Reisenbichler and Rubin 1999, HSRG 2004). Araki et al. (2009) found wild-born descendants of hatchery fish showed significant decreases in reproductive success, and that reproductive success can decrease as rapidly as 40 percent per captive reared generation. Hatchery fish may exhibit reduced homing fidelity relative to natural-origin fish (Grant 1997, Quinn 1997, Jonsson et al. 2003, Goodman 2005), resulting in unnatural levels of gene flow into recipient populations.

Natural populations in the Klamath and Trinity basins are heavily influenced by hatcheries (Weitkamp et al. 1995; Good et al. 2005) through genetic and ecological interactions. Genetic risks associated with out-of-basin and out-of-ESU stock transfers have largely been eliminated because such transfers rarely occur. However, two significant genetic concerns remain: 1) the potential for domestication selection in hatchery populations such as the Trinity River, where there is little or no infusion of wild genes, and 2) straying by large numbers of hatchery coho salmon either in basin or out-of-basin. Spawning by hatchery salmonids in rivers and streams is often not controlled (Independent Scientific Advisory Board 2002) and hatchery fish stray into rivers and streams, transferring genes from hatchery populations into naturally spawning populations (Pearse et al. 2007).

Because most of the main stocks in the SONCC coho salmon ESU (i.e., Rogue River, Klamath River, and Trinity River) remain heavily influenced by hatcheries and have little natural production in mainstem rivers (Weitkamp et al. 1995; Good et al. 2005), many of these populations have reduced genetic diversity. The genetic and life-history diversity of the Shasta

River population unit has been significantly impaired by the straying of hatchery-born coho salmon from Iron Gate Hatchery. Straying of adult hatchery coho salmon into the Shasta River has been estimated at 2, 73, 20, and 25 percent of the spawning population from 2007-2010, respectively (Chesney and Knechtle 2011b). Hatchery-origin coho salmon make up most of the spawning run to the Trinity River each year. On average, only three percent of in-river spawners in the Upper Trinity River were not reared in a hatchery (USFWS and HVT 1999). Between 1997 and 2002, hatchery coho salmon constituted between 85 percent and 97 percent of the coho salmon (adults plus jacks) returning to the Willow Creek weir in the Lower Trinity River (CDFG 2009). Most of these fish likely migrate upstream and interact with naturally-produced coho salmon in the Upper Trinity River. Spawning surveys in 1998-99 found a high proportion of hatchery strays (60-100 percent) in all Lower Trinity River streams where coho salmon were found (Dutra and Thomas 1999). Jong and Mills (1992) found that 35.8 percent of returning adults to the South Fork Trinity River in 1985 were of hatchery origin. Because adult coho salmon returns to Trinity Hatchery have been in excess of 25,000 fish during some years, it is likely that the stray rate of hatchery coho salmon to the South Fork Trinity River has continued to be high (>35 percent). Although the actual proportion of hatchery fish in the river changes from year to year and depends largely on natural returns, these data indicate that straying of hatchery coho salmon does occur in important tributaries of the Klamath River basin.

Not all effects of hatchery fish on natural origin fish are negative. In populations experiencing very low abundance, such as the Shasta River population, the presence of hatchery fish can help maintain a population until abundance increases or habitat improves. The addition of hatchery-origin fish to a population that is experiencing reduced abundance can assist in continuing the retention of a full set of genes and genetic characteristics that may only exist in the hatchery-origin population (Brannon et al. 2004). Using hatchery fish to improve genetic diversity may assist the population in the long run when abundance and productivity increase, allowing the complete life-history diversity and genetic traits of the population to exist for future generations (Brannon et al. 2004). Since hatchery fish retain genes from their originating population, increasing the breeding population size of an extant population by adding hatchery fish can provide a benefit by contributing genetic variation to the existing wild population, variation that is necessary to adapt to changing conditions over time (Brannon et al. 2004).

Disease

Natural-origin coho salmon may be exposed to diseases from hatchery-born coho salmon through hatchery effluent, which can contain fish pathogens. Interactions between hatchery fish and natural fish in the environment may also result in the transmission of pathogens if either the hatchery or natural fish are harboring fish disease and the two types of fish interact (NMFS 2002a). Under natural, low-density conditions, most pathogens do not lead to a disease outbreak. When fish disease outbreaks do occur, they are often triggered by stressful hatchery rearing conditions, or by a deleterious change in the environment (Saunders 1991). Hatchery-origin fish may have an increased risk of carrying fish disease pathogens because of relatively high rearing densities that increase stress and can lead to greater manifestation and spread of disease within the hatchery population.

3.1.2 Impaired Water Quality

One of the most important ecological requirements of coho salmon is cold, clean, well-oxygenated water. Impaired water quality parameters in the SONCC coho salmon ESU include increased water temperature, changes in pH above or below optimum levels, reduced dissolved oxygen, increased nutrient loading, and increased extent or duration of turbidity. Human activities that impair water quality include water diversions, in-channel construction, riparian vegetation reduction, agriculture, alteration of the streambed and banks, components of timber management, and the introduction of point- and non-point source pollution from urbanization and industrialization. NMFS concluded that impaired water quality is either a high or very high stress in 27 out of 40 populations in the SONCC coho salmon ESU, primarily due to increased water temperature, decreased dissolved oxygen, and increased turbidity (Table 3-4; Chapters 7 to 46).

Increased water temperature is one of the most widespread (and greatest) stresses in the SONCC coho salmon ESU. Water temperature influences coho salmon growth and feeding rates (partly through increased metabolism) and development of embryos and alevins (McCullough 1999), as well as timing of life-history events such as freshwater rearing, seaward migration (Holtby and Scrivener 1989), upstream migration and spawning (Spence et al. 1996). Increased water temperature can be detrimental to the survival of most life stages of coho salmon, but in the SONCC coho salmon ESU summer-rearing juveniles are the most likely to be affected by elevated water temperatures. Elevated water temperature can result in increased levels of stress hormones in coho salmon, often resulting in mortality (Ligon et al. 1999). Increased water temperature, even at sub-lethal levels can inhibit migration, reduce growth, stress fish, reduce reproductive success, inhibit smoltification, contribute to outbreaks of disease, and alter competitive dominance (Elliott 1981). Increases in water temperature may result from changes in the quantity and quality of riparian vegetation, the presence of dams, water diversions, other anthropogenic activities, and have also been correlated to large-scale (or localized) climate change and precipitation. Additionally, threats including timber harvest, urbanization, roads, and other land use activities affect water temperatures within the SONCC coho ESU.

In addition to appropriate water temperatures, salmonids need adequate concentrations of dissolved oxygen for the survival of all life stages (Spence et al. 1996). Reduced levels of dissolved oxygen can impair the growth (Herrmann et al. 1962) and developmental (Silver et al. 1963) processes of various life stages of salmon, including eggs and fry. Low dissolved oxygen can also decrease the swimming (Davis et al. 1963), feeding and reproductive ability of juveniles and adults (Bjornn and Reiser 1991). Such impacts can affect fitness and survival by altering embryo incubation periods, decreasing the size of fry, increasing the likelihood of predation, and decreasing feeding activity (Carter 2005). Under extreme conditions, low dissolved oxygen concentrations can be lethal to salmonids (Bjornn and Reiser 1991).

Nutrient contributions from sources such as fertilizer run-off, livestock, and septic systems may foster algae blooms that can contribute to elevated pH levels, increased ammonia toxicity, and depressed dissolved oxygen levels. Algae and other aquatic plants create diel 24 hour cycles in which photosynthesis causes high pH during daylight hours and respiration causes low dissolved oxygen at night (Nimick et al. 2011), both of which may be stressful or lethal to salmonids. Additional water quality impairments may be caused when large algae blooms begin to decay and increase the biological oxygen demand (Lathrop et al. 1998, Landsberg 2002). These water quality problems may be exacerbated by reduced flows.

Both acidic (pH <6.5) or alkaline conditions (pH >8.5) can cause salmonid stress (Spence et al. 1996). Adverse effects from low pH can occur at levels that are not lethal to adult fish, but which can impair reproduction and other processes. Reproductive impairments include altered spawning behavior, reduced egg viability, decreased emergence success and reduced survival of the early life stages which are known to be the most vulnerable to low pH (Jordahl and Benson 1987). Conversely, chronic high pH levels in freshwater streams can also decrease activity levels of juvenile salmonids, induce stress responses, decrease or stop feeding, and induce a loss of equilibrium (Murray and Ziebell 1984). Prolonged exposure to pH levels of 8.5 or greater may exhaust the ion exchange capacity at gill membranes and lead to increased alkalinity in the bloodstream of salmonids (Wilkie and Wood 1995). If water temperatures are high (e.g. 25 °C), high pH may also cause conversion of ammonium ions to highly toxic dissolved ammonia (Goldman and Horne 1983).

Historically, populations of adult Pacific salmon and steelhead released mass quantities of nutrients, energy, and other essential biomolecules into their natal watersheds through the process of reproduction. These salmon-derived materials (marine-derived nutrients) support the productivity of freshwater and riparian food webs through release of eggs and carcass decomposition. The salmon-nutrients promote both primary and secondary productivity and ultimately juvenile salmonid growth (Bilby et al. 1996, Schindler et al. 2003, Kiffney et al. 2014). However, salmon spawning populations are severely reduced across much of their native range (CA, OR, WA, ID); population reductions of over 90% in some rivers are likely contributing to widespread resource limitation for salmonid-rearing food webs (Gresh et al. 2000). For example, a recent study in the Cedar River, Washington documented that observed food limitation in juvenile coho salmon can be remedied by providing access to salmon analogs (pasteurized pellets formed from adult Chinook salmon); specifically coho body size was 50% greater at the end of a 45-d experiment in which salmon analogs were added at a biomass density of 0.6 kg/m^2 (Kiffney et al. 2014). Similar juvenile salmonid growth responses have been observed in a variety of field and experimental studies (Bilby et al. 1996, Wipfli et al. 2004, Guyette et al. 2013).

A number of studies have suggested that restoration of food web processes, including restoring the resources provided from spawning salmon, may serve as an effective strategy in addressing food-limitation in salmonid-rearing food webs thereby contributing to population recovery of listed salmon populations (Wipfli and Baxter 2010). There are four possible approaches to addressing resource limitation of salmonid-rearing food webs, including additions of inorganic nutrients, salmon carcass analogs, natural salmon carcasses and increased adult escapement. Resource additions of salmon carcass tissue have promoted food web productivity, including juvenile salmonid growth, across a range of loading rates (~0.1 – 1.0 kg/m^2 wet mass of salmon tissue or analogs; Claeson et al. 2006, Janetski et al. 2009, Kohler et al. 2012, Kiffney et al. 2014).

The four approaches to restoring inputs of marine-derived nutrients have a number of advantages and disadvantages; which method is most effective and practical depends on a variety of conditions including time of year, ambient nutrient levels, spawning biomass densities, and logistical constraints (e.g., remoteness, costs, access to disease-free carcasses, staff, see Kiffney et al. 2005 and Compton et al. 2006). For example, the ecological effects of live adult salmon exceed those of carcasses (Tiegs et al. 2011) and resource additions in summer likely exceed those in late fall or winter (Kiffney et al. 2014). All nutrient addition projects, regardless of the method of enhancement, should be coupled with monitoring programs to ensure objectives and targets are met and that unintended consequences are avoided. What to monitor depends on technical and logistical constraints but could include nutrient concentrations in water (total and dissolved nitrogen and phosphorus); periphyton and invertebrate productivity; salmonid growth, biomass and smolt production; and the stable isotopes of carbon and nitrogen, which provide a tracer for salmon-derived nutrients (Bilby et al. 2001, Kiffney et al. 2005, Compton et al. 2006).

Water Quality Programs

Federal and state programs exist to maintain and improve water quality conditions throughout the SONCC coho salmon ESU. Both California and Oregon have statewide water quality programs aimed at improving current water quality conditions, and the U.S. Environmental Protection Agency (USEPA) works closely with both states to identify and improve conditions in impaired watersheds.

In 1969, the California Legislature enacted the Porter-Cologne Water Quality Control Act (the Act) to preserve, enhance and restore the quality of the State's water resources. The Porter-Cologne Act is the principal law governing water quality in California. Unlike the Clean Water Act, Porter-Cologne applies to both surface water and ground water. Beyond establishment of the state framework, this act has been revised to comply with the federal Clean Water Act.

The Act established the State Water Resources Control Board (SWRCB) and nine Regional Water Quality Control Boards (RWQCBs) as the principal state agencies with the responsibility for controlling water quality in California. Under the Act, water quality policy is established, water quality standards are enforced for both surface and ground water, and discharges of pollutants from point and non-point sources are regulated. The Act authorizes the SWRCB to establish water quality principles and guidelines for long range resource planning including ground water and surface water management programs and control and use of recycled water. The California Coastal Act of 1976 extended the California Coastal Commission’s authority indefinitely. The California Coastal Commission was established by a voter initiative in 1972, and provides oversight for projects that impact water resources along the California coast. The California Coastal Commission has joint responsibility with the State Board and Regional Boards for implementation of the state’s Nonpoint Source Program (see section 319 of the Clean Water Act, section 309 of the Coastal Zone Management Act of 1972, and section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990).

The Oregon Department of Environmental Quality (ODEQ) is the state agency responsible for protecting Oregon’s surface waters and groundwater. ODEQ’s Water Quality Program develops water quality standards for Oregon’s waters, monitors water quality in designated river basins, regulates point source discharges, regulates injection systems by issuing permits to protect groundwater, and controls nonpoint sources of pollution through statewide management plans. Oregon has established both numeric and narrative water quality criteria, but does not have streamflow criteria to protect streamflow. Anti-degradation rules exist in areas around the state and help to maintain water beneficial uses of water. ODEQ is the state agency tasked with developing and implementing TMDLs.

Using the Oregon Water Quality Index to monitor trends in water quality, ODEQ regularly collects water samples at over 150 sites on more than 50 rivers and streams across the state. ODEQ visits most sites six times annually and tests a number of water quality variables at each visit. The state has monitored some sites routinely since the late 1940s (available at http://www.deq.state.or.us/lab/wqm/docs/09-LAB-004.pdf). The data are used to determine whether there is too much pollution in a water body, and to set limits on how much pollution a water body can receive. The ODEQ also maintains a volunteer water quality monitoring program around the state, providing equipment and assistance to volunteers and groups wanting to assist in water quality data collection (available at: http://www.deq.state.or.us/lab/wqm/docs/08-LAB-015.pdf). Oregon's Water Quality Nonpoint Source Control Program Plan (ODEQ 2000) identified the pollution management programs, strategies, and resources that were currently in place or that were needed to minimize nonpoint source pollution effects. The plan integrates a variety of other state and federal initiatives, and the state is currently completed the process of re-evaluating the program.

The Clean Water Act (CWA; 33 USC § 1251 et seq.) is a federal law aimed at improving and protecting water resources around the United States. The CWA was adopted "to restore and maintain the chemical, physical and biological integrity of the Nation's waters" (33 U.S.C. § 1251(a)). Under section 303(d) of the CWA (33 USC 1313(d)), States are required to identify those waters that are not meeting water quality standards. These waters are placed on the State's list of impaired waters, which is submitted to the U.S. Environmental Protection Agency (USEPA) for review and approval. States must develop total maximum daily loads (TMDLs) for these impaired waters. TMDLs are a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards. If the USEPA disapproves of the State's list of impaired waters and TMDLs, then the USEPA establishes the list and TMDLs.

Since the initial listing of SONCC coho salmon many TMDLs have been completed (Table 3-6), and California and Oregon are working to manage excessive pollutants and other water quality impediments. TMDLs in California are developed by RWQCBs. These TMDLs are designed as Basin Plan amendments and include implementation provisions. The beneficial use of salmonid fishes is most often affected by non-point source sediment and temperature impairments, so development of non-point source TMDLs is important. The ability of these TMDLs to protect coho salmon in Oregon and California is expected to be significant in the long term. Ultimately their efficacy in protecting coho salmon habitat will depend on how well the protective measures are implemented, monitored, and enforced.

Table 3-6. List of total maximum daily loads (TMDLs) and their status. Data from the North Coast Regional Water Control Board and the Oregon Department of Environmental Quality websites.

Watershed	Pollutant(s)	TMDL Status	Watershed	Pollutant(s)	TMDL Status
Mattole River	Sediment and Temperature	Completed - 2004	Klamath River	Sediment	In Progress
Lower Eel River	Sediment and Temperature	Completed - 2007	Salmon River	Temperature	Completed - 2006
Lower Eel River	Low Dissolved Oxygen	In Progress	Scott River	Sediment and Temperature	Completed - 2006
Van Duzen River	Sediment	Completed - 1999	Shasta River	Organic enrichment, Low DO, Temperature	Completed - 2007
Middle Fork Eel River	Sediment and Temperature	Completed - 2003	Upper Trinity River	Sediment	Completed - 2001
Middle Mainstem Eel River	Sediment and Temperature	Completed - 2004	Upper Trinity River	Mercury	In Progress
North Fork Eel River	Sediment and Temperature	Completed - 2002	South Fork Trinity River	Sediment	Completed - 2001
South Fork Eel River	Sediment and Temperature	Completed - 1999	South Fork Trinity River	Temperature	In Progress
Upper Mainstem Eel River	Sediment and Temperature	Completed - 2004	Upper Rogue River	Bacteria, DO, pH, Sediment, Temperature	Completed - 2008
Elk River	Sediment	Completed-2011	Middle Rogue River	Bacteria, Sediment, Temperature	Completed - 2008
Freshwater Creek	Sediment	Completed-2011	Lower Rogue River	Bacteria, Temperature	Completed - 2008
Humboldt Bay	PCBs	In Progress	Lobster Creek (Rogue River)	Temperature	Completed - 2002
Jacoby Creek	Sediment	In Progress	Bear Creek (Rogue River)	Temperature, Bacteria	Completed - 2008
Mad River	Sediment, Turbidity, Temperature	Completed - 2007	Lower Sucker Cr (Illinois River)	Temperature	Completed - 2002
Redwood Creek	Sediment	Completed - 1998	Illinois River	Temperature	Completed - 2008
Redwood Creek	Temperature	In Progress	Chetco River	Bacteria, DO, pH, Temperature	Initiated
Klamath River	Nutrients, Bacteria, Temperature, Low DO	Completed - 2010	Applegate River	Temperature, DO	Completed - 2004

Under CWA section 518(e) (33 U.S.C. § 1377(e)), tribes may apply to the USEPA to be treated as a State for purposes of various listed sections of the CWA, and USEPA-approved tribal water quality standards apply to surface waters within tribal lands. The Hoopa Valley, Yurok, and Karuk tribes have all developed water quality control plans (Hoopa Valley Tribe Environmental Protection Agency 2008, Yurok Tribal Environmental Program 2004, Karuk Tribe of California 2002) and the Quartz Valley and Resighini Rancherias have developed water quality programs (Quartz Valley Indian Reservation 2009, Resighini Rancheria Environmental Department 2006).

3.1.3 Degraded Riparian Forest Conditions

Riparian forests provide significant benefits to freshwater aquatic systems and the biota that live within and around them (Welsch 1991). Riparian forests influence the water table, moderate discharge during high flow events, regulate microclimates, provide shade to control temperature, protect stream banks from erosion (Bisson and Wondzell 2009), intercept sediment (Mellina and Hinch 2009), and help maintain instream water quality by filtering nutrient runoff (Welsch 1991). In addition, riparian forests are the source of instream large wood, which is important in creating and maintaining the habitat complexity necessary for high quality coho salmon rearing habitat (Crispin et al. 1993, Gallagher et al. 2012) and providing breeding sites for some amphibians and invertebrates (Moseley et al. 1998). Though all riparian forests supply wood to streams, old growth and late seral forests tend to be dominated by large conifers, which are uniquely capable of shaping instream and floodplain conditions as dead wood (Naiman et al. 2010).

Riparian dead wood provides numerous ecological functions, which vary somewhat depending on whether they remain standing or fall onto the forest floor or into water bodies such as streams, wetlands or ponds (Pollock and Beechie 2014). Thinning riparian conifer forests generally reduces the production of ecologically functional riparian dead wood (e.g., >30 cm or > 50 cm diameter) in both the short and long term, in correlation with the intensity of the thin (Pollock et al. 2012, Pollock and Beechie 2014). Optimal thinning conditions in moist Douglas-fir forests are in young (<40 years), densely planted (>300 trees per acre) stands where the primary management goal is to produce very large diameter live trees or very large diameter dead wood (Beechie et al. 2000, Pollock and Beechie 2014). For example, in Beechie et al. (2000), moderate thinning adjacent to large (15 m wide) streams increased "pool forming" wood production, whereas such thinning next to smaller streams reduced pool-forming wood production (See table 2 and figure 6 of Beechie et al. 2000). Riparian area structure and composition throughout the ESU has changed due to irrigation diversions, timber harvest, farming, grazing, wildfire, and urbanization, which all contribute to a high or very high ranking of degraded riparian forest conditions in 33 populations in the ESU (Table 3-4; Chapters 7 to 46). Of these, timber harvest has been the primary source of human disturbance in riparian areas (Villarin et al. 2009). In California, harvest of riparian redwood forests began in the middle of the 19th century but was then reduced after 1973 when the California Forest Practices Act set limits to harvest in riparian zones (Russell 2009). Historically, riparian forests were frequently harvested to the edge of the water and logs were dragged through the water to splash dams and haul roads (Richardson et al. 2012). Historic timber practices often significantly altered riparian forest composition to favor early successional stages dominated by deciduous species such as red alder and willow (Sedell et al. 1988, Russell 2009, Villarin et al. 2009). As a consequence, many stream banks have smaller trees of fewer species resulting in smaller, shorter-lived instream large wood (Sedell et al. 1988), even 100 years after harvest (Russell 2009).

Agriculture and livestock grazing have also degraded riparian forests. Geographic Information System (GIS) analyses of land use and ownership in coastal Oregon indicate that much of the larger low gradient, low elevation river valleys that historically supported coho salmon are privately owned and their riparian forests have been cleared for agricultural and developed uses (Burnett et al. 2007, Firman et al. 2011), a condition that also exists within coastal California. The conversion of forest to agriculture is associated with many negative effects on stream ecosystems, including lower densities of coho salmon, a lack of conifers, and a scarcity of large wood (Burnett et al. 2007, Firman et al. 2011). Livestock grazing affects riparian zones by compacting soil, removing vegetation, preventing woody seedling growth, and physically impacting stream morphology by breaking down banks, often resulting in wide, shallow channels (Belsky et al. 1999, Poff et al. 2011). Major bank erosion and mass wasting is much more prevalent on non-vegetated stream banks, resulting in increased sediment loads and channel widening (Naiman and Decamps 1997).

Riparian ecosystems are complex and the various threats to them should be viewed collectively (Poff et al. 2011). For example, episodic flooding plays a major role in structuring riparian vegetation in a natural ecosystem (Hawkins et al. 1997, Villarin et al. 2009), but after human alterations to riparian areas, the overall effects of floods are exaggerated (Hawkins et al. 1997). Disruption to natural landscapes, such as timber harvest (and associated road building), livestock grazing, and urbanization can promote rapid runoff (Hawkins et al. 1997, Beechie et al. 2012) and magnify the destructive power of peak flows to stream banks left unprotected by overgrazing or over-harvesting (Hawkins et al. 1997). Major floods occurring in the years 1955, 1964, 1974, 1986, 1997, and 2006 likely caused significant damage to riparian areas throughout the ESU. In general, eliminating or decreasing riparian areas may result in stream channelizing and straightening, channel widening, channel aggradation, and lowering of the water table (Belsky et al. 1999). The effects of degraded riparian conditions on fish habitat include reduction of streamside shade and cover, decreased large wood recruitment, increases in stream temperature, changes in water quality and stream morphology, and the addition of sediment through bank degradation and off-site soil erosion (Forest Ecosystem Management Team [FEMAT] 1993, Spence et al. 1996, Cohen 1997, Mellina and Hinch 2009).

3.1.4 Increased Disease/Predation/Competition

Disease and predation are locally significant throughout the ESU, and are likely limiting the recovery of some SONCC coho salmon populations. Currently, disease and predation are listed as a high or very high stress to 13 populations in the ESU (Table 3-4). Impacts from diseases are likely exacerbated by human-induced environmental impacts and activities, such as alteration of hydrologic function through dams and diversions, impaired water quality conditions, hatchery practices, habitat alterations, and changing climatic conditions. Coho salmon are exposed to numerous bacterial, protozoan, and parasitic pathogens throughout their lives, and have evolved with exposure to these and other organisms (Stocking and Bartholomew 2004). Susceptibility of fish to disease changes according to environmental condition and overall health. When water quality deteriorates, diminished flows cause crowding and stress, or when parasite spore loads are extremely high, then lethal disease outbreaks can occur (Foott 1995, Spence et al. 1996, Guillen 2003, CDFG 2004b, Yurok Tribal Environmental Program 2004, Nichols and Foott 2005). Disease issues arise when the interaction between host and pathogen is altered and when natural resistance levels become impaired by stressful environmental conditions or decreased fitness levels. Within the last few decades, the prevalence of diseases in wild stocks has been an increasing concern, and has become a factor in the continuing survival and viability of wild stocks of coho salmon (CDFG 2002a).

Diseases can affect coho salmon in almost any life stage where exposure occurs. Some diseases infect returning adults as they enter bays and estuaries, while other diseases attack or kill juveniles rearing upstream. Many pathogens may remain dormant in juveniles or when conditions are not stressful, and then appear symptomatically when fish return to freshwater and conditions become stressful. Different life stages have different susceptibilities, making it difficult to discern time of infection or disease infection rates and causes. Known diseases and disease agents that can cause significant losses to adults include: bacterial kidney disease (*Renibacterium salmoninarum*), furunculosis (*Aeromonas salmonicida*), columnaris (*Flexibacter columnaris*), *pseudomonas/aeromonas*, and *ichthyopthirius* or "Ich" (*Ichthyopthirius multifilis*). Juvenile salmonids are primarily affected by furunculosis, columnaris (*Flavobacterium columnare*), coldwater disease (*Flexibacter psychrophilis*), *Nanophyetus salmonicola*, Aeromonid bacteria, pseudomonas/aeromonas, ichthyopthirius, the kidney myxosporean *Parvicapsula minibicornis*, and ceratomyxosis (*Ceratonova shasta*) (CDFG 2002a, Federal Energy Regulatory Commission [FERC] 2007).

Diseases proliferate when fish are stressed by high water temperatures, crowding, environmental contaminants, or decreased oxygen (Warren 1991). In addition, adequate water quantity and quality during the late summer months are critical in controlling or triggering disease epidemics, and degraded condition of these variables may trigger the onset of epidemics in fish that are carrying the infectious agents (Holt et al. 1975, Wood 1979, Matthews et al. 1986, Maule et al. 1988). Problems remain in identifying the proximate and ultimate causes of death due to epidemic disease outbreaks, and the subsequent effect that these are having on population survival numbers. The lack of data continues to hamper the efforts of managers to understand the full effect that disease is having on coho salmon populations.

Although not emphasized in the original listing document, ceratomyxosis, which is caused by *C. shasta*, is one of the most significant diseases affecting juvenile coho salmon due to its prevalence and impacts in the Klamath Basin (Nichols et al. 2003). Bartholomew et al. (2006) believes that the recent increases in air temperature may be compounding the disease potential in the Klamath Basin. High water temperature, low dissolved oxygen, high pH (alkalinity) and possibly unionized ammonia in the mainstem Klamath River create stressful conditions for all ages and types of salmonids. These conditions can then increase disease transmission to coho salmon. Severe infection of juvenile coho salmon by *C. shasta* may be contributing to declining adult coho salmon returns in the Klamath basin (Foott et al. 2010). *C. shasta* has been responsible for most of the mortality of Klamath River juvenile salmonids in recent years. Mortality rates from temporary and longer term exposures at various locations in the Klamath River vary based on location, time of year, year, and water temperature, but are consistently high (10 to 90 percent) (Bartholomew 2008).

In addition, parasitic infections by *P. minibicornis* were detected in 65 percent of young of the year and 71 percent of yearling coho salmon in the mainstem Klamath River in 2007 (Nichols et al. 2008). Additionally, the Klamath River below Iron Gate Dam supports large populations of the intermediate host (a polychaete worm) of *C. shasta* due to an abundant food supply (particulate organic matter) and ample amounts of its two favored substrates (fine particulate organic matter that settles on the bottom of the river bed and mats of the attached algal species *Cladophora* that are stimulated by high nutrient levels).

Adults in the Klamath basin are also impacted by other diseases, primarily from the common pathogens *Ichthyopthirius multifilis* (Ich) and *Flavobacterium columnare* (columnaris) (NRC 2004). These pathogens were partially responsible for the 2002 adult fish kill on the Klamath River (USFWS 2003, Lynch and Risely 2003, Belchik et al. 2004, CDFG 2004b). During this event, over 300 coho salmon and 34,000 Chinook salmon were killed by a disease epizootic from Ich and columnaris, which was exacerbated by stressful conditions in the Klamath River (USFWS 2003, Belchik et al. 2004, CDFG 2004b). Conditions favoring massive growth of Ich and columnaris were created that year due to high densities of returning Chinook salmon, low September flows and warm water temperatures (USFWS 2003, Belchik et al. 2004, CDFG 2004b) that likely delayed and inhibited migration of adult fish further upstream (USFWS 2003). Adult mortality from Ich and columnaris are not as common as juvenile mortality from *C. shasta* or *P. minibicornis* (Bartholomew et al. 2003). In summary, disease effects are likely to negatively impact all of the VSP parameters for the SONCC coho salmon ESU, especially in the Klamath River Basin, because both adults and juveniles can experience high mortality in some years.

At the time of listing, predation was listed as a factor contributing to the decline and listing of coho salmon in the SONCC ESU, but more recent data suggests that it is a bigger problem than originally thought. Notable predators include non-native Sacramento Pikeminnow (*Ptychocheilus grandis*) and hatchery fish, as well as predation by other non-native species in some areas. These impacts are exacerbated by habitat modification, impaired water quality, hatchery practices, and other anthropogenic activities (Marine and Cech 2004).

In some watersheds, the rapid expansion of invasive predator populations was facilitated by alterations in habitat conditions (particularly increased water temperatures) that favor these species (Brown et al. 1994). Non-native fishes such as Sacramento pikeminnow, smallmouth bass (*Micropterus dolomieu*), brown trout (*Salmo trutta morpha fario*) and channel catfish (*Ictalurus punctatus*) can consume significant numbers of juvenile salmon (NMFS 1998). Sacramento pikeminnow have been observed throughout the Eel River basin and are a predator likely limiting juvenile coho salmon survival (CDFG 1994, 2004; NMFS 1996). In the Trinity River, brown trout are abundant enough to make up a substantial proportion of observations by biologists collecting juvenile salmonid habitat utilization data (Martin, A., pers. comm. 2009) and they likely consume naturally produced fry and juvenile coho salmon. Without adequate avoidance habitat (deep pools and undercut banks), and adequate flows for migration and rearing, predation can have a significant negative effect on juvenile salmonid growth (Quinn and Peterson 1996, Schlosser 1987, Bugert and Bjornn 1991, Bjornn and Reiser 1991, Brown 1999).

In addition to non-native species, hatchery fish can exert predation pressure on juvenile coho salmon. Native fishes in coastal streams and rivers have generally coevolved with native salmon and steelhead, which are also used for hatchery stocks. Under natural conditions native fishes may subsist with minimal, if any, negative interactions with salmon and steelhead in rivers and streams. The addition of large numbers of hatchery fish at one time and location, such as that occurring under salmon and steelhead stocking programs, may potentially result in locally elevated rates of predation and competition (ICF/Jones & Stokes 2010). The potential for predation and competition between hatchery‒reared and naturally produced salmonids depends on the degree of spatial and temporal overlap, differences in size and feeding habitats, migration rate and duration of freshwater residence, and the distribution, habitat use, and densities of hatchery and natural juveniles (Mobrand et al. 2005). Recently, concern has been expressed about the potential for hatchery‒reared salmon and steelhead to prey on or compete with wild juvenile Pacific salmonids (*Oncorhynchus* spp.) and the impact this may have on threatened or endangered salmonid populations (Naman 2008, Kostow 2009). Released at larger sizes and in great quantity, hatchery-reared salmonids prey on naturally-produced juvenile coho salmon (Kostow 2009). For example, predation by hatchery fish may result in the loss of tens of thousands of naturally produced coho salmon fry annually in some areas of the Trinity River (Naman 2008). Nickelson (2003) demonstrated that the productivity of wild coho salmon in 14 Oregon coastal basins was negatively correlated to the average number of hatchery smolts released into these basins, suggesting strong ecological interactions between hatchery and wild fish. Nickelson (2003) also reviewed evidence for the role of behavior and concluded that large numbers of hatchery fish likely increase mortality of wild fish by attracting predators and/or increasing their exposure to predators.

Predation by marine mammals (principally seals and sea lions) is a concern in areas experiencing dwindling run sizes of salmon (69 FR 33102, June 14, 2004). However, salmonids appear to be a minor component of the diet of marine mammals and therefore this type of predation is likely not contributing significantly to further decreases in run sizes (Scheffer and Sperry 1931, Jameson and Kenyon 1977, Graybill 1981, Brown and Mate 1983, Roffe and Mate 1984, Hanson 1993, Goley and Gemmer 2000, Williamson and Hillemeier 2001). Among other mammalian predators that can impact salmonid populations in freshwater areas, mink (*Mustela vison*) and otter (*Lutra canadensis*) can take significant numbers of overwintering coho salmon juveniles and migrating smolts, although this is dependent upon conditions favorable to predators and the availability of other prey (Sandercock 1991).

3.1.5 Altered Sediment Supply

The complex riverine habitat that coho salmon thrive in depends upon a balance of instream structure, transport capacity, and sediment supply (Yarnell et al. 2006). The alteration in the quantity and composition of the sediment supply into streams and rivers is a stress created through a variety of human induced threats. Increases in turbidity, changes in the quantity and quality of suspended sediment, and associated decreases in water quality can be caused by a variety of activities including timber harvest, grazing, agriculture, mining, road building, urbanization, and construction (Bash et al. 2001). These activities, when performed in excess or without proper management, have been shown to have the ability to contribute to periodic pulses or chronic levels of suspended sediment in streams (Bash et al. 2001) and likely have a wide range of effects on all life stages of salmonids. Impacts caused by these activities include changes to the size and composition of sediment entering the stream (Opperman et al. 2005, Kaufmann et al. 2009), changes to the quantity of sediment (Reid et al. 2010), and alterations in the timing of sediment entering stream channels (Cordone and Kelley 1961). Altered sediment supply is a high or very high stress in 31 populations in the SONCC coho salmon ESU (Table 3-4).

Many of the historical and ongoing anthropogenic activities in the ESU have caused changes to the amount and timing of sediment delivery to streams, most often evident as an increased amount of fine sediment. Increased sedimentation has been shown to have direct negative effects on coho salmon by interfering with their physiological and biological processes, and indirect effects through degradation of their habitat (Cordone and Kelley 1961, Koski 1966, Kondolf 2000). Accelerated rates of erosion and increased sediment delivery to streams after timber harvest and road construction are common occurrences in the mountainous, forested watersheds that are common in the ESU (Sidle et al. 1985, Montgomery et al. 2000). Impacts may result directly from increased sediment in suspension or through the deposition of fine sediment on or within the stream bed (Collins et al. 2011). High concentrations of suspended sediment can increase turbidity, decrease water clarity, and impair foraging efficiency thereby reducing growth and feeding rates of fish (Newcombe and McDonald 1991, Arauho 2011, Collins et al. 2011). Turbidity can reduce the amount of light available for photosynthesis and hence decrease primary production by algae and plants (Ryan 1991); however, there is also some evidence that these biota can adapt to maintain productivity at elevated sediment levels (Parkhill and Gulliver 2002, Izagirre et al. 2009). High suspended sediment loads can also clog or abrade sensitive fish gills and other soft tissues (Newcombe and Jensen 1996). The most common behavioral alteration associated with increased turbidity is reduced juvenile salmonid feeding behavior. There is an inverse relationship between turbidity and feeding efficiency or prey ingestion (Berg 1982, Berg and Northcote 1985, Sweka and Hartman 2001). Salmonids are visual predators that feed largely on drifting invertebrates, and changes in efficiency can be correlated to a decrease in their reactive distance to prey as turbidity increases. Feeding efficiency of juvenile coho salmon may drop by 45 percent at a turbidity level of 100 Nephelometric Turbidity Units (NTU) (Berg 1982), and turbidity as low as 70 NTU reduced salmonid foraging effectiveness and delayed their response to food (Bisson and Bilby 1982).

Increased sediment load can dramatically alter channel morphology. Pools may be filled, channels widened (Lisle 1982), riparian vegetation buried, streambank heights raised, and floodplain and flood prone areas disconnected (Kelsey 1980, Lisle 1982, Roberts and Church 1986, Knighton 1991). These alterations in geomorphology (i.e. excess sediment buildup, changes in proportion of fines) can increases the frequency and magnitude of localized flood events, which has occurred in Elk River, an important coho-bearing tributary to Humboldt Bay (Patenaude 2004). It may take decades before channels impacted by large aggradation events can fully recover (Madej et al. 2009). Lowland river systems are particularly susceptible to adverse effects of excess sedimentation owing to their low energy and limited ability to recover to their natural form (Kemp et al. 2011).

In spawning gravels, deposited fine sediment fills interstitial spaces between particles, reducing intergravel flow and inhibiting alevin movement, thereby decreasing survival rates (Kondolf 2000, Sparkman 2003, Greig et al. 2005). Excess fine sediment smothers habitat used by benthic organisms, decreasing the production of algae and macroinvertebrates that are an important food source for fry, juveniles, and smolts (Suttle et al. 2004, Cover et al. 2008). It can also decrease habitat availability and cover thereby increasing predation risks.

The quantity and timing of coarse sediment delivery to streams has also been altered by human activities throughout the SONCC ESU. Coarse sediment is an essential component of geo-fluvial mechanisms, such as gravel bar development (Ock and Kondolf 2012), and of spawning and rearing habitat for coho salmon (Lorenz and Eiler 1989). Reduced sediment supply can limit the availability of spawning substrate, alter availability of velocity refugia and macroinvertebrate habitat, and cause large scale changes in the morphology of downstream reaches (Cordone and Kelley 1961). Dams and other man-made barriers trap coarse sediment (Kondolf 1997) as well as decrease the frequency and magnitude of flows that mobilize these large particles thereby altering channel bed morphology, and impacting instream habitat (Ock and Kondolf 2012). Within the SONCC ESU, major dams on the Eel, Klamath, Applegate, Rogue, Shasta and Trinity rivers are of particular concern because they impede coarse sediment transport downstream into areas inhabited by coho salmon. Gravel mining also results in the removal of coarse sediment, which can significantly alter physical habitat characteristics and fluvial mechanisms, such as causing increased river depth, bank erosion, and head-cutting (Freedman et al. 2013). When upstream sediment sources are disturbed by dams or mining, high flows tend to transport only the finer fraction of the stream bed, leaving the coarser particles behind, causing channel incision and eventually an immobile channel (Kondolf 1997). These changes can create a significant stress on coho salmon, which rely on the natural dynamic structure of a river for instream cover, deep pools, appropriately sized spawning substrate and off-channel habitats, all of which cease to be created when the channel bed becomes immobile. These changes can last long after the dam or other structures are removed, and work to restore these areas may take years and even decades.

3.1.6 Lack of Floodplain and Channel Structure

Unconstrained reaches of low gradient rivers provide complex slow water habitats, including side-channels, lakes, backwaters, alcoves, sloughs, and beaver ponds (Independent Multidisciplinary Science Team [IMST] 2002, Branton 2011), that are essential for juvenile salmonid survival and rearing success. However, these reaches are highly susceptible to anthropogenic land use changes and alterations in channel morphology. Activities such as agriculture, timber harvest, mining and gravel extraction, flood control, road building, and urbanization and development of riparian areas can result in changes to floodplain and channel structure including channel straightening and reduced hydrological connectivity to off-channel and side channel habitat (Burnett et al. 2007 (timber harvest), Brown et al 1998 (mining and gravel extraction), Branton 2011 (flood control)). The lack of floodplain and channel structure is ranked as a high or very high stress in 39 of 40 populations of SONCC coho salmon (Table 3-4).

When stream channels are straightened, diked, and leveed, coho salmon suffer harmful effects through decreases of natural pool, winter rearing, and spawning habitats. Channel simplification also causes indirect changes in the timing of peak flows, increases in the frequency of scour events, and changes in the movement of sediment through the system (IMST 2002). Reduced hydrological connectivity may render these areas disproportionately susceptible to inter-annual variations in winter and summer stream flows (Sommer et al. 2005). When floodplains and off-channel habitats become disconnected from the main channel, juvenile fish can be displaced downstream during high flow events, encounter mortality from physical damage caused during high flows, and experience a decrease in the ability to survive through the winter from decreases in prey resources and slow water rearing and holding areas (Pess et al. 2002, Kock et al. 2012).

A lack of slow water, over-winter habitat has been shown to be a limiting factor to coho salmon populations. Solazzi et al (2000) showed that adding wood, alcoves, and dammed pools to a stream can significantly increase the over-winter survival of juvenile coho salmon.

A significant contributor to lack of floodplain and channel structure in the SONCC coho salmon ESU is a paucity of instream large wood. Coho salmon juveniles favor pools that contain shelter provided by large wood (Reeves et al. 1989). Research from across the Pacific Northwest has shown that streams with more large wood have more pools because large wood provides scour-forcing obstructions that create pools (Buffington et al. 2002, Montgomery et al. 2003, Rosenfeld and Huato 2003). Larger pieces of wood are more stable than smaller pieces of wood, and ratio of log length to channel width can be used as a gauge of stability (Montgomery et al. 2003). Past and current timber harvest practices have degraded riparian forests across the SONCC coho salmon ESU, decreasing the number of large conifers in riparian zones and reducing the potential for recruitment of long-lasting large wood (Sedell et al. 1988, Benda and Bigelow 2014). Hardwood trees like alder and willow are now the most abundant species in many riparian zones (Roni et al. 2002). These hardwood species do not provide long lasting large wood for channel forming processes (Cederholm et al. 1997) and their maximum potential size, and therefore stability, is much smaller than conifers. Early accounts of Pacific Northwest streams described prolific accumulations of wood in rivers and streams that settlers then cleared to facilitate movement of boats and logs during the late 1800s and early 1900s (Collins and Montgomery 2002). Then, during the 1950s, 1960s, and into the 1970s, fishery managers and biologists further removed large wood from streams, fearing it restricted fish passage and led to log jams and bank erosion (Sedell et al. 1988, Gallagher et al. 2012). As a result, the amount of large wood in streams is currently far lower than historical levels, resulting in a reduced capacity of stream habitats to support coho salmon.

The historical decline in beaver (*Castor canadensis*) populations has also contributed to lack of floodplain and channel structure. Beaver ponds provide high quality winter and summer rearing habitat for coho salmon (Reeves et al. 1989, Pollock et al. 2004). Beavers were highly valued for their fur pelts, and from the 1780s to 1840s, trappers swept through the Pacific Northwest, reducing the formerly robust beaver population to remnant levels (ODFW 2005b). The effect of decreased beaver abundance on coho salmon populations was likely very significant. For example, a study of the Stillaguamish River Basin in Washington compared current conditions with estimated historical conditions and concluded that the loss of beaver ponds accounted for most of the estimated 86 percent reduction in smolt production potential (SPP) of winter habitat and most of the 61 percent reduction of SPP for summer habitat (Pollock et al. 2004). Although still much reduced from pre-trapping levels, beaver populations have rebounded somewhat since the end of the era of intensive trapping. Recent studies in the Lower Klamath, Middle Klamath and Shasta sub-basins confirm that beaver ponds provide high quality summer and winter rearing habitat for coho salmon (Chesney et al. 2009, Silloway 2010). Information regarding the distribution and abundance of beavers within the SONCC coho salmon ESU is relatively limited (Lanman et al. 2013). In Oregon, ODFW fish habitat surveys detected beaver dams in the Rogue River basin but not in the Brush Creek, Mussel Creek, Hunter Creek, Pistol River, or Chetco River basins (although only a small portion of the Chetco basin was surveyed); there are no survey data available for the Elk River or Winchuck River. In California, beavers are present in the Smith River, Klamath River, Redwood Creek, Little River, Widow White Creek, Strawberry Creek, and Mad River basins. Beavers are absent in Humboldt Bay, Bear River, Mattole River, and most of the Eel River basin with the exception of Outlet Creek, mainstem Eel River in the vicinity of Cape Horn Dam, and a single sighting on Ten Mile Creek in the upper South Fork Eel sub-basin (Lanman et al. 2013, Riverbend Sciences 2014).

Using beaver as a salmon habitat restoration tool has proven to be effective and cost efficient (Pollock et al. 2007; DeVries 2012, Andonaegui 2000). In addition to creating off channel habitat for juvenile coho, beaver ponds can raise the water table, store spring runoff for late season release into streams (Parker 1986) and cool the water downstream of the beaver dams (Pollock et al 2003). Beaver ponds have been shown to expand riparian forests (Pollock et al 2007) and decrease erosive perturbation (Parker 1986). Beaver ponds slow high velocity stream flows and trap sediment behind their dams, which speeds up the recovery rate of down-cut stream channels and reduces turbidity downstream (Naiman et al 1988). Beavers are classified as a predatory species in Oregon and current regulations allow private landowners to destroy beavers and their habitat without notification to state agencies. In California, CDFW issues depredation permits to private landowners to destroy problematic beavers, and allows recreational trapping of beavers (no bag or possession limit) in Del Norte, Humboldt, Siskiyou, and Trinity counties. The coast of California south of Little River had previously been considered outside the historical range of beavers (Tappe 1942), but a recent review of historical evidence indicates that beavers were in fact native to the entire California coast (Lanman et al. 2013).

3.1.7 Altered Hydrologic Function

Water is the most essential component of fish habitat. The alteration of hydrology can create both environmental and physical changes that affect coho salmon. Environmental changes include altered timing and magnitude of high and low flows, alteration of temperature and dissolved oxygen levels, and changed cues for seasonal migration. Physical changes include aggradation or incision of the stream channel, scouring of the stream bed, disconnection of channel and floodplains, and damage to riparian vegetation from flooding events. Altered hydrologic function is ranked as a high or very high stress in 21 of the 40 populations in the ESU (Table 3-1, Chapters 7 to 46).

While every life stage of coho salmon requires adequate stream flow, summer rearing juveniles are most vulnerable because stream flows within the SONCC coho salmon ESU typically reach annual lows during the late summer or early fall due to lack of precipitation. Human water withdrawals for irrigation of agricultural crops and landscapes are highest during this period of lowest stream flow, resulting in the potential for significant flow reductions. Reduced summer flows can reduce growth and survival of coho salmon juveniles through several pathways, including: stream dewatering, increased water temperature, reduced habitat volume and quality, reduced food availability, and increased vulnerability to predation.

The most extreme case of reduced flow is stream dewatering, causing immediate mortality of any coho salmon rearing in the dry reach. While loss of surface flow can occur for prolonged durations, such as months, loss of surface flow can also occur on much shorter time scales such as hours or minutes. Small streams with multiple adjacent water diversions that operate simultaneously are particularly susceptible to running dry (Lancaster 2013) or experiencing rapid flow decreases (Deitch et al. 2009).

An additional stress to low-flow conditions is the emergence of marijuana cultivation in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer, S., pers. comm. 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer, S., pers. comm. 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (Humboldt Growers Association [HGA] 2010).

Juvenile coho salmon spend summer in freshwater and are sensitive to high summer water temperatures. Water temperatures can be strongly affected by the quantity of water in a stream, with effects varying by location and season according to site-specific factors. For example, computer simulations predict that a 50% reduction in flow would cause peak summer water temperature to increase as much as 2-3˚C in Bull Creek, a tributary to the South Fork Eel River, while a 50% increase in flow would decrease temperatures by a slightly lesser amount (Allen 2008). Similarly, another model predicts that a 50% decrease in groundwater accretions would increase peak summer water temperatures in mainstem Scott River by 2-3˚C, whereas a 50% increase would reduce water temperatures by as much as 2˚C (NCRWQCB 2005).

As flow decreases, so do the depth, volume, and complexity of pools where coho salmon juveniles over-summer (May and Lee 2004). Another potential result of low summer flow is loss of hydraulic connectivity in riffles (Magoulick and Kobza 2003). In such cases, pools become isolated from each other and drift of aquatic macroinvertebrates from riffles into pools is eliminated, reducing food availability for juvenile salmonids and hence reducing growth rates (Stillwater Sciences and Dietrich 2002, McBain and Trush 2012). Field experiments in a small Humboldt Bay stream found that even when hydraulic connectivity was maintained, reduced flow resulted in less invertebrate drift that reduced growth of rainbow trout (Harvey et al. 2006). With loss of connectivity, fish movement is restricted to single habitat units and they become more vulnerable to predation (Magoulick and Kobza 2003). Studies in a Washington stream found that juvenile coho that moved between habitat units grew faster than those who did not move (Kahler et al. 2001).

Increased flow (either total annual, spring or summer) results in increased smolt migration (Berggren and Filardo 1993, McCormick et al. 1998) and survival (Mathews and Olson 1980, Scarnecchia 1981, Giorgi 1993, Čada et al. 1994, Lawson et al. 2004). Berggren and Filardo (1993) found a significant correlation between average flow and smolt migration time in the Columbia River. Scarnecchia (1981) found a highly significant positive relationship between total stream flows and the rate of survival to the adult life stage for coho salmon in five Oregon rivers. Mathews and Olson (1980) documented a positive correlation between summer stream flow and adult coho salmon abundance. Coho salmon smolt production was positively correlated with summer flows in a coastal Washington stream (Beecher et al. 2010) and spring flows on the Oregon Coast (Lawson et al. 2004). Summer flow is an important explanatory variable of juvenile steelhead survival in tributaries of the Russian River (Grantham et al. 2012).

In addition to the relationship between flows and juvenile salmonid survival, flows can also affect juvenile salmonid growth. In studies on brook trout and juvenile Atlantic salmon, Davidson et al. (2010) and Xu et al. (2010) found that increased flow was generally associated with higher growth rates. Juvenile salmonids had 24 to 50 percent size reductions under low flow conditions (Davidson et al. 2010, Xu et al. 2010, Nislow and Armstrong 2012).

NMFS analyzed stream flow, precipitation, reservoir storage, and Geographic Information Systems (GIS) data to calculate a series of quantitative indicators, which were then used in conjunction with other information to inform NMFS' professional judgments, of the magnitude of the stress of altered hydrologic function for each coho salmon population and life stage (Asarian 2014). Altered hydrologic function is a high or very high stress in 18 of 39 populations throughout the ESU (Table 3-4).

As discussed in the following paragraphs, hydrologic function has been altered throughout the ESU by several mechanisms, including: 1) alteration of vegetation, which affects evapotranspiration and interception of precipitation; 2) landscape, channel, and floodplain alterations that increase storm flow, reduce infiltration, and reduce exchange between surface water and groundwater; and 3) water withdrawals reduce stream flow while dams impound water and shift the timing of stream flow.

The structure and species composition of vegetation in a watershed has a large effect on interception (i.e., precipitation that is caught by vegetation before it reaches the ground) and evapotranspiration. Timber harvest reduces the amount of precipitation intercepted by vegetation, resulting in increased peak flows during storm events (Reid and Lewis 2009), although this effect dissipates over time as vegetation re-grows (Grant et al. 2008). Reduced interception also elevates summer base flows for an initial number of years following harvest; as trees grow back, this effect diminishes with time and then reverses (Cafferata and Reid 2013, Surfleet and Skaugset 2013). Long-term studies in Oregon experimental forests showed that clearcut or thinning treatments, which replaced mature or old (100 to 250-yr-old) forest with young (i.e., 30 to 50-yr-old) forest reduced summer stream flow by 20-80% (Perry 2007), consistent with other studies showing higher evapotranspiration by young compared to old tree stands (Moore et al. 2004, Jassal et al. 2009, Wharton el al. 2009). In the Andrews Experimental Forest in Oregon, water use by riparian trees in a 40-year old stand was estimated to be 3.27 times greater than in a 450-year old stand, due to a combination of greater sapwood area, species composition (more alder and less Douglas fir and western hemlock), and younger trees in the 40-year old stand (Moore et al. 2004). Scaling sap flow measurements to the stand scale and using a forest growth model to predict future conditions, Stubblefield et al. (2011) concluded that stand-level water use by trees in the Mattole River watershed is likely to decline in future decades as the number of young (< 5 cm diameter at breast height) trees decreases due to canopy closure and stem suppression. A century of fire suppression has also altered vegetation communities, including the conversion of vast acreages of meadows (Mattole River and Range Partnership 2009) and oak woodlands (Engber et al. 2011) into dense stands of Douglas fir, which likely have higher evapotranspiration than the communities they replaced.

A variety of human activities reduce infiltration and groundwater recharge, resulting in increased storm flow and reduced base flow. By compacting soil and short-circuiting shallow subsurface flow paths, roads affect the timing and magnitude of peak flows (Grant et al. 2008). Other impervious surfaces such as parking lots and roofs have a similar effect (Spence et al. 1996, Booth and Jackson 1997). Filling of wetlands, channelization, and diking reduces floodplain connectivity and results in decreased groundwater recharge. In addition, trapping has greatly reduced the distribution and abundance of beavers (ODFW 2005b), resulting in fewer beaver dams available to recharge groundwater and promote floodplain connectivity (Pollack et al. 2007). The resulting channel incision can disconnect stream channels from their floodplains, causing a loss of riparian vegetation due to reduced groundwater levels and floodplain desiccation (Beechie et al. 2010). Salmon habitat can be severely altered by floods, sometimes requiring decades to recover. During flood events, land disturbances resulting from timber harvest, road construction, mining, urbanization, livestock grazing, agriculture, fire, and other uses may contribute sediment directly to streams or exacerbate sedimentation from natural erosive processes (California Advisory Committee on Salmon and Steelhead Trout 1988; California State Lands Commission 1993; FEMAT 1993). In some California streams, the pool-riffle sequence and pool quality still have not fully recovered from the 1964 regional flood. In fact, Lisle (1982) and Weaver and Hagans (1996) found that many Pacific coast streams continue to show signs of harboring debris flows from the 1964 flood, remaining shallow, wide, warm, and unstable.

By changing the flow of water, sediment, nutrients, energy, and biota, dams and water diversions interrupt and alter most of a river's important ecological processes, and therefore most aquatic organisms living in the river. There are numerous dams and diversions that occur throughout the SONCC coho salmon ESU, causing stress to coho salmon through a multitude of direct and indirect effects. More information on the effects of altered hydrologic function is included where applicable in other parts of Chapter 3, including section 3.2.9 (Dams and Diversions).

3.1.8 Barriers

Fish passage barriers in some way restrict the amount of available stream habitat on virtually all SONCC coho salmon rivers and are listed as a high or very high threat in 13 out of 41 populations (Table 3-4). The most common types of barriers include road-stream crossings (e.g., culverts), dams, tidegates, and agricultural diversions (Chapters 7 to 46). Unscreened diversions in particular were mentioned at the time of listing as a threat to SONCC coho salmon and are still a concern today (CDFG 2004a). Barriers can be inhibit salmonids through the physical blocking of stream reaches (e.g., dams, sediment buildup, changes in gradient at tributary mouths, etc.) or through water temperatures that increase to such an extent that salmonids cannot pass through the area during a portion of the year (Richter and Kolmes 2003, McElhany et al. 2000). These thermal barriers can be created by the removal of riparian vegetation, the simplification of stream channels, or from climate change, while physical alterations are mostly created by anthropogenic changes in land use.

While many road-stream crossing structures and diversions have been upgraded with structures that are designed to accommodate fish passage, several hundred road-related barriers and unscreened diversions still exist throughout the ESU, blocking access to hundreds of miles of freshwater habitat (CalFish 2009, ODFW 2008a). Efforts are currently underway to improve or remove fish passage barriers in as many places as feasible. Large dams used for water storage or hydroelectric purposes (such as the Trinity Dam, the Potter Valley Project dams in the Eel River basin, William L. Jess Dam on the Rogue River, and Matthews Dam on the Mad River) have blocked access to high quality habitat that was once accessible to coho salmon, in addition to changing the hydrologic function of their respective rivers. Efforts are being made around the ESU to remove or retrofit these structures, and return accessibility to previously blocked historical salmonid habitat. Dry stream reaches resulting from changes in stream flow, diversions, or channel aggradation can also present seasonal barriers to migration. The current lack of high quality habitat available within many populations has made the issue of barriers even more significant, because many barriers block some of the highest quality habitat and remaining refugia within key watersheds.

Approximately 450 manmade barriers remain throughout the California portion of the ESU (Koller 2010), which block access to historical spawning and rearing areas. Several significant fish passage improvements have occurred throughout the ESU. In the Rogue River, three dams were recently removed (Savage Rapids Dam in 2009, Gold Hill Dam in 2008, and Gold Ray Dam in 2010) and one was notched (Elk Creek Dam in 2008) to restore natural flow and fish passage. William L. Jess dam, the current upstream extent of the Rogue River, impounds Lost Creek Lake and is used for hydropower and flood control. Since 2005, in California 661 miles of stream have been opened to fish passage by removing 440 barriers (available at: http://www.dfg.ca.gov/fish/Administration/Grants/FRGP/index.asp). Overall, coho salmon passage has improved over the last five years, but barriers remain a major threat because many are still unaddressed and continue to block passage. More information regarding the direct and indirect effects of barriers can be found in the description of the effects of dams and diversions (Section3.2.9) and the description of altered hydrologic function (3.1.7). Geographically-specific information about barriers in need of remediation can be found in each population profile (Chapters 7 to 46) where applicable.

3.1.9 Impaired Estuary/Mainstem Function

Estuaries are semi-enclosed coastal water bodies where ocean and freshwater streams mix and include marshes, forested swamps, eelgrass beds, mudflats, tidal channels and backwater sloughs (Bottom et al. 2005, Gleason et al. 2011). Juvenile salmon use estuaries to acclimate to saltwater and to gather olfactory information for successful homing (Dittman et al. 1996, Bottom et al. 2005). During their freshwater to saltwater transition, juvenile coho salmon also depend on slow, backwater estuarine habitat, such as forested wetlands (Eaton 2010), to provide protection from predators and increased growth rates due to a highly productive macrodetrital food web based on accumulated organic matter (Sibert et al. 1977, Bottom et al. 2005). Examples within the SONCC coho salmon ESU include the Lower Klamath River, where coho salmon juveniles thrive in mainstem side channels, off-channel ponds, and backwaters where tributaries join the mainstem (Soto et al. 2008, Hillemeier et al. 2009). The typical coho salmon life cycle comprises one or more years of juvenile rearing in freshwater and then a relatively short but critical migration through the estuary on their way to the ocean (Shapovalov and Taft 1954, Thorpe 1994). However, coho salmon juveniles can rear extensively in estuaries (Miller and Sadro 2003, Lestelle 2007, Koski 2009, Craig 2010, Gleason et al. 2011, Jones et al. 2014), or move to the estuary for a season and then return to freshwater (Weybright 2011). For example, coho salmon smolts in Humboldt Bay, California spent an average of 9 to 12 days in tidal main channel floodplain and off-channel habitat and 15 to 21 days in the Humboldt Bay and the lower estuary (Pinnix et al. 2013). These diverse life-history strategies likely provide the species with resilience to detrimental conditions (Koski 2009, Bottom et al. 2009, Craig 2010).

Estuaries are found along the coastal shoreline, which is also home to a majority of the human population of the Pacific Northwest (Koski 2009, Gleason et al. 2011). In order to accommodate human development, many estuaries and associated low gradient stream reaches have been physically altered and degraded by diking, draining, and filling (Koski 2009). Anthropogenic activities have caused decreases in the quantity and quality of estuary habitat, decreases in water quality from timber harvest, road construction, riparian vegetation removal, and non-point source pollution (Gleason et al. 2011), as well as changes in estuary productivity from alterations in nutrient levels. In many watersheds, hydrologic connectivity and habitat have been reduced in estuaries and low gradient reaches by dikes, levees, tidegates, and culverts, which constrain and alter the natural hydrology, change instream channel morphology, and disconnect the channel from the surrounding floodplain (Koski 2009, Gleason et al. 2011). Estuarine habitat can be improved and expanded by removing or modifying tidegates (Roegner et al. 2010) or excavating new channels and ponds, as occurred recently in Salmon Creek (Love 2012) and Wood Creek (Anderson 2008, Hauer 2013) along Humboldt Bay.

More than half of Pacific Northwest wetlands have been lost due to anthropogenic activities, much of it in the stream-estuary zone commonly used by rearing coho salmon (Miller and Sadro 2003, Pinnix et al. 2013, Jones et al. 2014). For example, Redwood Creek is flanked for the first 3.4 miles by flood control levees that confine the channel to a 250-foot-wide channel migration zone, which bisects the estuary and has resulted in extensive loss of estuarine area and decreased habitat value (Cannata et al. 2006). Tideland reclamation and the construction of dikes and levees for agricultural purposes have considerably altered the natural function of the Eel River estuary, reducing estuarine habitat by 60% (Yoshiyama and Moyle 2010). Slough and creek channels that once meandered throughout the Eel River delta are now confined by levees that slow flow to a point that many have become filled with sediment (Yoshiyama and Moyle 2010). Levees occur in many populations within the ESU. Impaired estuary/mainstem function results in a high to very high impact in 28 out of 40 SONCC coho salmon populations (Table 3-4).

Estuaries and the salmonids that depend on them will be impacted by global warming in numerous ways (Katz et al. 2012). An acceleration of current rates of sea level rise will cause a shift in the extent and diversity of the coastal marshes, swamps, beaches, and other estuarine habitats in many areas of the Pacific Northwest (Galbraith 2005). Many low lying coastal and intertidal areas are expected to be inundated causing loss of freshwater marshes, swamps, and tidal flats and conversions to salt marshes and transitional marshes (National Wildlife Federation (NWF) 2007). Estuarine beaches will likely suffer losses due to inundation and significant erosion (NWF 2007). Under a conservative scenario of 2ºC warming within the next century, the Humboldt Bay estuary could lose 29% of its tidal flats, although salt marshes would expand (Galbraith 2005). Since marshes play a critical role in the regulation of nutrients and filtering of pollutants, net losses to coastal marsh habitat will likely cause declining water quality (NWF 2007). Habitat changes that result from sea level rise will be determined by local topography and estuaries in some populations, such as Elk River, are predicted to expand significantly with sea level rise (Flitcroft et al. 2013b). Climate change will alter precipitation and runoff patterns, which could increase estuarine salinity and in turn magnify the toxicity to fish of several pesticides often found in estuaries draining agricultural watersheds (Schlenk and Lavado 2011).

3.1.10 Adverse Fishery and Collection-Related Effects

Historical Fishing Impacts

In the final rule to list SONCC coho salmon (62 FR 24588, May 6, 1997) overfishing was recognized as a contributing factor in the compromised escapement levels seen between 1950 and 1990. Fishing regulations were changed to be more protective of coho salmon beginning in 1994, when the retention of coho salmon in ocean commercial and recreational fisheries was prohibited from Cape Falcon, Oregon (south of the Columbia River) to the U.S./Mexico border. In recent years, there has been some limited commercial fishing for coho salmon in the area from Cape Falcon, Oregon to Humbug Mountain, Oregon, but these fisheries have operated within the ESA-related limits for the Lower Columbia River, Oregon Coast, and SONCC coho salmon ESUs. California waters were open to coho salmon retention prior to 1998. Currently, coho salmon retention is limited to the mark-selective recreational hatchery coho salmon fishery in Oregon waters, and tribal harvest under federal reserved fishing rights in the Klamath River basin.

On average, only two percent of coho salmon eggs survive to the smolt stage, and only 10% of those smolts survive to adulthood (Quinn 2005). Fishing affects SONCC coho salmon recovery because it targets these adult fish. Adult fish have demonstrated the ability to survive the stresses and threats affecting egg, fry, juvenile, and smolt life stage and will soon reproduce, and their capture before reproduction prevents successful reproduction.

Federally Managed Fisheries

Salmonid fisheries

SONCC coho salmon are managed as part of the Oregon Coast Natural (OCN) stock aggregate, which includes coho salmon produced from all Oregon river and lake systems south of the Columbia River and contributes primarily to ocean fisheries off Oregon and California (Pacific Fishery Management Council [PFMC] 1999). OCN coho salmon are part of a larger aggregate of natural and hatchery production south of Leadbetter Point, Washington known as the Oregon Production Index (OPI) (Sharr et al. 2000). SONCC coho salmon are vulnerable to incidental mortality due to hooking and handling in the commercial and recreational ocean fisheries that primarily target Chinook salmon.

Amendment 13 to the PFMC Pacific Coast Salmon Plan, which was adopted in 1997, was designed to ensure that fishery-related impacts do not act as a significant impediment to the recovery of depressed OCN coho salmon stocks (Sharr et al. 2000). In contrast to previous management approaches, fishery management under Amendment 13 is based upon exploitation (i.e., mortality) rates, not escapement targets. These exploitation rates are based upon estimates of habitat production potential that incorporate effects of both freshwater and marine environments and are derived from habitat-based assessment and modeling of OCN coho salmon production (Sharr et al. 2000). Amendment 13 considers recovery of OCN stocks by ensuring sufficient spawner escapement to seed spawning habitat. A review of the effectiveness of Amendment 13 proposed more conservative allowable exploitation rates at very low levels of spawner abundance and marine survival, and slightly higher rates when conditions of spawner abundance and marine survival are favorable (Sharr et al. 2000). This proposal was adopted by the PFMC (L. Kruzic, NMFS, pers. comm. 2011). Two recent amendments to the Pacific Coast Salmon Plan are relevant to SONCC coho salmon. Amendment 14 (PFMC 2000b) redefines optimal yield, and both Amendment 14 and Amendment 16 (PFMC 2011a and NMFS 2011) provide new criteria to prevent or end overfishing of non-ESA listed species.

Ocean exploitation rates for SONCC coho salmon are based on the exploitation rate on Rogue/Klamath (R/K) hatchery stocks (NMFS 1999a). NMFS issued a biological opinion requiring that the overall annual ocean exploitation rate for R/K hatchery coho salmon remain less than 13% (NMFS 1999a). In 2001, the PFMC adopted management measures for Federal ocean waters under which all key coho salmon management objectives, based on the 1999 NMFS biological opinion, the Pacific Coast Salmon Plan, and the OCN Coho Salmon Work Group recommendations, were met. The major salmonid fishery affecting SONCC coho salmon is for Chinook salmon. Current regulations on Chinook salmon fisheries include time and area closures, seasonal quotas, minimum sizes, gear restrictions, and allowable take. Since 1999 the estimated exploitation rates on R/K hatchery coho salmon have been considerably lower than 13 percent (Figure 3-1). Due to a lack of life cycle monitoring stations and fishery monitoring effort, the effect of the fishery on particular populations within the SONCC coho salmon ESU is unknown. The viability criteria presented in this recovery plan were not considered in the biological opinion (NMFS 1999a), as they were not yet available when that opinion was prepared.

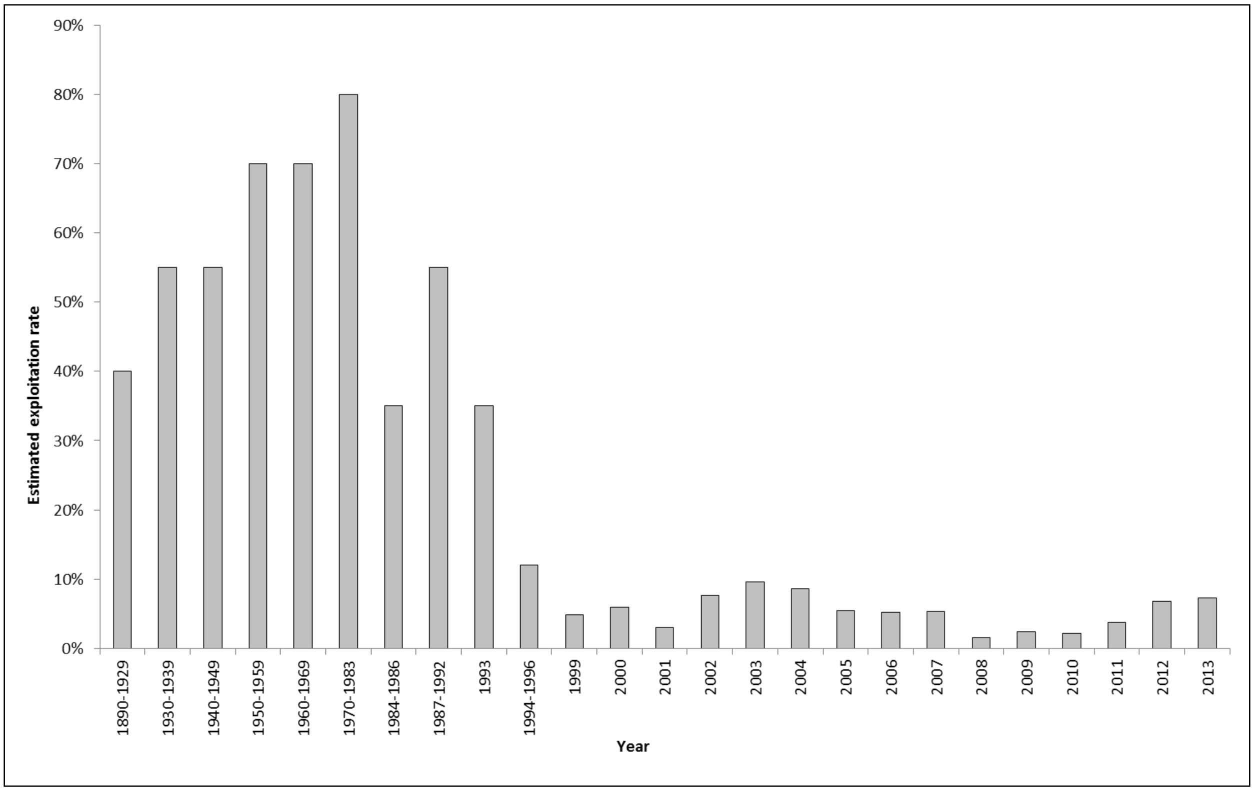

Figure 3-1. Estimated exploitation rate of coho salmon in southern Oregon and northern California. 1890 to 1996 rates are Oregon coast natural (OCN) stock aggregate estimates from ODFW (1997); 1998 rate is a preseason estimate for the OCN stock aggregate (PFMC 1999); 1999 to 2012 rates are post-season estimates for Rogue/Klamath (R/K) coho salmon (PFMC 2000 to 2004, 2005a, and 2006 to 2013, respectively); and the 2013 rate is a preliminary post-season estimate for R/K coho salmon (PFMC 2013a).

Non-salmonid fisheries

Groundfish

The groundfish fishery management plan includes 82 species, nearly all of which live on or near the ocean floor. Major types of fishes included in this group include rockfishes, flatfishes, roundfishes, sharks, and skates (NMFS 2003a). Most groundfish are harvested using trawls, pots, and hook-and-line gear. Mid-water and bottom trawls have been known to catch salmon (NMFS 1999b). NMFS has evaluated the impact of this fishery on listed salmon and steelhead and concluded it is not likely to adversely affect salmon or adversely modify critical habitat (NMFS 1999b and NMFS 2006). The Biological Opinion limits allowable bycatch of Chinook salmon in the trawl fisheries, but does not limit bycatch of other salmon or steelhead. The rationale is as follows: "Coho, chum, sockeye are caught in relatively low numbers in both the midwater trawl whiting fishery and the bottom trawl fishery with average catch per year coastwide in the tens to a few hundred of fish, and in the bottom trawl fishery in the tens of fish. Therefore, it is unlikely that listed ESUs of coho, chum, or sockeye will be significantly affected by the groundfish fishery" (NMFS 1999b)". Al-Humaidhi et al. (2012) summarized the observed and estimated total bycatch of salmon in West Coast fisheries, including groundfish, between 2002 and 2010. It is unknown what proportion of coho salmon observed in these fisheries originated in the SONCC coho salmon range. Bycatch of coho salmon in the coastwide non-hake groundfish sectors varied, but remained below 100 fish (Al-Humaidhi et al. 2012). In the Pacific hake sectors, coastwide bycatch peaked in 2007 at 475 coho salmon, and the bycatch in each of the next three years was below 100 (Al-Humaidhi et al. 2012). Based on the NMFS (1999b) and NMFS (2006) consultations, the threat posed by the groundfish fishery to SONCC coho salmon is low.

Coastal Pelagics

Coastal pelagic species (CPS) include northern anchovy, market squid, Pacific sardine, Pacific (chub or blue) mackerel, and jack (Spanish) mackerel. Anchovy and sardine are known as important forage species for all predators including salmon and steelhead. All the species in this group are extremely important to the ecosystem used by SONCC coho salmon. As explained in the 2003 regulatory amendment to the CPS fisheries management plan (PFMC 2005b):

> Anchovy, sardine, hake, jack mackerel, and Pacific mackerel achieve the largest populations in the California Current region as well as in other major eastern boundary currents. These populations are key to the trophic dynamics of the entire California Current ecosystem. Anchovies and sardines are the only fish in the ecosystem that consume large quantities of primary production (phytoplankton), all five of the species are significant consumers of zooplankton. All five species of fish, particularly mackerels and hake, and also squid are important predators of the early life stages of fish. The juvenile stages of squid and all five species of finfish, and in many cases the adults, are important as forage for seabirds, pinnipeds, cetaceans, and other fish.

As coho salmon grow, fish make up a greater proportion of their diet (Shapovalov and Taft 1954). The diet of ocean-caught coho salmon is dominated by fishes such as herring, sand lance, sardines, and smelts (Sandercock 1991). Targeted CPS fisheries could reduce the amount of prey available to SONCC coho salmon. Such deficits could negatively impact salmon, marine mammals, and top predators. In addition, harvest of prey species could increase the predation pressure on juvenile salmon. Prey species provide alternate food sources for predators of juvenile salmonids such as hake, and the presence of prey species can reduce predation pressure on juvenile salmonids (Emmett and Sampson 2007). There is an ongoing debate over how to account for the needs of all predators in the ecosystem when developing models to determine acceptable harvest levels of prey species (e.g., Marine Fish Conservation Network 2007). The National Research Council concluded there was a need for an ecosystem-based assessment of fishery impacts, rather than management of a single fish species in isolation (NRC 2006). NMFS has recognized the need for ecosystem-based management on the west coast, most recently through formulation of the NOAA Ecosystem Approach to Management and establishment of the California Current Regional Ecosystem as a management area (NOAA 2004).

The PFMC has adopted a conservative, risk-averse approach to management of CPS, which reduces the likelihood of such negative effects on salmon and their ecosystem. The need to "provide adequate forage for dependent species" is recognized as a goal and objective of the CPS fisheries management plan (PFMC 2011b). A control rule is a simple formula used by the PFMC in evaluating allowable harvest levels for each of the CPS. The CPS control rules contain measures to prevent excessive harvest, including a continual reduction in the fishing rate as the biomass declines. In addition, the control rule adopted for species with significant catch levels explicitly leaves thousands of tons of CPS biomass unharvested and available to predators. No ecosystem model currently exists that could calculate the caloric needs of all predators in the ecosystem, so the amount of this set aside is necessarily an estimate that may be modified if new information becomes available. Ocean temperature is a factor in the control rule for Pacific sardine, in recognition of the effects of varying ocean conditions on fish production rates. Allowable harvest rates are automatically reduced in years of poor production. The PFMC developed the Fishery Ecosystem Plan (FEP) to enhance the PFMC's species-specific management programs with more ecosystem science, broader ecosystem considerations, and management policies that coordinate Council management across its Fishery Management Plans and the California Current Ecosystem (PFMC 2013b). The FEP includes an initiative to protect unfished lower trophic level (forage) fish species (PFMC 2013b). NMFS has determined CPS fisheries are not likely to adversely affect ESA-listed species, including the SONCC coho salmon ESU (PFMC 2014). Due to the conservative control rules used to manage CPS fisheries, and the preservation of a portion of CPS biomass for predator consumption, the CPS fishery poses a low threat to SONCC coho salmon recovery.

Pacific Halibut

Pacific halibut (*Hippoglossus stenolepis*) occur on the continental shelf from California to the Bering Sea. Harvest of this species (not to be confused with the California halibut, *Paralichthys californicus*) is managed by the International Pacific Halibut Commission (IPHC), which determines allowable catch. The Pacific Fishery Management Council then allocates portions of the catch to commercial, recreational, and tribal fisheries in California, Oregon, and Washington. Although fishing for this species is allowed in California, in the past ten years only one Pacific halibut was commercially landed in waters off California (Bruce Leaman, Executive Director, IPHC, personal communication 12/18/07). Even in areas where commercial fishing for this species is more prevalent, bycatch of salmonids is rare. Perhaps this is because the favored commercial halibut gear, demersal longlines, are set near the ocean floor at depths where salmonids rarely occur. The IPHC conducts an annual survey of the species caught on commercial Pacific halibut longlines. The survey includes 1,200 stations off of Washington and Oregon, with one station on the Oregon/California boarder. Less than one salmon is captured per year survey wide, on average (Claude Dykstra, Survey Manager, IPHC, personal communication 12/18/07).

The recreational fishery for Pacific halibut extends into California. A very small portion of the allowable catch (8,308 lbs. in 2007) was allocated to the U.S. recreational fisheries south of Humbug Mountain, Oregon. The number of salmon caught in the recreational halibut fishery off California appears to be very small. In 2007, there were only five reported cases when recreational fishermen caught salmon and Pacific halibut on the same trip (Melody Palmer-Zwahlen, CDFG, 12/19/07, personal communication).

Based on the low incidence of bycatch of Pacific salmon in commercial or recreational Pacific halibut fisheries, and the fact that relatively little Pacific halibut fishing occurs in California, effects from this fishery pose a low stress to SONCC coho salmon recovery.

State-Managed Fisheries

In Oregon, adipose-fin-clipped coho salmon (hatchery coho salmon) can be retained when caught recreationally in state-managed waters (streams, rivers, tidewaters and bays), subject to area-specific season and bag restrictions (ODFW 2011a). NMFS (2007a) estimated that 3.3 percent of Rogue/Klamath (R/K) hatchery coho salmon caught in this mark-selective fishery would die post-release. Retention of coho salmon caught in any California-managed fisheries in the range of the SONCC coho salmon ESU is prohibited (CDFG 2011). Some incidental coho salmon mortality likely occurs in association with the release of coho salmon in Chinook- and steelhead-directed freshwater fisheries, but is likely low (NMFS 1999a). The impact of California-managed inland fisheries on SONCC coho salmon has not been formally evaluated by NMFS. Formally evaluated means an ESA Section 7 consultation has been completed or a determination has been completed under any applicable limit in NMFS' protective regulations promulgated under ESA Section 4(d) (50 CFR 223.203).

Tribal-Managed Fisheries

The Yurok and Hoopa tribes have federally recognized fishing rights and pursue subsistence, ceremonial, and commercial fisheries for Chinook salmon and steelhead in the Klamath River basin (CDFG 2002a). The number of coho salmon harvested by these tribes is less than the number of Chinook salmon taken in subsistence fisheries in the Klamath River and the Trinity River. The Karuk tribe uses dip nets to catch salmonids at Ishi Pishi Falls on the Klamath River. The Round Valley tribe holds a federally recognized right to pursue fisheries for salmon in the Eel River (Langridge 2002). The impact of in-river tribal fishing on the SONCC coho salmon ESU has not been formally evaluated by NMFS. Formally evaluated means an ESA Section 7 consultation has been completed or a determination has been completed under any applicable limit in NMFS' protective regulations promulgated under ESA Section 4(d) (50 CFR 223.203 or 223.204).

Fishing for coho salmon within the Yurok tribe’s reservation on the lower Klamath River, which extends from about 2 miles upstream of Weitchpec, California, to the Pacific Ocean, has been monitored since 1992. During the period of monitoring, the Yurok Tribe has harvested approximately 70% of their catch below the Highway 101 bridge. The median Yurok harvest from the entire area from 1994 to 2012 was 345 coho salmon (YTFP 2014), which approximates an average annual maximum[6] harvest of 3.1 percent of the total run. The total run size for the Klamath basin was determined by combining wild and hatchery adult counts at the Trinity River, Iron Gate Hatchery, and Shasta and Scott river weirs (YTFP 2014). On average, about 42 percent of the coho salmon harvested by the Yurok Tribe were progeny of coho salmon that spawned in the wild (Williams 2010). The effect of the Yurok fishery on particular populations

[6]Denominator for calculation only includes coho salmon counts at Trinity River Weir, Scott and Shasta river, and Iron Gate Hatchery, and therefore does not include all Klamath and Trinity basin coho salmon escapement. Therefore, it is a maximum estimated harvest rate.

within the SONCC coho salmon ESU is unknown, because all nine of the Klamath River basin coho salmon populations migrate through the lower Klamath River.

Trinity River coho salmon are harvested by the Yurok and Hoopa tribes Table 3-7 describes the estimated percentage of the total Trinity coho salmon run harvested by each tribe.

Table 3-7. Estimated number of Trinity River coho salmon harvested by the Yurok and Hoopa tribes. Includes percentage of total adult run size harvested by Yurok and Hoopa tribes, from 1997 to 2008. M= Marked (hatchery), U = Unmarked (natural origin).

Year	Estimated Yurok harvest		Estimated Hoopa harvest[2]		Estimated total Trinity River adult escapement[3]		Percentage harvested by Yurok tribe		Percentage harvested by Hoopa tribe	
	M	U[1]	M	U	M	U	M	U	M	U
1997	22	2	39	3	1,885	271	1.2%	0.7%	2.1%	1.1%
1998	117	6	88	54	10,285	1,297	1.1%	0.5%	0.9%	4.2%
1999	120	9	65	36	4,785	630	2.5%	1.4%	1.4%	5.7%
2000	70	1	211	22	10,586	386	0.7%	0.3%	2.0%	5.7%
2001	1214	111	506	100	28,139	3,389	4.3%	3.3%	1.8%	3.0%
2002	327	4	327	20	15,653	526	2.1%	0.8%	2.1%	3.8%
2003	121	23	85	17	22,963	4,352	0.5%	0.5%	0.4%	0.4%
2004	553	302	312	80	27,167	10,092	2.0%	3.0%	1.1%	0.8%
2005	640	24	153	21	27,947	2,856	2.3%	0.8%	0.5%	0.7%
2006	241	24	442	38	18,774	1,734	1.3%	1.4%	2.4%	2.2%
2007	61	17	68	14	4,436	1,257	1.7%	1.4%	1.5%	1.1%
2008	147	13	262	53	6,864	1,302	2.1%	1.0%	3.8%	4.1%
Median 1997-2008	**134**	**15**	**182**	**29**	**13120**	**1300**	**1.9%**	**0.9%**	**1.7%**	**2.6%**

[1] Calculated as follows: (Estimated harvest of marked Trinity River Hatchery (TRH) fish, provided by Yurok Tribal Fisheries Program / estimated proportion of marked Trinity River Hatchery coho salmon that migrated upstream of the Willow Creek weir) - estimated harvest of marked Trinity River Hatchery fish. Jacks were excluded.
[2] Source: Hoopa Tribal Fisheries Program, unpublished data.
[3] Calculated as follows: Est. adult escapement above WC weir + Est. ocean incidental mortality[4] + Est. Yurok marked harvest + Est. Hoopa marked harvest + Est. recreational harvest upstream of WC weir (source: CDFG, unpublished data) + Est. recreational harvest downstream of WC weir (source: Hoopa Tribal Fisheries Program, unpublished data).
[4] Calculated as follows: (Est. Yurok marked harvest + Est. Hoopa marked harvest + Est. recreational harvest upstream of WC weir + Est. recreational harvest downstream of WC weir)* pre-season projected ocean incidental mortality rate (source: Pacific Fishery Management Council [PFMC] 2011).

Karuk fishermen are allowed by CDFW to catch salmon using dip nets at Ishi Pishi Falls on the Klamath River if they adhere to the same limits as Chinook salmon sport fishermen (CDFG 2002a). A Karuk tribe representative stated “its members rarely harvest more than 200 salmon and steelhead per year, that protected species such as coho salmon are never kept, and that these protected species are released alive" (Driscoll 2009).

Collection for Research Purposes

When NMFS re-affirmed the listing of SONCC coho salmon in 2005 (70 FR 37160, 37196; June 28, 2005), NMFS identified collection or handling of fish among activities that may harm certain listed salmon ESUs and thus result in violation of the ESA Section 9 take prohibition. Information on SONCC coho salmon populations is needed for the NMFS 5-year status reviews, as well as to determine the effectiveness of habitat restoration actions, and ultimately for de-listing. This information is derived from research studies of life-history strategies, abundance, distribution, and genetics, and involves take of individuals.

Within the ESA, there are two mechanisms to enable listed fish to be taken for research purposes, and exempt the permit holder from the prohibitions of the ESA. Under Section 10(a)(1)(A) and NMFS implementing regulations at 50 CFR § 222.308, NMFS may issue permits for scientific research purposes or to enhance the propagation or survival of species listed as threatened or endangered under the ESA. The permitted activities must not operate to the disadvantage of the listed species and must provide a bona fide and necessary or desirable scientific purpose or enhance the propagation or survival of the listed species. NMFS generally issues permits for up to five years, although permits for longer periods have been issued.

NMFS regulations under ESA Section 4(d) (50 CFR § 223.203(b)(7)), provide that take prohibitions for certain listed threatened species of anadromous salmonids, including SONCC coho salmon, do not apply to scientific research activities conducted by employees or contractors of certain tribes and state fish and wildlife agencies, including the California Department of Fish and Wildlife and the Oregon Department of Fish and Wildlife, or as a part of a monitoring and research program overseen by or coordinated with that agency, if the agency meets specific requirements listed in these regulations.

Specific activities authorized for research purposes by either a permit issued under ESA section 10(a)(1)(A) or the ESA section 4(d) regulations described above may include: direct observation, capture (electrofisher, nets, trawls, and traps), handling, anesthetizing, marking, tagging, tissue sampling, and other activities necessary to conduct various studies to promote the conservation of the species, enhance the species' survival, or add significantly to the body of knowledge of SONCC coho salmon. The primary effects of these activities are in the form of harassment associated with intentional take. Harassment generally leads to stress and other sub-lethal effects and is caused by observing, capturing, and handling fish. Unintentional mortality may occur during handling or after the fish has been released. Depending on the activities and life stage, NMFS anticipates from one to five percent of handled fish may die. Permits may include any conditions deemed necessary by NMFS, including reporting or inspection requirements for monitoring the impacts of permitted activities.

Prior to issuance of either a permit under ESA section 10(a)(1)(A) or approval of a research program under the ESA section 4(d) regulations described above, NMFS must determine whether the action is likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat.

3.2 Threats

Threats are the activities or processes that have caused, are causing, or may cause the stresses and thus the destruction, degradation and/or impairment of SONCC coho salmon and their habitat. The major factors listed in 1997 as responsible for the decline of SONCC coho salmon were timber harvest, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals and unscreened diversions for irrigation (62 FR 24588, May 6, 1997). Many of these activities continue to threaten coho salmon populations in this ESU, while additional threats have emerged as significant factors that should be addressed in order for recovery to occur. NMFS' an analysis of current threats in this recovery plan has identified the following as currently contributing to the destruction, modification, or curtailment of habitat or range: dams and diversions, channelization and diking, agricultural operations, timber harvest, climate change, roads, urban/industrial/residential development, high severity fire, mining and gravel extraction, invasive species, hatcheries, and fishing and collecting (See Chapters 7 to 46).

These threats have led to significant stresses on coho salmon populations throughout the ESU (Chapters 7 to 46) and have contributed to the decline of the species. The following threats (Table 3-8) occur throughout the ESU and are believed to be the main causes of the previously described stresses (Table 3-4). Table 3-8 lists the ranking assigned to each threat in each population of the SONCC coho salmon ESU. Population-specific ratings are discussed in Chapters 7 to 46.

Table 3-8. Threat severity ranking by population.

	Threats													
Population	Climate change	Roads	Channelization/ Diking	Agricultural Practices	Timber Harvest	Urban / Residential Industrial Development	High Severity Fire	Mining/Gravel Extraction	Dams/Diversions	Invasive/Non Native Alien Species	Hatcheries	Road Stream Crossing Barriers	Fishing and Collecting	Total High or Very High
Elk River	M	M	H[1]	VH[1]	M	L	L	L	H	M	L	H	L	4
Lower Rogue River	M	VH[1]	H	M	H	H[1]	L	M	M	M	M	L	L	4
Chetco River	M	H	H[1]	M	H	VH[1]	M	H	M	M	L	M	L	5
Winchuck River	L	H	VH[1]	H	M	VH[1]	M	M	M	H	L	M	L	5
Brush Creek	M	VH[1]	H	NA	H[1]	L	L	NA	M	NA	L	L	L	3
Mussel Creek	L	VH	VH[1]	M	VH[1]	H	L	NA	L	NA	L	L	L	4
Hunter Creek	M	VH[1]	VH	H	VH[1]	H	M	L	M	L	L	M	L	5
Pistol River	M	VH[1]	VH	H	VH[1]	M	M	L	M	NA	L	L	L	4
Smith River	M	H	H[1]	H[1]	L	M	M	M	L	M	M	H	M	4
Lower Klamath River	H	H	VH[1]	VH[1]	H	M	L	M	H	M	M	M	L	6
Redwood Creek	M	VH[1]	VH[1]	M	M	M	M	H	M	M	L	L	L	3
Maple Creek/Big Lagoon	L	VH[1]	M	L	H[1]	L	M	NA	M	M	L	L	L	1
Little River	L	H[1]	M	H[1]	M	M	M	NA	M	NA	L	L	L	2
Mad River	M	VH[1]	H	M	M	M	M	H[1]	M	NA	M	L	L	3
Elk Creek	L	M	H[1]	M	L	H[1]	L	NA	L	NA	L	L	L	2
Wilson Creek	L	VH[1]	L	L	M[1]	L	L	NA	L	NA	L	L	L	1
Strawberry Creek	L	M	H[1]	M	H	M	NA	NA	L	NA	L	H[1]	L	2
Norton/Widow White Creek	L	VH[1]	VH[1]	M	M	VH	M	NA	M	L	L	H	L	4
Humboldt Bay Tributaries	M	VH[1]	VH[1]	H	H	H	L	NA	M	M	L	L	L	5
Low Eel/Van Duzen Rivers	M	VH	H[1]	H	H	H	M	M	H[1]	H	L	L	L	8

Population	Threats													
	Climate change	Roads	Channelization/ Diking	Agricultural Practices	Timber Harvest	Urban / Residential Industrial Development	High Severity Fire	Mining/Gravel Extraction	Dams/Diversions	Invasive/Non Native Alien Species	Hatcheries	Road Stream Crossing Barriers	Fishing and Collecting	Total High or Very High
Bear River	M	VH[1]	L	H	H[1]	NA	M	L	L	NA	L	L	L	2
Mattole River	M	H	M	M	H	H[1]	H	L	VH[1]	NA	NA	L	L	5
Guthrie Creek	L	H	L	H[1]	H[1]	L	L	NA	L	NA	L	L	L	2
Illinois River	H	VH[1]	H	H	H	M	M	VH	VH[1]	M	M	H	L	8
Mid. Rogue/Applegate Rivers	L	VH	VH	VH	H	VH[1]	M	H	VH[1]	M	M	H	L	8
Upper Rogue River	H	VH	H	VH[1]	VH	VH[1]	M	M	H	M	M	M	L	7
Middle Klamath River	H	M	L	L	L	NA	H[1]	M	H[1]	L	M	M	L	3
Upper Klamath River	HV	VH[1]	VH	H	M	L	M	L	VH[1]	L	VH	M	L	7
Salmon River	VH[1]	M	NA	L	L	L	M[1]	M	L	L	M	L	L	1
Scott River	VH	H	VH	VH[1]	M	M	H	M	VH[1]	NA	M	L	L	7
Shasta River	H	H	H	VH[1]	L	M	M	M	VH[1]	NA	H	L	L	6
South Fork Trinity River	H	VH[1]	L	M	L	L	M	L	H[1]	L	VH	L	L	4
Lower Trinity River	H	H	VH[1]	M	M	M	M	L	H	L	VH[1]	L	L	5
Upper Trinity River	H	H	M	M	M	M	M	L	VH[1]	H	VH[1]	H	L	5
South Fork Eel River	M	VH[1]	M	M	H	H	H	M	H[1]	H	L	H	L	7
Mainstem Eel River	H	VH	M	M	H	M	H	M	H[1]	H[1]	L	M	L	6
Mid. Fork Eel River	H	H[1]	H[1]	M	M	M	H	NA	M	H	L	L	L	5
Mid. Mainstem Eel River	H	H[1]	H	H	H	M	H	M	VH[1]	H	L	L	L	8
Upper Mainstem Eel River	VH	VH[1]	NA	M	L	L	H	NA	VH[1]	VH	L	L	L	5
North Fork Eel River	H	VH[1]	L	M	M	L	H[1]	NA	M	H	L	L	L	4

[1] Identified as a key limiting threat.

3.2.1 Climate Change

Climate change impacts salmonids throughout the Pacific Northwest and California (Battin et al. 2007, Moyle et al. 2013). The overwhelming majority of climate models predict a warming trend resulting from rising levels of greenhouse gases in the atmosphere, although the magnitude varies among models (Barnett et al. 2005, Daniels et al. 2012). Climate change is expected to detrimentally affect SONCC coho salmon in freshwater, estuarine, and ocean habitats. Climate change will likely alter runoff patterns by causing a precipitation shift from snow to rain (Kiparsky and Gleick 2003), earlier snowmelt (Knowles et al. 2006), lower summer flows (Barr et al. 2010), and more intense storms that will increase peak flows (Doppelt et al. 2008, Bates et al. 2008). In addition, ocean acidification is expected to reduce ocean productivity (Feely et al. 2008) and sea level rise will alter estuarine habitat (Galbraith et al. 2005).

Coho salmon are particularly vulnerable to climate change due to their need for year-round cool water temperatures (Welsh et al. 2001). SONCC coho salmon spend an extended period rearing in freshwater and, being near the southern end of their distribution, often reside in streams already near the upper limits of their thermal tolerance. Through effects on air temperatures and stream flows, climate change is expected to increase water temperatures to the detriment of coho salmon. Climate change effects on stream temperature within the SONCC coho salmon ESU are already apparent (Isaak et al. 2012). For example, in the Klamath River, Bartholow (2005) observed a 0.5 ºC per decade increase in water temperature since the early 1960s, and model simulations predict a further increase of 1-2 ºC over the next 50 years (Perry et al. 2011).

Models of future climate change project that the western United States will have reduced volumes and persistence of snowpacks across the region (Gleick 1987, Lettenmaier and Gan 1990), reduction in the fraction of precipitation that falls as snow rather than rain (Kiparsky and Gleick 2003), and hastening of the onset of snowmelt once snowpacks have been formed (Knowles et al. 2006), resulting in earlier runoff relative to current conditions (Kiparsky and Gleick 2003). Warmer winter air temperatures will decrease the snowpack in northern California and southern Oregon by up to 75% by 2040 and nearly 100% by 2080 (Doppelt et al. 2008). Snow acts as a natural reservoir by delaying runoff from winter months when precipitation is high, and climate change is projected to shift the timing and duration of releases from these natural reservoirs, altering instream conditions that salmon have evolved with (Kiparsky and Gleick 2003). Overall this would result in earlier and higher high flows, and earlier and lower low flows (Doppelt et al. 2008, NMFS and USFWS 2013). An analysis of the past 50 years in California has already revealed trends toward warmer winter and spring temperatures, a smaller fraction of precipitation falling as snow, a decrease in the amount of spring snow accumulation in lower and middle elevation mountain zones, and an advance in snowmelt of 5 to 30 days earlier in the spring (Knowles et al. 2006).

High flows and associated flooding are a natural process and can be beneficial to salmon and salmon habitat as a disturbance mechanism for scouring fine sediment from gravel, distributing large wood, recharging aquifers, allowing fish passage, transporting sediment and organic matter, and maintaining channel features (Lisle 1989). However, the potential increased rain and earlier snowmelt resulting from climate change could also detrimentally impact SONCC coho salmon populations by altering the timing of spring freshets, potentially increasing severity and quantity of flood events, increasing water temperatures, and altering the intensity of winter storms, thereby changing habitat accessibility, run timing, and egg development (Roos 2003). Eggs will likely develop faster in the higher winter and spring water temperatures, leading to earlier emergence. The early coho salmon fry could then be displaced downstream during high spring flows (Doppelt et al. 2008) thereby increasing exposure to predation. Even though higher spring temperatures would increase the growth rate of fry, the higher summer temperatures would decrease the amount of cold water refugia, which could lead to thermal stress and juvenile mortality (NMFS and USFWS 2013).

A potential shift to earlier and higher flows caused by climate change could have other effects on coho salmon and their habitat. Higher frequency and magnitude of winter flood events could affect coho salmon by increasing the risk of redd scouring, displacing eggs and alevins from the gravel before they emerge (Goode et al. 2013, NMFS and USFWS 2013). The timing of downstream migration by coho salmon smolts could be altered in relation to upwelling and ocean conditions and would likely influence smolt survival (NMFS and USFWS 2013). Increased erosion of hill slopes, roads, and streambanks could cause sedimentation of stream beds, which has been implicated as a principal cause of declining salmonid populations (Frissell 1992). Juveniles and smolts can be stranded by flood events, washed downstream out of rearing habitat, or washed out to sea prematurely.

Climate change may also decrease the frequency of fog on the California coast, which would increase air temperature and decrease humidity, leading to increased evapotranspiration by riparian vegetation, decreased stream flow, and increased water temperature. Data from 1901 to 2008 indicate that coastal temperatures have increased more than inland temperatures, accompanied by a reduced number of hours of coastal fog (Johnstone and Dawson 2010). If coastal fog continues to diminish, there will be increased drought stress and potentially a reduction in the range of coast redwoods and associated fish and wildlife communities.

Less snowpack, increased summer temperatures, and drought conditions lead to greater risk of wildfire. The summer of 2012 displayed the sorts of weather and climate extremes that climate change is bringing. Average temperatures for June through August were the third warmest on record, with July the hottest month ever recorded for the nation. Nearly two-thirds of the contiguous U.S. experienced drought conditions. Wildfires spanned more than 3.6 million acres across the western and central U.S. during August, a record for the month (NOAA 2012). An increased frequency of high severity wildfires not only can create lethal water temperatures for coho salmon, but also contributes to multiple stresses such as altered sediment supply and degraded riparian conditions, which are described below in Section 3.2.7 (High Severity Fire).

The impacts of climate change on coho salmon are not restricted to fresh water habitats. Survival of coho and other salmon species in the ocean is dependent on ocean food webs, which are strongly influenced by climate (Peterson et al. 2012, Rupp et al. 2012, Ruzicka et al. 2011, Sharma et al. 2013). Ocean acidification is increasing in surface waters off northern California more rapidly than previously estimated (Feely et al. 2008) and is likely to affect plankton and marine food webs, resulting in decreased coho salmon growth rates (Crozier et al. 2008). Global sea level has risen over the last several decades at a rate of about 20 cm per century and with climate change that rate is increasing (Cayan et al. 2009), causing a mean sea level rise expected to reach almost a meter by 2100 (Cayan et al. 2009, Laird et al. 2013). Sea level rise is projected to affect estuaries, coastal wetlands, and other low-lying lands, change the amount and location of critical estuarine and brackish habitats for salmon, and increase the salinity of rivers, bays, and groundwater tables (Intergovernmental Panel on Climate Change [IPCC] 2007). The IPCC (2007) suggests that by 2080, sea level rise could convert as much as 33 percent of the world's coastal wetlands to open water. Sea-level rise will also extend areas of salinization of groundwater and estuaries, resulting in a decrease in freshwater availability for fish and wildlife that inhabit these coastal areas (Kundzewicz et al. 2007). New brackish and freshwater wetland areas will be created as seawater inundates low-lying inland areas or as the freshwater table is pushed upward by the higher stand of seawater (Pfeffer et al. 2008).

The threat and stress assessment for this recovery plan included consideration of climate change and resultant environmental conditions. Climate change poses a serious threat to the viability of SONCC coho salmon populations (NRC 2004, Moyle et al. 2013, NMFS and USFWS 2013). Although SONCC coho salmon are diverse and resilient and have persisted through many climatic changes over the millennia, the modern climate change is happening at a rapid pace during an already warm period in which populations are already depressed and fragmented from intense human development (Battin et al. 2007, Isaak et al. 2012). The reduced genetic diversity resulting from depressed population size may limit the ability of individuals to adapt to changing climatic conditions. In addition, as climate change reduces the carrying capacity of the habitat within the range of SONCC coho salmon, species viability may be more difficult to achieve. Even if greenhouse gas emissions that cause climate change were stabilized, warming and sea level rise would continue for centuries because greenhouse gas emissions remain in the atmosphere for decades and there are time lags in climate system feedbacks (Solomon et al. 2009).

Beechie et al. (2012) recommended restoring stream flow, re-connecting floodplains, and re-aggrading incised channels as the best strategies to mitigate the anticipated effects of climate change on salmonids. Protecting beaver populations in watersheds vulnerable to climate change may help buffer some of the effects of climate change by reconnecting the floodplain, slowing and storing water in the basin, extending summer flows and restoring perennial flows to some streams. Beaver ponds help recharge groundwater tables and increase interaction between surface and groundwater flows, often cooling the water downstream of beaver dams. Beaver restoration can be an effective solution for many types of climate related issues in aquatic and riparian ecosystems, and it is generally far less expensive than alternatives (Scheffer 1938, Fouty 2003, Müller Schwarze and Sun 2003).

Furniss et al. (2010) describe the most effective response to a changing climate as a renewed commitment to the principles and practices of sound watershed management, with the objective of maintaining or improving watershed resilience. Watershed vulnerability assessments can evaluate relative resilience to changing climate and help set management priorities. Vital signs of a resilient watershed include capture and storage of rainfall, recharge of groundwater reservoirs, minimization of erosion, regulation of stream flows, storage and recycling of nutrients, and provision of habitat for native aquatic and riparian species.

3.2.2 Roads

Roads are a pervasive feature throughout the ESU and reflect a legacy of land use activities. Nearly all populations that comprise the SONCC coho salmon ESU are affected by high road density, with some populations having greater than 10 miles of road per square mile. Roads are ranked as a high or very high threat in 35 of 40 populations in the ESU (Table 3-8, Chapters 7 to 46). Roads can affect salmon populations by blocking migration, through interrupting and disrupting natural drainage patterns, increasing peak flow (Ziemer 1998), and increasing stream bed and bank instability (Chamberlin et al. 1991, McIntosh et al. 1994). Roads have been shown to impact spawning habitat, channel form, sediment inputs, and prey production. Additionally, roads placed immediately adjacent to watercourses can affect coho salmon through the removal of riparian vegetation, floodplain disconnection, and non-point source pollution inputs. Armentrout et al. (1998) used a reference of 2.5 mi/mi^2 of roads as a watershed management objective to maintain hydrologic integrity in Lassen National Forest watersheds harboring anadromous fish. Cederholm et al. (1981) found that fine sediment in salmon spawning gravels increased between 260 to 430 percent over background levels in watersheds with more than 4.1 mi/mi^2. Although some roads have been decommissioned, there are still many miles of existing roads and maintenance is often lacking, leading to chronic impacts on habitat. Road building for access to marijuana cultivation sites is common on many areas of the SONCC coho salmon recovery domain. Many of these roads are likely unpermitted and contribute excessive amounts of fine sediment to coho salmon streams. Across the ESU, sediment from roads has contributed to decreased emergence survival, and reduced carrying capacity for juvenile salmonids due to the filling of pools, channel simplification, and reduced feeding and growth due to high turbidity levels. Landslides triggered from road building-related activities are large sources of sediment (Spence et al. 1996) and may create large scale episodic mass wasting events that can severely impact a year class. Cederholm et al. (1981) reported that the percentage of fine sediments in spawning gravels increased above natural levels when more than two and a half percent of a basin area was covered by roads.

In addition to contributing fine sediment, roads can also affect water quality through the addition of heavy metal, gas, oil and other pollutants deposited on roads and subsequently washed into streams (Sandahl et al. 2007). These pollution inputs are difficult to remedy since they come from a variety of sources and can be spread out along the entire road length. Many pollution inputs occur during the winter months, which may have an effect on embryo and alevin salmon life stages, further decreasing survival and altering reproductive success.

Despite recent efforts to address impacts associated with roads, there still remains inadequate funding for road maintenance and rehabilitation projects, inadequate regulations for maintenance and building on private roads, and a large number of existing problems associated with private and public roads throughout the ESU.

Plans Addressing Road Sediment

While management programs and plans that help alleviate effects from road development are lacking in many areas of the ESU, several counties within northern California have worked collaboratively to develop a comprehensive manual to guide road installation, maintenance, and remediation. To qualify their road programs under the applicable limit in NMFS' protective regulations promulgated under ESA Section 4(d) [4(d) rule; 50 CFR 223.203(b)(10)], Humboldt, Del Norte, Trinity, Siskiyou and Mendocino counties (Five Counties) collaboratively developed the "Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California Watersheds" (Five Counties Salmon Conservation Program 2002; hereafter referred to as "Manual"), which is based largely on the Oregon Department of Transportation (ODOT) Road Maintenance Handbook (ODOT 1999). The Manual includes design and construction guidelines and best management practices that minimize erosion and maintain or improve fish passage. This manual is the first to be developed in California and represents a collaborative effort in addressing road maintenance impacts on coho salmon. Since 1998, the Five Counties effort has assessed and prioritized 245 road crossings for repair or replacement, using the biological needs of salmonids as their main driving factor. This program has repaired or replaced 56 road culverts, improved or enabled access to 137 miles of fish habitat, and completed Road Erosion Inventories on over 2,000 miles of road (Five Counties Salmonid Conservation Program 2010). In 2007, NMFS approved the Five Counties' Manual under the 4(d) rule.

Similarly, ODOT's "Routine Road Maintenance Water Quality and Habitat Guide Best Management Practices" (ODOT 1999) is utilized across the state of Oregon to identify and implement measures, or best management practices, that minimize potential environmental impacts associated with ODOT activities. In California, the state transportation agency (Caltrans) utilizes the "Caltrans Storm Water Quality Handbook, and Construction Site Best Management Practices Manual" to provide contractors and Caltrans staff with detailed information of construction site best management practices (BMPs) to be used on state-managed roads.

Other important programs to address road-related sediment issues include the Northwest Forest Plan for land administered by U.S. Forest Service and Bureau of Land Management, the North Coast Regional Water Quality Control Board's regulation of private and state timber lands, and the Habitat Conservation Plans (HCPs) for lands managed by Humboldt Redwood Company, Green Diamond Resource Company, and Fruit Growers Supply Company. Information about these programs is included in Section 3.2.5 (Timber Harvest).

3.2.3 Channelization and Diking

NMFS identified stream channelization and diking as a threat to SONCC coho salmon at the time of listing and it remains a threat today in 26 of 40 populations in the ESU (Table 3-8, Chapters 7 to 46). Diking and channelization are especially prominent in the low-lying areas of most watersheds (Ricks 1995). Stream reaches have been channelized and diked to aid in the conversion of land from forest and riparian to agricultural, industrial, and urban land use. In nearly all the lowlands and estuaries within the ESU, the majority of historical floodplain and off-channel habitat have been diked for agriculture purposes and flood protection (Chapman and Knudsen 1980).

Diking leads to the direct loss of habitat through disconnection of channel, floodplain, and wetland habitat. The simplified channel disrupts normal hydrologic function, often increasing the velocity of the water and in turn displacing complex woody structures that provide important rearing habitat for juvenile coho salmon. Channelization and diking will often transition a complex channel containing pools, riffles, and side channels, into a single thread channel primarily dominated by riffle habitat. In the fall, juvenile coho salmon typically move from summer nursery areas to off-channel habitat such as side channels, ponds, and sloughs to rear in the winter (Brown and Hartman 1988; Nickelson et al. 1992). During the winter coho salmon also selectively inhabit deep pools with substantial accumulations of LWD (Bustard and Narver 1975; Murphy et al. 1984). Juvenile coho salmon seek these slow water habitats associated with complex channels to avoid being displaced by the high velocity flows in the mainstem channel during the winter. Quinn and Peterson (1996) found a positive correlation between reach scale complexity and the overall survival and body size of juvenile coho salmon. More recently, Sommer et al. (2005) found that salmonids that were able to access floodplain habitat in the winter increased in size substantially faster due to higher prey consumption, and that survival of fish released into floodplain habitat was higher than of those released into the main channel.

Channelization and diking disrupts natural hydrologic processes, leading to long term geomorphic changes to the stream channel. Levees and dikes reduce bank overflow and access to the floodplain. Because levees are designed to decrease the width of the flow, rivers respond by cutting deeper channels and reaching higher velocities (Poff et al. 1997). Natural erosion and floodplain deposition processes are prevented when the channel banks are hardened and restricted from overflow. Additionally, channel migration and formation of secondary channels is prevented in the channelized stream setting (Shankman and Drake 1990). Because channelization disconnects the channel from sloughs, wetlands, and the floodplain which could hold water that breaches the banks, the magnitude of floods can often be increased. The reduction in upstream water storage will result in accelerated water delivery downstream. Much of damage caused by flooding is a result of levee failures as rivers try to reestablish historical connections to the floodplain (Poff et al. 1997).

Water quality is often degraded due to the disconnection of stream channels from floodplain and wetland features. Channelized coastal plain streams were found to have higher nutrient concentrations than unchannelized streams due at least in part to loss of contact between flowing water and the riparian forests (Kuenzler et al. 1977). Wetlands can be characterized as nutrient sinks and, because most are hydrologically connected to other waters and wetlands, the loss of those wetlands has potentially negative impacts on the water quality of downstream systems. Richardson et al. (2007) found that a multi-phased restoration of a stream and its adjacent wetlands resulted in a significant reduction of downstream nutrients, coliform bacteria, and sediment. In addition, storm water nutrient budgets indicated a substantial attenuation of nitrogen and phosphorus after passing through the wetlands.

Many California and Oregon estuaries have been significantly reduced in size due to the construction of levees and irrigation canals. Estuaries constitute important rearing habitats and migration corridors for juvenile coho salmon, as described in Section 3.1.9 (Impaired Estuarine Function).

3.2.4 Agricultural Practices

Conversion of many lowland areas to agricultural use has greatly altered the form and function of streams and their riparian corridors. Irrigated agriculture and livestock grazing can negatively impact coho salmon habitat (Nehlsen et al. 1991) and can directly impact juvenile coho survival and fitness. Agricultural operations located immediately adjacent to watercourses and stream channels have degraded habitat and limited both water quality and quantity through the filling and diking of wetlands, installation of irrigation diversions, channelization, grazing in riparian areas, compaction of soils in upland areas, and indirectly through the use of pesticides and fertilizers (Botkin et al. 1995, Spence et al. 1996). A large proportion of estuaries and floodplains have been converted to agricultural land through the diking and filling of floodplain habitat (see section 3.2.3). The loss of these areas has had major impacts on the form and function of watersheds and their ability to support salmon, especially juvenile coho salmon, which require diverse, complex rearing habitats and floodplain connectivity. In the SONCC coho salmon ESU, Agricultural Practices ranks as a high or very high threat in 18 of 40 populations (Table 3-8, Chapters 7 to 46).

One of the major stresses associated with agricultural practices has been the removal of water from many streams for irrigation or stock watering, which has led to reduced stream flows in the summer and fall, including seasonal loss of surface flow in some streams. Water is the most essential component of fish habitat; without adequate water, coho salmon cannot survive. Water diversions can cause fragmented habitats and increase stream temperatures while impeding the geomorphological processes that maintain stream health (Cone and Ridlington 1996). Decreased water availability can create stressful situations for salmonids, and can decrease fitness and survival of juveniles rearing in areas with degraded water quality (Bjornn and Reiser 1991). For instance, water use in the Scott River Valley, California, has been associated with reductions in summer and fall base flows (Van Kirk and Naman 2008), which has been cited as a limiting factor in coho salmon production in this system (NRC 2004). Consumptive water use has also lowered the water table near affected streams, which has limited the ability of riparian plant species to proliferate and contributes to low flow barriers. In some areas, seasonal and permanent dams are constructed to provide water for agricultural operations and have resulted in altered stream function, migration barriers, changes in stream temperature, and temporary increases in sedimentation.

Agricultural practices can result in the degradation or elimination of riparian areas. Within many riparian areas, the vigor, composition, and diversity of natural vegetation are altered by livestock grazing and agriculture. This alteration has affected the ability of riparian areas to control erosion, provide stability to stream banks, and provide shade, cover, and nutrients to the stream (Mundy 1997). Soil compaction in riparian and upland areas has appreciably reduced soil productivity and caused bank and slough erosion (Bellows 2003). Bank damage can lead to channel widening, lateral stream migration, increased water temperature, and sedimentation (Scholz et al. 2000).

Agriculture is a key producer of non-point-source pollution in the form of nutrients and sediments, which can enter streams with runoff from livestock areas or cultivated fields, and agricultural chemicals. Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality in coho salmon streams.

Impacts of agricultural chemical use on coho salmon has been identified as a concern throughout the Pacific Northwest (Laetz et al. 2009); pesticides known to harm salmonids (NMFS 2008) are used within the SONCC coho ESU. For example, herbicide use has resulted in fish kills in the Rogue River basin, including juvenile coho salmon in Bear Creek in 1996 (Ewing 1999). The USEPA is currently consulting with NMFS Office of Protected Resources for the re-registration of 37 pesticide active ingredients that are commonly used in agricultural practices, urban landscaping, and forestry practices. To date, NMFS has completed six opinions addressing 27 active ingredient including organophosphate and carbamate insecticides, thiobencarb, and various herbicides and fungicides. Of these 27 pesticide ingredients with completed consultations, NMFS determined that the continued use of a third of those would jeopardize the continued existence of SONCC coho salmon. Reasonable and Prudent Alternatives (RPAs) were developed for the registration of the following chemicals: Naled, Phosmet, 2, 4-D, Carbaryl, Carbofuran, Methomyl, Chloropyrifos, Diazinon, and Malathion. RPAs include elements such as relabeling, application restrictions in windy conditions or prior to a precipitation event, necessary buffer zones around water bodies, reduced concentrations, reporting requirements for fish mortality, and the implementation of a monitoring program. In April 2013, the National Academy of Sciences' National Research Council released their recommendations for assessing risks from pesticides to listed species under the ESA and the Federal Insecticide, Fungicide, and Rodenticide Act. The USEPA, U.S. Department of Agriculture (USDA), USFWS, and NMFS are working collaboratively to review the report and identify improvements in the current scientific procedures used in evaluating the potential impacts of pesticides to endangered and threatened species. The Federal agencies will develop an implementation plan to provide a timeline and approach for responding to the panel's recommendations and implementing the appropriate revisions to these procedures and approaches. The plan is expected to be available to the public soon.

Agricultural Regulations

Historically, the impacts to fish habitat from agricultural practices have not been closely regulated. Oregon's Agricultural Water Quality Management Act, also known as Senate Bill 1010, was enacted in 1993 (requirements are currently codified at Oregon Revised Statutes 568.900 to 568.933), and is the basis for the Oregon Department of Agriculture's Agricultural Water Quality Program, which includes Agricultural Water Quality Management Area Plans (see Oregon Administrative Rules Chapter 603, Divisions 90 and 95). Although these plans are intended to reduce the impacts of agricultural practices on water quality, state water quality standards are still not met. The state of California does not have regulations that directly manage agricultural practices, but relies on the TMDL process to improve water quality from all applicable parties. See Section 3.1.2 for more information on the TMDL process. The TMDL process is one way that the federal government, through state agencies, is able to regulate the amount of pollutants and other contaminants that enter a watercourse.

Another more direct federal regulation is the registration of fertilizers and pesticides by the Environmental Protection Agency (USEPA). USEPA has established a program to monitor and regulate pesticides and other chemicals that may harm listed species (Washington State Department of Agriculture (WSDA) 2010). USEPA has accomplished this through the implementation of a pesticide registration and registration review program for a suite of chemical fertilizers used across the United States. USEPA's strategy is to address listed species concerns within the context of the pesticide Registration and Registration Review process. The intent of this program is to provide appropriate protection to listed species and their critical habitat from pesticides while avoiding unnecessary burden on pesticide users and agriculture (WSDA 2010). In order to address the ESA during the pesticide Registration and Registration Review process, USEPA developed the Endangered Species Protection Program (ESPP). The ESPP requires refinements to geographic and biological components of the ecological risk assessment as they apply to listed species. The USEPA may use Bulletins (described below) to mitigate risk to listed species either prior to initiation of consultation or as a mechanism to implement Reasonable and Prudent Alternatives (RPAs) and Reasonable and Prudent Measures (RPMs) identified through consultation with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service (WSDA 2010).

Once risks to listed species are identified through either the USEPA registration process or consultation with the NMFS and U.S. Fish and Wildlife Service, USEPA issues Endangered Species Protection Bulletins (Bulletins) that specify mitigation or protective measures. Bulletins describe specific geographic areas within individual U.S. counties where use limitations exist. When needed, Bulletins are referenced in pesticide label statements that inform users the product may harm a threatened or endangered species or their critical habitat (WSDA 2010). The use limitations specified in Bulletins are supplemental label language enforceable for the county specified.

3.2.5 Timber Harvest

Substantial timber harvest has occurred throughout the SONCC coho salmon ESU. Timber harvest is ranked as a high or very high threat in 20 of 39 populations in the ESU (Table 3-8, Chapters 7 to 46). In many of these populations, while timber harvest activity has decreased since the peak over 50 years ago, and practices and management have improved, the effects of future timber harvest continues to be a potential threat to coho salmon. In many streams, timber harvest in the riparian areas has resulted in reduced inputs of leaf litter, terrestrial insects, and large wood (Reeves et al. 1993, Nakamoto 1998). Reduction of large wood from the harvest of streamside timber has resulted in the reduction of cover and shelter from turbulent high flows (Cederholm et al. 1997). Numerous studies have identified impacts including reduced large woody debris, increased water temperature, and increased erosion and sedimentation. These impacts have been shown to impair the reproductive success of salmon due to increased turbidity, loss of interstitial spaces for use by juveniles, the smothering of eggs by fine sediments, loss of deep pools, and blockage of spawning habitat by landslides (Beschta and Taylor 1988, Beschta 1978, Brown and Krygier 1971).

The threat from future timber harvest lies in the inability of already degraded landscapes to rebound from continued impacts. If detrimental timber harvest (i.e., clear cutting, decreased age of trees removed) continues, cumulative effects and large scale, landscape-size issues may be perpetuated. In many populations of the SONCC coho salmon recovery domain, forest lands are likely being cleared and graded to create new marijuana cultivation sites. In most cases the land disturbance is not regulated, and likely contributes to excessive amounts of fine sediment in coho salmon streams. The continuation of these harmful timber harvest practices will result in decreased cover and reduced storage of gravel and organic debris, and will likely result in continued loss of pool habitat and a reduction in overall hydraulic complexity (CDFG 2002a).

By altering hydrology and slope stability, timber harvest can increase the amount of fine sediment delivered to streams and impair water quality. There is a strong relationship between the percent of a watershed harvested in the past 15 years and the duration of stream turbidity that exceeds thresholds of salmonid feeding impairment (Klein 2012). Timber harvest reduces the amount of precipitation intercepted by vegetation, resulting in increased peak flows during storm events (Grant 2008). Increased peak flows have only been detected during storms with a return period of 6 years or less (Grant 2008), and the effect diminishes over time as vegetation recovers (Keppeler et al. 2003). Long-term paired watershed studies in Caspar Creek on the Mendocino Coast, where road-related erosion is only a minor contributor to sediment, found that despite robust riparian buffer strips, increased peak flows induced by timber harvest increased gully erosion in small stream channels, expanding drainage networks and contributing significantly to suspended sediment yields (Reid et al. 2010). Timber harvest can also affect slope stability and increase the frequency of shallow landslides. Studies on the Oregon Coast found reduced root strength in clear cuts and industrial forests relative to old-growth conifer forests (Schmidt et al. 2001), and that shallow landslides tended to occur in localized areas with reduced root strength such as gaps in the root network between large trees or in areas lacking large trees (Roering et al. 2003).

One of the greatest continuing stresses from timber harvest is the residual effects of increased input of fine sediment into streams. This impact does not cease when timber harvest activities are complete, but instead continues a legacy of negative effects that begin anew during each winter storm event or high flow. Road building and other timber harvest activities have resulted in mass wasting and surface erosion that will continue to elevate the level of fine sediments in spawning gravels and fill the substrate interstices inhabited by invertebrates (Platts et al. 1989, Suttle et al. 2004). Changes in channel morphology will continue to alter the hydrology and timing of flows in areas affected by these chronic events. Bisson et al. (1997) estimated that, due to anthropogenic activities such as timber harvest, the frequency of major floods was 2 to10 times greater, debris flows and dam-break floods were 5 to 10 times more frequent, and slumps and earth flows were 2 to 10 times more frequent, compared to natural, background conditions. This increase in catastrophic events will likely continue to dramatically alter the conditions in which coho salmon spawn and rear and cause a reduction in food supply, reduced quality of spawning gravels, and an increased severity of peak flows during heavy precipitation. Additionally, the continued removal of riparian canopy cover from these events will result in increased solar radiation, which will create further increase in water temperature (Spence et al. 1996).

While harmful timber harvest practices have been shown to be detrimental to salmon populations, new timber harvest methods that promote stand diversity, thin overcrowded plantations, and help restore fire-damaged lands should be implemented to provide an active recovery for degraded systems throughout the ESU. Appropriate timber harvest will aid in the re-establishment of riparian vegetation, sediment storage, and stand diversity, all ecosystem characteristics that are beneficial to salmonid populations. When thinning, stands should be thinned from below (i.e., the largest trees should be left standing), and post-thinning densities of canopy conifers should generally not be less than 200 trees per acre, unless it can be demonstrated, using properly calibrated forest growth models (e.g., Forest Vegetation Simulator) that more intensive thinning is likely to increase long-term production rates of large dead wood. Trees > 50 cm diameter should not be cut for thinning purposes. Thinned trees should be felledon site and placed in streams and other water bodies, if possible, unless they would greatly increase fire hazard (dry forests only),

USFS Land Resource Management Plans and BLM Resource Management Plans

The Northwest Forest Plan (NWFP) is a comprehensive ecosystem management strategy for federally managed lands administered by the U. S. Forest Service (USFS) and Bureau of Land Management (BLM) within the range of the northern spotted owl (USFS and BLM 1994). Approximately 53 percent of the land area within the SONCC coho salmon ESU is managed under the NWFP. Over 70 percent of the land in the Trinity River basin is managed by the USFS, and within that area, about 85 percent is designated as critical habitat for SONCC coho salmon. Additionally, within the Six Rivers National Forest which is within the NWFP jurisdiction, there are four independent SONCC coho salmon populations, and public lands account for 75 percent of the population areas.

The Aquatic Conservation Strategy (ACS), a primary component of the NWFP, was designed to protect salmon and steelhead habitat on federal lands managed by the USFS and BLM by maintaining and restoring ecosystem health at watershed and landscape scales (NMFS 1997). Aquatic ecosystem elements embedded in the ACS include: maintenance of hydrologic function, high water quality, adequate amounts of coarse woody debris, complex stream channels that provide a diversity of aquatic habitat types, and riparian areas with suitable microclimate and vegetation. There are four primary components of the ACS: 1) Riparian Reserves, 2) Key Watersheds, 3) Watershed Analysis, and 4) Watershed Restoration. The ACS contains nine objectives that describe general characteristics of functional aquatic and riparian ecosystems, and these objectives are intended to maintain and restore good habitat in the context of ecological disturbance.

Some types of USFS and BLM Land Management Plans contain protective management direction, in some cases more protective than the ACS. With the intention of maintaining connected late-successional and old-growth ecosystems, a system of late-successional reserves and riparian reserves was delineated across federal lands and represents one of these more protective types of Land Management Plans. Late-successional reserves are large blocks of lands designed to maintain well-distributed habitat for the late-successional-dependent species. The riparian reserve network was intended to reverse habitat degradation for at-risk fish species or stocks, including coho salmon, and to serve a terrestrial function by providing a system of old forest structural elements to connect the late-successional reserves. Late-successional reserves provide increased protection for all stream types. Late-successional reserves and riparian reserves serve as core areas of high quality stream habitat, fish refugia, and centers from which degraded aquatic systems can be recolonized once they are restored.

The ACS, late-successional reserves, and riparian reserves are intended to prevent further degradation of aquatic ecosystems and restore habitat over broad landscapes (Lanigan et al. 2012). While the NWFP covers a very large area, the overall effectiveness of the NWFP in conserving Oregon and California coho salmon is limited by the extent of USFS and BLM federal land ownership, which is not uniformly distributed in watersheds within the ESU. However, where administered, the NWFP has made improvements on the landscape through better management of both timber harvesting and road maintenance and construction. A report by Lanigan et al. (2012) documented trends in watershed, riparian and upslope condition throughout the area of the NWFP. Ten percent of watersheds displayed a positive change in indicator categories, with these changes attributed to the combined effects of natural vegetation growth and road decommissioning. A greater proportion of positive changes in watershed condition occurred on late-successional reserve and matrix lands than on congressionally reserved lands (e.g., wilderness areas and national parks), which were already in good condition (Lanigan et al. 2012). Declines in watershed condition were seen in some areas, with declines attributed to the Biscuit Fire of 2002, and other fire complexes that occurred during the 15 years of the study. Overall road density changed only slightly across the area of the NWFP; however, dramatic changes were accomplished in targeted watersheds. For example, road density in Lower Fish Creek in the western cascades declined from 3.3 mi/mi^2 in 1994 to 0.8 mi/mi2 in 2008 through the decommissioning of 118 miles of roads (Lanigan et al. 2012). Overall, Lanigan et al. (2012) stated that road decommissioning in landslide prone areas provided the most benefits.

Although public lands tend to be located in the upper reaches of watersheds or river basins, upstream of the highest quality coho salmon habitat, Lanigan et al. (2012) documents that efforts made by both the USFS and BLM through the NWFP have begun to improve coho salmon habitat, and provided improved water quality conditions starting in headwater areas. In other areas, public lands are distributed in a checkerboard fashion, resulting in fragmented landscapes that are more difficult to improve.

State Forest Practices Acts

State forest practices acts in both Oregon (1971) and California (1973), along with their associated forest practice rules, were designed to promote the continuous economic activity of growing and harvesting forest trees while meeting federal and state environmental standards, rules, and regulations (e.g., CWA, ESA). The state forest practices acts and forest practice rules apply to all non-federal forestland, including private, state-owned and local government-owned forestlands. Because of the preponderance of private timberland and timber harvest activity in the range of this ESU, and potential adverse effects, careful consideration of state forest practices rules and regulations is prudent. At the time of listing, most reviews of the forest practice rules indicated that implementation and enforcement of these rules did not adequately protect coho salmon or their habitats (CDFG 1994, Murphy 1995, Ligon et al. 1999, IMST 1999). The state forest practices acts and forest practice rules in both Oregon and California are continually reviewed, and state regulatory agencies in Oregon and California receive recommendations for improved aquatic habitat protection. Neither has fully adopted recent recommendations, and both Oregon and California Forest Practices Acts are inadequate for the complete protection of salmon in the SONCC coho salmon ESU (NMFS 2009, Ligon et al. 1999). Although the California forest practice rules have a requirement for disapproval of timber harvest plans that would result in a ‘taking’ or finding of jeopardy for listed species (14 CCR § 898.2(d)), the rules do not explicitly describe the method for effectively implementing this requirement.

California Forest Practices

In 1997, at the time of the original listing of the SONCC coho salmon ESU (62 FR 24588, May 6, 1997), timber harvest was identified as a significant threat to the species and their habitat.

Specifically, NMFS identified inadequacies of the forest practice rules to address large wood recruitment, streamside tree retention, canopy retention standards, monitoring of timber harvest operations, and salvage harvesting. A scientific review panel was formed in November 1998 to evaluate the effectiveness of the California forest practice rules in protecting salmonid species and their habitat. The scientific review panel concluded that the forest practice rules, including their implementation process, do not ensure protection of anadromous salmonid populations (Ligon et al. 1999). One of the primary finding was that cumulative effects were not properly accounted for, suggesting the need for a watershed analysis approach.

In July 2000, The California State Board of Forestry and Fire Protection (BOF) adopted interim Threatened or Impaired Watershed Rules (T&I rules) to protect and restore watersheds with threatened or impaired values. The T&I rules were intended to minimize impacts to salmonid habitat resulting from timber harvest by requiring special management actions in watersheds where either state or federally listed threatened, endangered or candidate populations of anadromous salmonids are present or where they can be restored. Examples of special management actions required by the T&I rules include constructing watercourse crossings that allow for unrestricted fish passage, increasing large wood recruitment, and increasing soil stabilization measures. The T&I rules also require coordination between the California Department of Forestry and Fire Protection (CalFire) and the State and Regional Water Quality Control boards to minimize sediment discharge. The BOF never permanently adopted the T&I rules. Rather, the BOF readopted the T&I rules six times subsequent to 2000.

The T&I rules expired in December 2009, and the Anadromous Salmonid Protection (ASP) rules replaced them in 2010. The BOF's primary objectives in adopting the ASP rules were to: (1) ensure rule adequacy in protecting listed anadromous salmonid species and their habitat, (2) further opportunities for restoring the species' habitat, (3) ensure the rules are based on credible science, and (4) meet Public Resources Code (PRC) § 4553 for review and periodic revisions to the forest practice rules. NMFS staff have actively engaged and participated in BOF meetings and expressed concern to the BOF that the ASP rules, while resulting in some improvements to riparian protections, would not adequately protect anadromous salmonids until several inadequacies in the forest practice rules are addressed (NMFS 2009). Specifically, take of listed salmonids resulting from timber harvest operations in California could be minimized (but not entirely avoided) if the following protections were added to the existing ASP rules: (1) provide Class II-S (standard) streams with the same protections afforded Class II-L (large) streams, (2) include provisions to ensure hydrologic disconnection between timber management roads and streams, and (3) include provisions to avoid hauling logs on hydrologically connected roads during winter periods (NMFS 2009). In addition, NMFS believes the use of scientific guidance will provide additional limitations on the rate of timber harvest in watersheds to avoid cumulative impacts of multiple harvests, and provide greater protections to ensure the integrity of high gradient slopes and unstable areas. This may include limiting the areal extent of harvest in such areas.

ASP rules do not apply where the following plans, permits, or measures apply: an approved Habitat Conservation Plan (HCP) that addresses anadromous salmonid protection; a valid Incidental Take Permit (ITP) issued by CDFG; a valid Natural Community Conservation Planning (NCCP) permit approved by CDFG; or project revisions, guidelines, or take avoidance measures pursuant to a Memorandum of Understanding (MOU) or a planning agreement between the plan submitter and CDFG in preparation of obtaining a NCCP that addresses anadromous salmonid protection. ASP rules also do not apply to upstream watersheds where permanent dams block anadromy and reduce the transport of fine sediment downstream, or watersheds that do not support anadromy and feed directly into the ocean.

The California Forest Practice Rules (CalFire 2013) include an Article 6 on Watercourse and Lake Protection under the Coast, Northern, and Southern Forest District Rules subchapters. The section on Intent of Watercourse and Lake Protection (14 CCR §§ 916, 936, and 956) under this Article and each of these subchapters provides, in relevant part:

> The purpose of this article [6] is to ensure that timber operations do not potentially cause significant adverse site-specific and cumulative impacts to beneficial uses of water, native aquatic and riparian-associated species, and the beneficial functions of riparian zones; or result in an unauthorized take of listed aquatic species; or threaten to cause violation of any applicable legal requirements. This article also provides protective measures for application in watersheds with listed anadromous salmonids and watersheds listed as water quality limited under Section 303(d) of the Federal Clean Water Act.
>
> It is the intent of the BOF to restore, enhance and maintain the productivity of timberlands while providing appropriate levels of consideration for the quality and beneficial uses of water relative to that productivity. Protections include: guidelines for the removal of debris and soil, prohibition of road construction, prohibition of use of tractor roads, requirements to comply with TMDLs, objectives for streamside bank protection, riparian buffers, and providing appropriate shading.

NMFS is working collaboratively with the BOF to limit the effects of forestry operations on threatened and endangered salmonid populations in California, including the SONCC coho salmon ESU. At this time, however, the effects of present timber harvest activities in California continue to pose an ongoing threat to the ESU.

Oregon Forest Practices

At the time of listing, the Oregon Forest Practices Act (OFPA), modified in 1995 and improved over the previous OFPA, did not have implementing rules that adequately protected coho salmon habitat. In particular, the OFPA did not provide adequate protection for the production and introduction of large wood to medium, small and non-fish-bearing streams. Since the listing of SONCC coho, the Oregon Plan for Salmon and Watersheds (Oregon Executive Order 99-01; 1999) directed the creation of the Forest Practices Advisory Committee to help the Oregon Board of Forestry assess forest practices changes that may be needed to meet state water quality standards and protect and restore salmonids. As of 2003, draft water protection rules and non-regulatory recommendations based on the recommendations of Forest Practices Advisory Committee had been developed, but had not been adopted by the Board of Forestry. A review of OFPA and forest practice rules (IMST 1999) showed the regulations in place may be ineffective at protecting water quality and promoting riparian function and structure, especially in small- and medium-sized streams. In their review of the forest practice rules, the Oregon IMST found that one of the greatest shortcomings of the current rules is that they are dominated by site- and action-specific strategies which, taken together are insufficient for recovering habitat of listed stocks of salmonids (Everest and Reeves 2007). Everest and Reeves (2007) report that current forest practice rules in the Pacific Northwest represent improvements over their preceding rules, but continued change and evolution of the forest practices rules is of vital interest.

Though significant improvements have been made to the current rule package, the Oregon Forest Practice Rules represent the least conservative forest practice regulations administered by the state governments within the SONCC coho salmon ESU. Some riparian areas may be protected by narrow, no-harvest zones; however, the stands located upslope of the no-harvest zones could be subject to intense harvest, leading to diminished riparian function and cumulative effects to anadromous salmonid habitat. In a 2010 status review of Oregon Coast (OC) coho salmon, NMFS concluded that the Oregon Forest Practices Act does not adequately protect OC coho habitat in all circumstances. In particular, disagreements persist regarding: (1) whether the widths of riparian management areas (RMAs) are sufficient to fully protect riparian functions and stream habitats; (2) whether operations allowed within RMAs will degrade stream habitats; (3) operations on high-risk landslide sites; and (4) watershed-scale effects. On some streams, forestry operations conducted in compliance with this act are likely to reduce stream shade, slow the recruitment of large woody debris, and add fine sediments. Since there are no limitations on cumulative watershed effects, road density on private forest lands, which is high throughout the range of this ESU, is unlikely to decrease under the Oregon Forest Practices Act (NMFS 2009).

Other State Regulatory Mechanisms

Additional mechanisms designed to protect aquatic habitat and species have been put in place to provide further review prior to timber harvest. For example, all Timber Harvest Plans (THPs) on private land must be submitted to CalFire. CalFire distributes the THPs to state and federal reviewing agencies including CalFire, CDFW, the California Regional Water Quality Control Board, NMFS, and the California Geological Survey. Filed THPs are open to public comment. Pre-harvest inspections occur at the proposed harvest site, and recommendations and changes are made to the THP prior to approval by the CalFire director, who takes into account BOF rules, the review teams recommendation, and public comment. Finally, CalFire Unit Forest Practice Inspectors periodically inspect the timber harvest operation to ensure compliance with the approved THP and all laws and regulations.

In addition to their role as a reviewer of THPs, CDFW permits certain activities associated with timber harvest such as road building, which may require Lake and Stream Bed Alteration Agreements when stream crossings are present. CDFW ensures that all activities comply with the California Endangered Species Act and California Environmental Quality Act. The Regional Water Quality Control Boards (Regional Water Boards) are active in regulating discharges from timber harvest and associated activities. The Regional Water Boards are responsible for enforcing the Porter-Cologne Water Quality Act that restricts the discharge of materials that adversely affect the beneficial uses of the waters of the State. The Regional Water Board issues permits, referred to as Waste Discharge Requirements (WDRs) and Waivers of WDRs, which establish conditions or requirements to control discharges of waste to waters of the State. Discharges associated with timber harvesting activities typically include sediment from erosion and/or increased water temperature from loss of riparian canopy.

Habitat Conservation Plans

Habitat conservation plans (HCPs), Natural Community Conservation Plans (NCCP), and other landscape scale plans, which contain robust monitoring programs and adaptive management elements, have enhanced management of private timberlands in northern California. The monitoring conducted by those engaged in such landscape plans is essential to evaluate whether populations of SONCC coho salmon and their habitat remain viable as management occurs over time. These plans allow for meaningful adjustments in the event that the goals or objectives of the plans are not being achieved. NMFS has approved three private timberlands HCPs within the range of SONCC coho salmon.

The Humboldt Redwood Company (HRC) HCP (formerly Pacific Lumber Company [PALCO] HCP) covers approximately 210,000 acres of industrial timberlands in northern California and includes activities related to timber management, forest road construction and maintenance, and rock quarrying (PALCO 1999). The HCP was finalized in 1999 and is valid through 2049. The major watersheds covered by the HRC HCP include portions of Freshwater Creek, Elk River (in Humboldt Bay Tributaries population), Eel River, Van Duzen River, and the Mattole River. The HRC HCP is habitat-based, having a defined goal of achieving or trending towards properly functioning aquatic conditions. An Aquatics Conservation Plan (ACP) was developed within the HCP with a defined goal to maintain or achieve, over time, properly functioning aquatic habitat conditions. The key variables in the ACP are water temperature, canopy cover, sediment, instream large wood, large wood recruitment, pool frequency, and pool quality. The HRC HCP relies heavily on watershed analysis, monitoring, and adaptive management tools to ensure achievement of habitat goals. HRC has agreed to assess all roads and associated sediment sources on its lands and stormproof all high- and medium-priority sites at a rate of 75 miles per year. As part of the HCP, HRC conducts monitoring for the Best Management Practices Evaluation Program, compliance monitoring, and effectiveness monitoring. Specifically, parameters such as large wood debris levels, water temperature, and in-stream sediment levels are monitored. This type of monitoring is the basis for evaluating the results of carrying out prescriptions on the features or processes that occur on the hill slope and the in-stream environment. The monitoring and effectiveness studies provide for the adaptive management component of the HCP.

Finalized in 2006 and valid through 2056, the Green Diamond Resource Company Aquatic Habitat Conservation Plan (AHCP) applies to approximately 410,000 acres in coastal northern California. This AHCP includes portions of all coastal coho salmon population areas from the Oregon border south to, and including, the Eel and Van Duzen rivers (GDRC 2006). The Yurok Tribe assumed responsibility for and holds an AHCP and ITP for 22,000 acres of the original 410,000 AHCP (Yurok Tribe and GDRC 2011).

The biological goals and objectives of the GDRC AHCP reflect in biological terms the intended result of the operating conservation program (GDRC 2006). The five goals of the AHCP are to: 1) maintain cool water temperature temperatures for aquatic species covered by the AHCP, 2) minimize and mitigate human-caused sediment inputs, 3) provide for the recruitment of large woody debris for instream habitat, 4) maintain or increase amphibian species across the landscape, and 5) monitor and adapt the plan as new information becomes available to provide those habitat conditions as needed to optimize conservation measures that benefit the covered species. Objectives that identify measurable parameters for each goal have also been set and are described in the plan.

Green Diamond describes the conservation benefits of the AHCP as follows (GDRC 2006):

> In addition to the measures to avoid or address specific impacts, the plan includes measures to improve conditions for the covered species and/or their habitats. These additional measures provide a level of mitigation that exceeds the anticipated impacts of taking. Examples include the road decommissioning and upgrading measures (and the accelerated implementation of the measures) and the LWD recruitment measures. Green Diamond also believes that the plan as designed provides for a significant improvement in the habitat conditions for all covered species within the plan area in all HPAs [Hydrographic Planning Areas]. In particular, the Road Management Measures will significantly accelerate the recovery of stream conditions negatively impacted by sediment, and other measures will provide similar improvements of habitat conditions.
>
> The extra measures supply added assurance that a sufficient level of conservation is being provided to address any concern about the sufficiency of any particular measure to address the extent of a particular type of impact. Furthermore, the improvement in conditions that will result from these measures exceeds that needed to meet the ITP [Incidental Take Permit] "minimize and mitigate" standard and will contribute both to the recovery of the ITP species and to efforts to preclude the need to list the ESP [Enhancement of Survival Permit] species.

As part of a conservation program within the AHCP, Green Diamond will remove 50 percent of the high and moderate priority road sites within the first 15 years of plan implementation. These measures, coupled with provisions for riparian protection, mass wasting avoidance, and adaptive management, ensure that adverse impacts to coho salmon rearing, migration, and spawning habitats are minimized, avoided or mitigated. Effectiveness monitoring will track the success of the Conservation Program in relation to the AHCP's biological goals and objectives and provide the basis for the AHCP's Adaptive Management Measures. Four categories of monitoring will be implemented: 1) rapid response monitoring, 2) response monitoring, 3) long-term trend monitoring/research, and 4) experimental watersheds program. Monitoring thresholds will trigger management responses when exceeded.

The Fruit Growers Supply Company (FGSC) HCP covers over 150,000 acres of industrial timberlands in Siskiyou County and includes activities related to timber management and forest road construction and maintenance (FGSC 2012). The plan was finalized in 2012 and is valid through 2062. The timberland covered under the HCP exists primarily in the Upper Klamath watershed, including Scott Valley and portions of Cottonwood Creek. It is the intent of the FGSC HCP to promote hydrologic and forest conditions that contribute to a larger regional recovery strategy for covered species. The four biological objectives of the Aquatic Species Conservation Program included in the HCP are: (1) Protect hydrologic and riparian processes that influence water quality, aquatic habitat, and riparian functions; (2) Maintain a high level of stream shading that contributes to cool water temperature regimes that are consistent with the requirements of the individual Covered Species; (3) Provide for the recruitment of LWD into streams so as to maintain and allow the development of functional stream habitat conditions; (4) Minimize and mitigate human-caused sediment inputs; and (5) Monitor to ensure compliance and effectiveness of the aquatic protection measures for providing those habitat conditions needed to meet the general goals that benefit the Covered Species (FGSC 2012). Specific targets for sediment control include a 50 percent reduction of road-related erosion delivery potential within the first 10 years of the Permits (FGSC 2012)

3.2.6 Urban/Residential/Industrial Development

Substantial development and urbanization has contributed to habitat impairment throughout the ESU. Development ranks as a high or very high threat in 13 of the 40 populations of the SONCC coho salmon ESU (Table 3-8, Chapters 7 to 46). Although most of the range of the SONCC coho salmon ESU is considered to be rural, there are three highly urbanized population centers. The Humboldt Bay and Yreka areas in California and the Medford/Grants Pass area in Oregon all have urban centers with high percentages of impervious surfaces that contribute to the degradation of habitat and coho salmon viability. Development and urbanization often leads to degraded habitat through stream channelization, floodplain disconnection, damage or loss of riparian and wetland areas, point and non-point source pollution, bank hardening, and consumptive water use (Botkin et al. 1995). When watersheds are developed, natural vegetative ground cover is removed and/or replaced by impervious surfaces or structures, water infiltration is reduced, and runoff from the watershed is flashier, with increased flood hazard (Leopold 1968). Flood control and unnatural drainage patterns may concentrate runoff, resulting in increased bank erosion, which causes an additional loss of riparian vegetation and undercut banks, and eventually causes widening and down cutting of the stream channel. Streams that are channelized and/or diked frequently lack native riparian vegetation and provide little coho salmon habitat value.

In developed areas, point-source and nonpoint-source pollution are common. Sediments washed from urban and industrial areas often contain trace metals such as copper, cadmium, zinc, and lead (California State Lands Commission 1993, Sandahl et al. 2007). An acute example of this phenomenon is when toxic storm water runoff from urban and industrial sources led to high pre-spawn mortality of adult coho salmon in tributaries to Washington's Puget Sound (Booth et al. 2006). Improperly maintained underground septic systems in residential areas can leach bacteria and nutrients into the water table. One significant emerging issue is the input of pharmaceuticals, endocrine disruptors, and personal care products to the watershed, products that are not effectively removed in standard treatment processes (Sumpter and Johnson 2005). These products, together with pesticides, herbicides, fertilizers, gasoline, and other petroleum products, contaminate drainage waters and harm juvenile coho salmon and their aquatic invertebrate prey (Crisp et al. 1998, Flaherty and Dodson 2005). The North Coast Regional Water Quality Control Board (NCRWQCB 2001) reported that non-point-source pollution is the cause of 50 to 80 percent of impairment to water bodies in California.

Additionally, the magnitude of peak flow and pollution increases with increased total impervious area (TIA; e.g., rooftops, streets, parking lots, sidewalks). Spence et al. (1996) recognized that channel damage from urbanization is clearly recognizable when TIA exceeds 10 percent, and that reduced fish abundance, fish habitat quality and macroinvertebrate diversity are seen with total impervious area levels from 7 to 12 percent (Klein 1979, Shaver et al. 1995). May et al.

(1997) showed almost a complete simplification of stream channels as total impervious area approached 30 percent and measured substantially increased levels of toxic storm water runoff in watersheds with greater than 40 percent total impervious area. Booth and Jackson (1997) found that total impervious area greater than 10 percent caused increased peak flows, decreased base flows, simplified channel conditions, increased non-point-source storm water pollution, and resulted in a loss of aquatic system function.

Urban Growth Management

Urban growth management in both Oregon and California has some significant shortcomings that prevent the full protection of coho salmon habitat. Inside Oregon's urban growth boundaries, some upgraded riparian area protection was afforded under the Oregon Coastal Salmon Restoration Initiative (The Oregon Plan; State of Oregon 1997) and local governments amended their local comprehensive county general plans to implement these new requirements. Unfortunately, this goal only provides general guidance and does not require establishment and protection of riparian vegetation and wetlands. Buffer widths or types for riparian and wetlands are not included in these guidelines, resulting in insufficient stream bank and riparian vegetation protection, and continuing to allow for the degradation of coho salmon habitat. Rapid population growth in California has caused harm to coho salmon and their habitat and may constitute a reason to evaluate urban growth management practices and their effectiveness at protecting SONCC coho salmon.

County and city planning in both Oregon and California (Mendocino, Humboldt, Siskiyou, Trinity, Del Norte, Lake, Curry, Josephine, Jackson, and Klamath counties) benefit from the development and implementation of comprehensive general plans that include some protective measures for fish and wildlife species and habitat. The Humboldt County General Plan helps to sustain and enhance water resources throughout Humboldt County. Through its policies and standards, the General Plan is an effective tool to ensure that any new development occurs without damaging water resources on an individual and cumulative basis. The Plan also serves to guide the County in its interaction with neighboring counties, state, and federal agencies and lawmakers and guides the County's activities and commitment of resources. The plan includes a water resources element, which addresses water planning issues including river and stream water quality, stormwater runoff, groundwater management, water needs of fish and wildlife, water consumption, conservation and re-use methods, and state and federal regulations. The goals of the water resources element include: high quality and abundant surface and groundwater water resources that satisfy the water quality objectives and beneficial uses; river and stream habitat capable of supporting abundant salmon and steelhead populations and sufficient water flows; support of salmon and steelhead recovery plans, recreation activities, and the economic needs of river dependent communities; and no additional upper or mid-level watershed exports from rivers flowing through the county. Siskiyou County also has a comprehensive General Plan that works towards protection of water quality, ecosystem processes and the natural environment.

3.2.7 High Severity Fire

Fires provide for many ecological functions including recycling woody and detritus fuels, preparing mineral seed beds, facilitating vegetative reproduction, and reducing understory vegetation (Stephens and Fry 2005). Fire has always been an important part of the disturbance process in the western United States (Bisson et al. 2003). Recent findings support the notion that fire can also be a valuable restorative tool because it has the capacity to increase physical and biological diversity and can support the maintenance of complex and productive aquatic habitats (Reeves et al. 1995; Benda et al. 2003; Bisson et al. 2003). Frequent yet dispersed surface fires were once a dominant fire regime in many forests. That regime has been altered throughout the ESU range due to the loss of Native American ignition sources, implementation of fire suppression policies starting in the 1930s, and other changes brought about by Euro-American settlement and land-use (Brown 2007; Scanlon 2007;). High severity fire is ranked as a high or very high threat in 9 of the 40 populations in the ESU (Table 3-8, Chapters 7 to 46).

Low severity fires are beneficial to coho salmon habitat because they burn on the ground and remove many of the smaller trees and shrubs, while leaving the larger, more fire resistant trees (Minshall 2003). This type of fire dampens fuel loading and forest vegetation crowding, while potentially boosting invertebrate production (Minshall 2003). High severity fires, on the other hand, refer to severe surface burns or crown fires that result in the creation of an entirely new stand (stand replacing fire; Agee 1998). High severity fires threaten aquatic organisms via direct physical effects, such as mortality from rapid increases in temperature and accumulation of toxic chemicals, and indirect effects, such as habitat destruction, reduced extent and connectivity of habitat, and the temporary reduction or elimination of food resources (Rieman et al. 2012, Reeves et al. 1995). Fires pose the greatest threat to coho salmon in terrestrially dry, inland areas where high severity fire naturally occurs. Many watersheds have experienced a change in their fire regime due to past land use, drought and climate change (Fried et al. 2004).

High severity fire may cause significant changes to the ecosystem, including: alteration of soil structure, such as increased hydrophobicity (water repellency) and iron oxidation; increased air and water temperatures as a result of tree canopy mortality; white ash deposition and charred organic matter; and the consumption of the soil organic layer and surface litter of all sizes (Turner et al. 1994; Ryan 2002). Fire severity is an important indicator of the potential for water runoff and erosion (Robichaud et al. 2000; Keeley 2009) and hydrophobic soils have been linked to floods and increased erosion (Rieman et al. 2012). Snow pack and water retention are also reduced in denuded areas, which affects the hydrology of the basin (Minshall 2003). Instream wood typically declines immediately after fires due to fire consumption, and declines may be significant if a large portion of the riparian vegetation (including debris jams) is burned completely, or if remaining wood is transported out of the stream system during periods of elevated flows (Rieman et al. 2012). Fire in upslope areas can lead to increased soil erosion and sediment delivery, which may result in stream aggradation, pool filling, and in extreme cases landsliding, debris torrents, or other forms of mass wasting (Elder et al. 2002). Population level implications of wildfire appear to depend on longer-term processes, and there are no known examples of population extirpation associated with the immediate effects of wildfires (Rieman et al. 2012).

Catastrophic fires are known to fully expose riparian areas, which may temporarily increase water temperatures through the loss of riparian shading (Dwire and Kauffman 2003, Minshall 2003, Spencer et al. 2003). Riparian plants have evolved a tolerance to disturbance and ability to rapidly recover following fires, as evidenced by epicormic and basal sprouting as well as strategic seed dispersal adaptations (Reeves et al. 2006). In some cases, water temperature changes can become permanent if a fire initiates a transition to vegetation types that are better suited to a warming climate (Isaak et al. 2010, Rieman et al. 2012). For example, if riparian vegetation transitions from mature native trees to herbaceous non-native species as a result of fire, and the conversion is amplified by climate change, then the pre-fire mesic (cool, wet) conditions may never be restored due to intense competition and eventual displacement.

According to a report completed by the Intergovernmental Panel on Climate Change, climate in the western United States is projected to warm substantially before the end of this century (Young 2012). Climate variability affects fire occurrence, with more frequent and larger fires associated with warmer, drier regimes (Bisson et al. 2003). Higher temperatures, reduced snowpack, and earlier spring snowmelt all contribute to the frequency, intensity, and extent of fires. Combined effects of climate change and fire places populations at even greater risk of extirpation during or shortly after a severe fire. The reduction in habitat connectivity, reduction of refugia, and lack of shading from stand-replacing fires in the riparian zone may threaten already reduced numbers of coho salmon. Subsequent increases in water temperature may result in areas becoming uninhabitable for cold water species (Young 2012). Many watersheds have experienced a change in their fire regime due to past land use, drought and climate change (Fried et al. 2004). The probability of large fires (more than 500 acres) might increase by more than 75 percent in areas within the Klamath and Smith River basins, with increases of 50 percent predicted throughout the inland areas of Northern California and Southern Oregon (Luers et al. 2007). However, active forest management through thinning second growth stands, creating fuel breaks, and completing controlled understory burns has reduced the potential threat of catastrophic fire in some areas by increasing the number of fire resistant stands (Pollet and Omi 2002).

3.2.8 Mining and Gravel Extraction

Currently, mining within the SONCC coho salmon ESU is primarily in the form of instream gravel mining, placer mining, suction dredging and upslope hardrock mining. The greatest threat from instream gravel mining is the alteration of channel morphology and hydraulic processes that alter the quantity and quality of instream habitat (e.g., pools and riffles) (Kondolf 1997). The greatest threat from upslope mining is the increased potential for chemicals, sediment or other types of contaminants to enter watercourses. Threats from placer mining and suction dredging include the rearrangement or destabilization of substrate and subsequent changes to macroinvertebrate assemblages (Kondolf and Wolman 1993). Mining and gravel extraction are listed as a high or very high threat in five populations of 40 SONCC coho salmon populations (Table 3-8).

Gravel extraction has the potential to impact channel form, sediment delivery, and hydrologic functions in a river or stream (Brown et al. 1998). The severity of this threat is primarily dependent on the location of activity, the intensity, and the types of methods used. Instream gravel mining affects habitat primarily through the removal of gravel from the top of gravel bars by skimming. Lowered bars result in unstable riffles that scour redds, wider and shallower channels that present migration barriers, and simplified habitat with fewer pools for juvenile rearing and adult holding (Kondolf and Swanson 1993). Extensive mining for sand, gravel, construction aggregate and gold in a stream’s floodplain and channel can create major habitat impacts already exacerbated by flow regulation in systems such as the Trinity River, Mad River, and Eel River. Flow reductions and the associated reduction in sediment transport into a regulated, mined system can modify a stream's geomorphological and hydrological processes. These modifications can result in very limited gravel recruitment and sediment transport (Kondolf 1997). With altered hydrologic and geomorphological processes, remaining salmonid spawning gravel is immobile and susceptible to compaction and/or armoring. When armoring occurs, the potential salmonid habitat becomes unavailable for salmonid production. Furthermore, mining tailings often leave much of the floodplain perched. These impacts, coupled with channel incision due to the sediment and hydrograph budget modification, can further reduce the availability of needed rearing habitat. Armored banks from remaining dredge tailings do not allow lateral channel migration, accelerating channel scour further decoupling the river from its floodplain and potentially eroding remaining spawning gravel (Brown et al 1998, Kanehl and Lyons 1992, Kondolf 1997). Instream gravel mining is regulated at the federal, state, and county levels in California and Oregon. Federal laws and regulations that apply in both states include permitting under Section 404 of the Clean Water Act (administered by the Army Corps of Engineers), the General Mining Law of 1872, the Federal Land Policy and Management Act (FLPMA), and ESA section 7 and implementing regulations requiring consultation on issuance of federal permits or other federal agency actions that may affect listed species or critical habitat.

Hydraulic mining (placer and suction dredging) can have a negative effect on habitat quality and lead to direct mortality through entrainment of eggs and offspring and the disturbance and alteration of streambed substrate (Griffith and Andrews 1981). Seasonal protections to minimize these effects have been effective by limiting the timing of permitted suction dredging to when eggs and larvae will not be entrained. Material is often deposited into tailing piles, creating unnatural channel formations and flows. The persistence of such features is variable and the impacts can be seasonal and site-specific or long-term and widespread. Tailings piles are unstable and egg-to-fry survival was found to be reduced for Chinook salmon that spawn in tailings (Harvey and Lisle 1999), a finding that likely also applies to coho salmon. Lode or hard-rock mining in upland areas has the potential to unearth contaminants, which can eventually make their way into tributary and river systems.

Placer mining has the potential to alter riparian areas, damage instream habitat, and input fine sediment and pollutants. Past placer mining has damaged some riparian areas to the point where future recruitment of vegetation is impossible. Additional threats from placer mining include removal of riparian vegetation leading to long-term increases in water temperature and lack of wood recruitment, potential water diversions, potential streambank failures and increased sediment. When stream channels are changed or sediment concentrations are increased through placer mining, it can affect benthic invertebrates in the stream. Their populations can decline, or the species types may change and these changes can place stress on fish populations (Wagener and LaPerriere 1985). Results showed that placer mining caused increased turbidity and increased amounts of settleable solids and suspended sediments. These effects were correlated with decreased density and biomass of invertebrates (Wagener and LaPerriere 1985).

Federal Regulations

The Bureau of Land Management (BLM) has primary responsibility for administering the laws and regulations regarding the removal of all minerals from all federally owned lands. The BLM's statutory authority here is derived from the General Mining Law of 1872, as amended (30 U.S.C.

§ 21 et seq.), the original public land authority in 43 U.S.C. §§ 2, 15, 1201 and 1457, and FLPMA (43 U.S.C. 1701 et seq.). These statutes, together with the implementing regulations (43 CFR Parts 3710-3870) generally make up the body of the mining law system. Most Federal agencies have regulations to protect the surface resources of Federal lands during exploration and mining activities. In addition, CWA section 404 and Army Corps of Engineers (Corps) implementing regulations require a permit from the Corps for placement of material, impoundments, or other control of water in waters of the United States.

California Regulations

In California, state requirements include the need to obtain a Streambed Alteration Agreement from CDFW, and compliance with the Surface Mining and Reclamation Act (SMARA). SMARA is implemented by each individual county through the issuance of Conditional Use Permits. For suction dredging, new regulations in California including special closed areas, closed seasons, and restrictions on methods and operations have been developed to minimize and prevent negative impacts from mining operations. These new regulations are in place to help protect habitat, but careful monitoring of mining activity must occur to ensure that there is compliance.

In August 2009, all California instream suction dredge mining was suspended following enactment of state law SB 670 (Wiggins),which prohibits the use of vacuum or suction dredge equipment in any California river, stream or lake regardless of whether the operator has an existing permit issued by CDFW. The moratorium does not apply to suction dredging operations performed for the regular maintenance of energy or water supply management infrastructure, flood control, or navigational purposes. While CDFW was in the process of completing a court-ordered environmental review of its permitting program, a new state law, AB 120, was enacted to extend the moratorium until June 30, 2016. Two other specifications of AB 120 are that any "new regulations fully mitigate all identified significant environmental impacts." and that the suction dredge permit fees be increased to fully fund all of CDFW's costs for administrating the suction dredge program.

Oregon Regulations

The State of Oregon has a number of mining regulations. Many state prohibitions exist, and most public lands are off-limits to exploration or development of mining claims. The Oregon Department of Environmental Quality requires issuance a permit before mining can begin. Operating an in-stream suction dredge and discharging the resultant wastewater requires a national pollutant discharge elimination system (NPDES) General Permit 700-PM. Persons assigned to the NPDES 700-PM permit must not operate a suction dredge more than 16 horsepower or with an inside diameter intake nozzle greater than four inches in essential salmon habitat. Suction dredging is allowed only during the in-water work schedule to protect fish and wildlife resources (ODFW 2008c), and measures must be taken to prevent the spread of invasive species. Suction dredging is prohibited on any stream segment that is listed as water quality limited for sediment, turbidity, or toxics on the list published by ODEQ. Mining must not cause any measureable increase in turbidity in selected wilderness and reserve areas. A measureable increase in turbidity is measured as visible turbidity. Performing small-scale, non-chemical off-stream placer mining adjacent to a waterway requires a Water Pollution Control Facility (WPCF)

General Permit 600, which prohibits discharge of wastewater generated by the operation to the waters of the state. These permit requirements were set in place to protect and preserve fish and wildlife species inhabiting the waterways of the state of Oregon (Oregon Division of State Lands 1999). In July 2013, Senate bill 838 passed the Oregon legislature and included several measures to better protect Oregon streams from suction dredging, including an increase in permit fees to cover the cost of a more rigorous permitting and enforcement program and a limit of 850 permits. Under the Senate bill, the state is required to draft new protective measures by the end of 2014 with an implementation date of 2015. If new measures are not implemented, a five year moratorium will go into effect in January of 2016.

Oregon state law currently restricts equipment size, nozzle diameter, and suction speed and efficiency. In the SONCC coho salmon ESU, as of June 1998, portions of the Rogue, Illinois, and Elk rivers, as well as areas of the North Fork of the Smith River are closed to mineral entry except for federal mining claim holders working within valid claims under approved Plans of Operations. While these prohibitions and requirements help curtail mining activities, illegal mining has been recently documented in the SONCC coho salmon ESU (e.g., Preusch 2009, Learn 2011).

National Marine Fisheries Service Gravel Extraction Guidance

In 2005, the 1996 NMFS National Gravel Extraction Policy was revised and reissued as the NMFS National Gravel Extraction Guidance (Hogarth 2005). The revised Gravel Guidance includes updated information, recommendations and references that can provide meaningful assistance to NMFS staff and other managers involved in regulatory activities were gravel mining in or near streams may affect anadromous fishes and their habitat. The guidance document is meant to be adaptable and address regional needs and local physical and biological settings.

Recommendations in the guidance are as follows: 1) upland aggregate sources, terraces and inactive floodplains be used preferentially to active channels, their deltas and floodplains. 2) pit excavations located on the adjacent floodplain or terraces should be preferentially sited outside the channel migration zone, and as far from the stream as possible. NMFS recommends pits be separated from the active channel by a bugger designed to maintain this separation for several decades, 3) larger rivers and streams by used preferentially to small rivers and streams, 4) braided river systems be used preferentially to other river systems, 5) instream gravel removal quantities be strictly limited so that gravel recruitment and accumulation rates are sufficient to avoid prolonged impacts on channel morphology and anadromous fish habitat, 6) gravel bar skimming be allowed only under restricted conditions, 7) prior to gravel removal, a thorough review of sediments and point and non-point sources of contaminants be conducted, 8) removal or disturbance of instream roughness elements during gravel extraction activities be avoided, and that those that are disturbed be replace or restored, 9) gravel extraction operations be managed to avoid or minimize damage to stream/river banks and riparian habitats, 10) cumulative impacts of gravel extraction operations to anadromous fishes and their habitats be addressed by the Federal, state, and local resource management and permitting agencies and be considered in the permitting process, 11) an integrated environmental assessment, management, and monitoring program be a part of any gravel extraction operation, and encouraged at Federal, state, and local levels, 12) mitigation be an integral part of the management of gravel extraction projects, and 13) gravel extraction projects proposed as stream restoration activities be regarded with caution.

3.2.9 Dams and Diversions

Dams and diversions are among the most significant threats to SONCC coho salmon populations. Permanent dams are almost always associated with water control features for flood control, municipal or agricultural water uses, and/or hydropower operations. Temporary dams are usually built for recreational or agricultural purposes on private land. Many dams are associated with water diversions. Dams and diversions can be potential barriers to fish passage, and if diversions are not screened, fish can be entrained and die. In addition, dams and diversions can alter stream flows (Magilligan and Nislow 2005), sediment transport (Graf 2006), channel morphology (Ligon et al. 1995), water quality (USDOI and CDFG 2012), and food webs (Power et al. 1996). These changes can lead to reduced survival and production of coho salmon. NMFS analyzed stream flow, precipitation, water use, reservoir storage, and Geographic Information Systems (GIS) data to calculate a series of quantitative indicators, which were then used in conjunction with other information to inform professional judgments of the magnitude of the threat of dams and diversions for each coho salmon population and life stage (Asarian 2014). NMFS ranked dams and diversions as a high or very high threat in 18 of 40 populations (Table 3-8, Chapters 7 to 46).

Dams and diversions alter the hydrologic regime by shifting the timing and magnitude of flow. The hydrologic effects of dams vary according to factors such as management objectives (e.g., flood control, hydropower, summer water supply, and/or conservation of aquatic resources), the volume of the reservoirs relative to stream flow, and the location of dams within the hydrologic network. Large dams often reduce the magnitude and frequency of high flow events, and reduce differences between annual minimum and annual maximum flows (Graf 2006). The primary purpose of most large dams within the SONCC coho salmon ESU is to store water from high flows in the fall, winter, and spring so that it can be used for irrigation and municipal supply during the low-flow summer months. This can affect coho salmon by reducing flows when juveniles and smolts are migrating downstream in spring and adults are returning in the fall to spawn. While large reservoirs generally have greater hydrologic impacts, if a large number of small reservoirs are present they can act cumulatively to substantially alter the hydrology, particularly at the start of the rainy season (Deitch et al. 2013); however this phenomenon likely affects only a very small portion of the SONCC coho salmon ESU. Both juveniles and adults use flow events as migratory cues and depend on natural flow regimes for migration and access to habitat. Additional information on the hydrologic effects of dams and diversions is provided in Section 3.1.7 (altered hydrologic function).

Dams also impede the geomorphological processes that maintain stream health (Ligon et al. 1995). By halting recruitment of coarse sediment from upstream (Kondolf 1997) and decreasing the frequency and magnitude of bed-mobilizing flows, dams simplify channels and degrade salmonid habitat (Ock and Kondolf 2012, Ligon et al. 1995). Re-establishing flow regimes that mimic the natural hydrograph has the potential to reduce the detrimental effects of dams on geomorphology, fish habitat, and riparian vegetation (USFWS and HVT 1999, Burke et al. 2009).

Dams and diversions can also degrade water quality. As discussed in section 3.1.7 , water diversions can deplete stream flows and increase summer water temperatures. By stagnating water and exposing it to solar radiation, shallow reservoirs can increase summer water temperatures (Spence et al. 2006). In contrast, deeper reservoirs that stratify and release water from their depths can provide an important source of cold water during the summer, such as occurs at dams on the Trinity and Rogue rivers. When nutrient-rich water is impounded, reservoirs can host prolific summer blooms of blue-green algae that degrade downstream water quality, such as occurs on the mainstem Klamath River (USDOI and CDFG 2012). As human population growth continues, the number of water diversions increase and threaten SONCC coho salmon populations. For example, recent investments in residential water storage have significantly reduced summer water withdrawals in areas such as the headwaters of the Mattole River (Klein 2012).

An emerging threat to SONCC coho salmon is water diversion related to marijuana cultivation. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer, S., pers. comm. 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer, S., pers. comm. 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (Humboldt Growers Association 2010).

Permanent and seasonal dams can be partial or complete barriers to coho salmon migration. For example, dams completely block access to more than 15 percent of potential coho salmon habitat in the following populations: Upper Rogue River (16%), Shasta River (18%), Upper Klamath River (43%), Upper Trinity (47%), and Upper Mainstem Eel River (80%) (Asarian 2014). Recent dam removal projects throughout the ESU have allowed for improved passage in the Rogue River, and efforts towards installing fish screens have significantly decreased impacts to salmonids. For example, many diversions in the Shasta basin now have CDFG- and NMFS-approved fish screens, and Scott Valley has 100 percent of the diversions located in coho habitat screened to reduce impacts to SONCC coho salmon.

Recent efforts in the Klamath Basin have brought about the creation of the Klamath Basin Hydroelectric Settlement Agreement (KHSA) and the Klamath Basin Restoration Agreement (KBRA). The KHSA describes the process for conducting necessary additional studies, environmental reviews, and a decision by the Secretary of Interior (Secretarial Determination) as to whether removal of the lower four dams on the Klamath River owned by PacifiCorp 1) will advance restoration of the salmonid fisheries of the Klamath Basin, and 2) is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes. The KHSA includes provisions for the interim operation of the dams prior to dam removal as well as the process to transfer, decommission, and remove the dams if the Secretarial Determination is affirmative. The KHSA establishes 2020 as the target date for dam removal. This timeline allows for completion of necessary environmental and regulatory reviews and the collection of $200 million for dam removal from PacifiCorp customers if the Secretarial Determination is affirmative.

The KBRA is a settlement agreement among many diverse parties that creates a solid path forward on long-standing, resource disputes in the Klamath Basin. The KBRA takes a multi-dimensional approach that resolves complex problems by focusing on species recovery while recognizing the interdependence of environmental and economic problems in the Basin's rural communities. The goals of the KBRA are to 1) restore and sustain natural production and provide for full participation in harvest opportunities of fish species throughout the Klamath Basin; 2) establish reliable water and power supplies that sustain agricultural uses and communities and National Wildlife Refuges; and 3) contribute to the public welfare and the sustainability of all Klamath Basin communities. The key negotiated outcomes of the KBRA include mutually-beneficial agreements for the Klamath, Karuk, and Yurok Tribes not to exercise water right claims that would conflict with water deliveries to the Bureau of Reclamation's Klamath Project water users and for project water users to accept reduced water deliveries. As a result, there would be more support for fisheries restoration programs, greater certainty about water deliveries at the beginning of each growing season, and agreement and assurances that certain of the parties will work collaboratively to resolve outstanding water-right contests pending in the Oregon Klamath Basin Adjudication process. In addition, the KBRA includes an Off-Project voluntary Water Use Retirement Program in the Upper Basin, three restoration projects intended to increase the amount of water storage in the Upper Klamath Basin, regulatory assurances, county and tribal economic development programs, and tribal resource management programs. Copies of the KHSA and KBRA in their entirety are available electronically at: http://klamathrestoration.gov/. The implementation of these two agreements will be a significant step forward in restoring fish populations in the Klamath River Basin, once a stronghold for SONCC coho salmon.

Several timber companies have developed HCPs that include improved water diversion practices. These activities will help to reduce the impact of these diversions on the SONCC coho salmon landscape. The HCPs are described in Section 3.2.5.

Federal and State Acts and Water Allocation

Federal statutes that include provisions relevant to instream flow protection include the ESA, CWA, National Environmental Policy Act (NEPA), and the Federal Power Act.

Given the lack of federal regulatory authority over instream flow in many areas and waterbodies, state water laws are the primary mechanism for protecting instream flow in many areas. In the SONCC coho salmon ESU, the states of Oregon and California are charged with allocating and adjudicating water quantities to qualified users, as well as enforcing water rights.

Oregon's water rights system is based primarily on the doctrine of prior appropriation, although some form of riparian water rights still exist (Oregon Water Resources Department [OWRD] 2009) and instream flow rights can be established through water right purchase or lease. Surface and groundwater use in Oregon is administered by the OWRD, which is responsible for implementing Oregon's water policy.

Oregon was one of the first western states to recognize instream flow as a beneficial use. In 1955, the state adopted minimum stream flows to support aquatic life through administrative rules, and in 1983 amendments were adopted that authorized ODFW, ODEQ, and the Oregon

Department of Parks and Recreation to apply for minimum instream flow rights. In 1987 and 1993, further amendments strengthened instream flow rights, allowing for transfers and for the use of water markets to acquire instream flow rights (OWRD 2009). Instream flows for particular watersheds can be found under the relevant "basin program" (e.g., Rogue Basin Program contains Rogue tributaries) here: http://www.oregon.gov/owrd/pages/law/oar.aspx.

State resource managers in Oregon have also attempted to protect and conserve instream flows, and promote water conservation, through the implementation of voluntary programs for private water users. The allocation of conserved water program, administered by OWRD, allows a water user who conserves water to use a portion of the conserved water on additional lands, lease or sell the water, or dedicate the water to instream use. The program is intended to promote the efficient use of water to satisfy current and future needs, both out of stream and instream. Oregon's instream leasing program is also designed to provide a voluntary means to aid the restoration and protection of stream flow. This arrangement provides water users with options that protect their water rights while leasing water for instream benefits. The success of this program is largely dependent on the participation of landowners and therefore the program may be unable to meet the instream flow needs of coho salmon populations in some areas.

In Oregon, a permit is generally necessary to use water from any source, including underground. Certain activities are exempt from this requirement (e.g., stock watering, watering lawns or noncommercial gardens, domestic, industrial, or commercial purposes) (OWRD 2009). Groundwater withdrawal has a cumulatively substantial effect on the amount of water available in streams (Barlow and Leake 2012). Groundwater withdrawal works together with the removal of water through surface water rights to alter availability of water at low flows. The analysis of altered hydrologic function in this document, which describes the amount and timing of water availability, finds it ranks a high or very high stress for many Oregon populations (see Chapters 7-9, 12-14, and 30-32).

Responsibility for water allocation and use enforcement in California is shared among several agencies. California courts have jurisdiction over the use of percolating ground water, riparian use of surface waters, and the appropriate use of surface waters initiated prior to 1914 (California Department of Water Resources [CDWR] 2001). The State Water Resources Control Board (SWRCB) is responsible for the water rights and water quality functions of the state (CDWR 2001). The SWRCB has the jurisdiction to issue permits and licenses for appropriation of water from surface and underground streams. This board also has the authority to declare watercourses fully appropriated. Many of the streams and rivers in the California portion of the ESU have been deemed to be fully appropriated by the SWRCB (SWRCB 1998). A declaration that a stream system is fully appropriated means that the supply of water in the stream system is being fully applied to beneficial uses, and the SWRCB has determined that no water remains available for appropriation. From and after the date of adoption of a declaration that a stream system is fully appropriated, and subject to subdivision b of California Water Code section 1206, the SWRCB shall not accept any application for a permit to appropriate water from the stream system and the board may cancel any application pending on that date.

Table 3-9. Stream systems declared fully appropriated by the SWRCB.

County	Stream	Tributary to	Critical Reach
Del Norte County	Smith River	Pacific Ocean	refer to Section 5093.54 of California Wild and Scenic Rivers Act for specific critical reaches
	Jordan Creek	Lake Earl	from the confluence with Lack Earl upstream
Humboldt County	Eel River	Pacific Ocean	the main stem from 100 yards below Van Arsdale Dam to the Pacific Ocean
	Klamath River	Pacific Ocean	from the main stem about 100 yards below Iron Gate Dam to the Pacific Ocean
	South Fork Eel River	Eel River	the south fork of the Eel from the mouth of Section Four Creek near Branscomb to the river mouth below Weott
	South Fork Trinity River	Trinity River	from the junction of the river with State Highway Route 36 to the river mouth near Salyer
	Trinity River	Klamath River	the main stem from 100 yards below Lewiston Dam to the river mouth at Weitchpec
	Van Duzen River	Eel River	from Dinsmore Bridge downstream to the river mouth near Fortuna
	Jacoby Creek	Humboldt/Arcata Bay	from the confluence of Jacoby Creek and Humboldt/Arcata Bay upstream
	Mad River	Pacific Ocean	from the mouth of the Mad River at the Pacific Ocean upstream
Mendocino County	Middle Fork Eel River	Eel River	from the intersection of the river with the southern boundary of the Middle Eel-Yolla Bolly Wilderness Area to the river mouth at Dos Rios
	North Fork Eel River	Eel River	from the Old Gilman Ranch downstream to the river mouth near Ramsey
	Mill Creek	Middle Fork Eel River	from the SE corner of Section 16, T22N, R12W, MDB&M where the accretion flow comes into Mill Creek upstream
Siskiyou County	North Fork Salmon River	Salmon River	from the intersection of the river with the south boundary of the Marble Mountain Wilderness Area to the River mouth
	Scott River	Klamath River	from the mouth of Shackleford Creek west of Fort Jones to the river mouth near Hamburg
	Wooley Creek	Salmon River	from the western boundary of the Marble Mountain Wilderness Area to its confluence with the Salmon River
	French Creek	Scott River	from the confluence of French Creek and the Scott River upstream
	Scott River	Klamath River	at the U.S. Geological Survey located on the Scott River near Fort Jones upstream

County	Stream	Tributary to	Critical Reach
Siskiyou County	Shackleford Creek	Scott River	from the confluence of Shackleford Creek and the Scott River upstream
	Willow Creek	Klamath River	from the York Bridge Road located within Section 8, T46N, R5W, MDB&M, upstream
	Seiad Creek	Klamath River	from the confluence of Seiad Creek and the Klamath River upstream
	Shasta River	Klamath River	from the confluence of the Shasta River and the Klamath River upstream
	Shasta River	Klamath River	from the confluence of Willow Creek located within Section23, T44N, R6W, MDB&M upstream
	McKinney Creek	Klamath River	about 1 1/2 miles downstream from the point of diversion on McKinney Creek upstream
	East Fork of SF of the Salmon River	Salmon River	at a point on the East Fork of South Fork Salmon River located within T39N, R10W, (Shadow Creek Campground(upstream
	Douglas Creek	Klamath River	from a point on Douglas Creek located within the NE1/4, Section 19, T15N, R7E, MBD&M upstream
Trinity County	New River	Trinity River	from the intersection of the river with the southern boundary of the Salmon-Trinity Primitive Area downstream to the river mouth near Burnt Ranch
	North fork Trinity River	Trinity River	from the intersection of the river with the southern boundary of the Salmon-Trinity Primitive Area downstream to the river mouth at Helena
	Mule Creek	Trinity River	from Clair Engle Lake upstream

The CDWR is responsible for planning the use of state water supplies and consults with the California Water Commission to develop rules and regulations for this purpose (CDWR 2001). The vast majority of California's groundwater is unregulated and the state does not have a comprehensive groundwater permit process to regulate ground water withdrawal. The lack of groundwater regulation has led to overutilization of this resource, which has had major impacts on surface flow and constitutes a major shortcoming of California water law.

In 1991, California adopted changes to its water laws that permitted the transfer of existing consumptive water rights to the purpose of instream flow through either purchase or lease. When a new water use permit application is submitted, the State Water Board (Board) must notify CDFW, which has the authority to recommend amounts of water necessary to preserve fish, wildlife, and recreation in the affected stream. The Board then considers these recommendations and may set instream flow requirements as conditions for the new permit. In this way, current flows can be protected even though new appropriations for instream flow rights are prohibited (California Environmental Protection Agency 2011).

Other efforts to protect instream flows include the adoption of California Water Code section 1259.4, and the adoption and use of Section 1707. California Water Code section 1259.4

addresses the draft guidelines that CDFG and NMFS (2002) presented to the SWRCB for maintaining instream flows downstream of water diversions in mid-California coastal streams. The draft joint guidelines call for limiting new water diversions to only the winter period from December 15 to March 31, establishing bypass flows for new dams, establishing a cumulative maximum rate of withdrawal, and restricting construction of new on-stream dams. Water transfers for dedicated instream uses are accomplished through Section 1707. An instream flow dedication under Section 1707 allows a water user to transfer all or a portion of any water right to instream uses – for example, designating that such conserved water must remain in the watercourse for the benefit of aquatic habitat. It is available to owners of either riparian or appropriative water rights, and can be crafted for either short-term (less than a year) or long-term duration. These transfers may be used to ensure that water flows downstream to satisfy any applicable federal, state, or local regulatory requirements governing water quantity, water quality, instream flows, fish and wildlife, wetlands, recreation, and other instream beneficial uses.

In November 2009, the California State Legislature passed a series of bills that encourage stricter groundwater monitoring and enforcement of illegal diversions, more ambitious water conservation policy, and water recycling and conservation programs. If effectively implemented, these California water bills should contribute to improved instream habitat in the future.

Instream Flow Requirements

Many rivers within the SONCC coho salmon ESU contain large dams. Dam operators at most of these dams have regulatory mandates to maintain adequate instream flows for the protection of fish and wildlife species. Examples of dams with flow requirements include J.C. Boyle, Copco 1, Copco 2, and Iron Gate dams on the Klamath River; Trinity and Lewiston dams on the Trinity River; R.W. Matthews Dam (Ruth Lake) on the Mad River, and Scott Dam (Lake Pillsbury) in the Eel River. Large dams lacking instream flow requirements include William L. Jess Dam (Lost Creek Reservoir) on the Rogue River, Applegate Dam on the Applegate River, and Dwinnell Dam on the Shasta River.

On the Trinity River, the Bureau of Reclamation is required to release between 369,000 and 815,000 acre feet to the Trinity River annually depending on the water year type. Discharge from Lewiston Dam remains at 450 cubic feet per second (cfs) during the summer months, 300 cfs during the winter months, and has a variable flow regime in the spring depending on the water year type.

The total volume of water impounded and diverted by the Humboldt Bay Municipal Water District (HBMWD) represents a small percentage of the natural yield of the Mad River watershed. The Mad River's average annual discharge into the Pacific Ocean is just over 1,000,000 acre-feet (available at http://www.hbmwd.com/water_supply). Ruth Lake, in its entirety, represents less than 5 percent of the total average annual runoff from the Mad River basin. The entire 48,030 acre-feet capacity of Ruth Lake is not drawn down each year, so the amount of winter-season runoff captured in the reservoir is yet a smaller percentage of the total runoff. With respect to diversions, the current withdrawal rate at Essex is approximately 25 to 30 MGD (28,000 to 34,000 acre-feet per year), which is only 3 percent of the total annual average runoff of the Mad River watershed (available at http://www.hbmwd.com/water_supply). The full diversion capacity of 75 MGD (84,000 acre-feet per year) is just 8 percent of the total annual average runoff of the watershed.

From 1992 to 2004, up to approximately 160,000 acre-feet of Eel River water was annually diverted into the East Fork of the Russian River for hydropower production and agricultural uses. From 2007-2012 the Potter Valley Project annually diverted approximately 22% of the estimated unimpaired flow at the point of diversion (i.e., Cape Horn Dam), with an average diversion of 77,000 acre-feet (Kubicek, P., pers. comm. 2013). Until 2004, flows released downstream of Cape Horn Dam were approximately 3 cfs during most of the summer. In 2004, the Federal Energy Regulatory Commission issued an order requiring Pacific Gas and Electric (PG&E) to implement an instream flow regime consistent with the Reasonable and Prudent Alternative in the NMFS (2002b) Biological Opinion. The new flow requirement increased the minimum Cape Horn Dam release flows and incorporated within-year and between-year variability. Minimum flows are dependent on a number of factors and formulas, including cumulative inflow into Lake Pillsbury, current and previous water year, and time periods.

Habitat Conservation Plans

Finalized in 2012 and valid through 2022 except under certain circumstances, the PacifiCorp's Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for Coho Salmon (dated February 16, 2012) (PacifiCorp 2012) addresses the impacts of PacifiCorp's Klamath Project on coho salmon. The goals of PacifiCorp's HCP are to:

- Offset biological effects of blocked habitat upstream of Iron Gate dam by enhancing the viability of the Upper Klamath coho salmon population;
- Enhance coho salmon spawning habitat downstream of Iron Gate dam;
- Improve instream flow conditions for coho salmon downstream of Iron Gate dam;
- Improve water quality for coho salmon downstream of Iron Gate dam;
- Reduce disease incidence and mortality in juvenile coho salmon downstream of Iron Gate Dam;
- Enhance migratory and rearing habitat for coho salmon in the Klamath River mainstem corridor; and
- Enhance and expand rearing habitat for coho salmon in key tributaries.

These goals are accompanied by specific biological objectives and measures, which are detailed in the HCP.

Finalized in 2004 and valid through 2054, the Humboldt Bay Municipal Water District's Habitat Conservation Plan (HBMWD 204) addresses the impacts of HBMWD's Mad River operations on coho salmon, Chinook salmon, and steelhead. Activities covered under the HCP include:

- Flow release and management activities;
- Diversion activities in the Essex Reach of the Mad River;
- Maintenance activities, including repair of existing structures if damaged; and
- Periodic excavation and fill activities.

The primary benefit to coho salmon described in the HCP is augmented baseflow in the Mad River during the dry season.

3.2.10 Invasive/Non Native/Alien Species

Invasive or non-native alien species pose a high or very high threat to seven of 40 populations in the SONCC coho salmon ESU (Table 3-8, Chapters 7 to 46). Sacramento pikeminnow are prevalent throughout much of the Eel River basin and have recently been discovered in Martin Slough, a tributary to Elk River in Humboldt Bay; and brown trout have been observed in the Upper and Lower Trinity River (CDFG 1997, Waters 1983, Dewald and Wilzbach 1992, Wang and White 1994, McHugh and Budy 2006). Both species reduce native coho salmon populations by increasing competition for food resources, increasing predation on juveniles, and utilizing less than desirable water quality conditions to flourish and become more abundant, out-competing native salmonids. The effects of these species are explained under Section 3.1.4 (increased disease, predation, and competition). Additionally, recent reports have shown that the New Zealand mud snail has been observed in Redwood Creek (Benson, K., pers. comm. 2010), although little if any information exists on the effects that these animals have on local salmonids.

Reed canary grass is an invasive non-native perennial grass that was not identified as a threat at the time of SONCC coho salmon federal listing. The grass prohibits native riparian growth, chokes stream channels, provides poor to non-existent habitat for fish and other native aquatic wildlife, inhibits the mobility of fish at lower flows, increases sedimentation, contributes to low levels of dissolved oxygen, and causes overbank flooding during winter and spring base flow conditions (Miller et al. 2008). Over 150 adult unspawned coho salmon were found dead in a field dominated by reed canary grass, likely stranded by the dense reed canary grass when high flows receded quickly in an ill-defined channel (Carrasco 2000). The invasive grass is found throughout southern Oregon and northern California and is a threat to SONCC coho salmon and their habitat. Overall, the threat of reed canary grass has increased since the last status review.

Some basins in the SONCC coho salmon ESU, including Hunter, Strawberry, and Norton/Widow White creeks, have extensive residential development in their lower floodplains and riparian areas. In these areas, it is likely that invasive plant species will spread from residential landscaping into riparian areas, particularly if there are pre-existing gaps in the riparian vegetation. Some of these species could impede restoration of riparian forests and wetlands. The extent to which this has already occurred is unknown.

3.2.11 Hatcheries

Hatcheries can pose a significant threat to populations where they occur in the SONCC coho salmon ESU. As discussed in Section 3.1.1, hatcheries and the introduction of hatchery fish into wild populations can have direct and indirect effects on wild, native fish populations. More information regarding hatcheries can be found under adverse hatchery related effects in the above-mentioned stress section.

3.2.12 Fishing and Collecting

Fisheries Harvest Management

Significant changes in fisheries harvest management have occurred in recent decades, resulting in substantial reductions in harvest of SONCC coho salmon. Currently, fishing-related incidental mortality of SONCC coho salmon occurs primarily from hooking and handling in Chinook-directed commercial and recreational fisheries off the coasts of California and Oregon. Incidental hooking and handling mortality occurs in the mark-selective hatchery coho salmon fishery in the Rogue River, and also in Chinook and steelhead-directed fresh water fisheries in both Oregon and California

In establishing fishing seasons and regulations each year, the Pacific Fishery Management Council (PFMC) considers the potential impacts on various ESA-listed stocks within the region. Because there are no data on exploitation rates on wild SONCC coho salmon, Rogue and Klamath (R/K) hatchery stocks have traditionally been used as a fishery surrogate stock for estimating exploitation rates on SONCC coho. The annual coho salmon exploitation rate averaged approximately 5% from 2000 to 2013, with a maximum exploitation rate of approximately 10% in 2003 to a low of 1.6% in 2008. California's statewide prohibition of coho salmon retention maintains consistently low impacts from freshwater recreational fisheries on SONCC coho salmon.

Collection for Research Purposes

NMFS authorizes scientific collection activities through ESA section 10(a)(1)(A) research permits and ESA section 4(d) programs. The authorized activities must not operate to the disadvantage of the listed species and must provide a bona fide and necessary or desirable scientific purpose or enhance the propagation or survival of the listed species. In addition, NMFS must determine whether the scientific collection is likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. These provisions ensure the threat from collection activities is low for all populations.

More information about the effects of fishing and collecting can be found in Section 3.1.10.

3.2.13 Inadequate Regulatory Mechanisms

Inadequate regulatory mechanisms were identified as a factor when SONCC coho salmon were listed in 1997, and the problems associated with these regulations continues to hinder salmon recovery. The set of regulatory mechanisms that will govern recovery of this species span a full range of protective strengths and weaknesses and provide a varying degree of protection for populations in the SONCC coho salmon ESU. Since 1997, many regulatory mechanisms that were originally cited as being inadequate have been strengthened in their ability to protect coho salmon and their habitat. In addition, many new management plans and programs have been implemented that either directly or indirectly benefit coho salmon. However, because of the lack of coordination in implementation and management, some regulations are not fully implemented or monitored for compliance and therefore do not provide adequate, or even minimal protection. In addition, there is an overall lack of regulations to fully address the range and magnitude of current and future threats to recovery. As discussed below, the regulatory landscape in which recovery will take place has both strengths and weaknesses in terms of its ability to protect and restore SONCC coho salmon and habitat.

Although some of the current land and resource management policies in place are specifically designed to protect SONCC coho salmon and their habitat (e.g., Federal and State Endangered Species Acts), many are designed for other purposes and only indirectly protect the species (e.g., state forest practice rules). Several federal and state land management regulations and acts have been enacted to protect and preserve public lands for current and future public use, and to ensure that these lands are held in good condition, and species utilizing these lands are protected to ensure continued survival. Additionally, many federal and state regulations and acts aid in the protection of private lands and also work towards the protection of salmonids and other species not protected under state and federal laws for public lands. These regulatory mechanisms are in place to control and regulate mining activities, timber harvesting, instream dredging and construction, and urban growth. Many aspects of these regulations are regulated and monitored by both Federal and State agencies, and may apply to both public and private lands in both Oregon and California. Several inadequate regulatory mechanisms identified in the final rule listing the SONCC Coho Salmon ESU (62 FR 24588, 24596-24598; May 6, 1997) are discussed elsewhere in this chapter: Northwest Forest Plan (Section 3.2.5), State Forest Practices (Section 3.2.5), Water Quality Programs (Section 3.1.2), State Agricultural Practices (Section 3.2.4), Harvest Management (Section 3.2.12), and Hatchery Management (Section 3.2.11).

Dredge, Fill, and In-water Construction Programs

The Army Corps of Engineers (ACOE) regulates removal/fill activities under section 404 of the Clean Water Act (CWA) (see http://www.epa.gov/OWOW/wetlands/laws/). When listing the SONCC coho salmon ESU under the ESA, NMFS noted that ACOE did not have a method to adequately assess the cumulative effects in issuing permits for removal/fill activities under CWA section 404 (62 FR 24588, 24596; May 6, 1997). Although currently the ACOE requires an evaluation of cumulative impacts from these permits, the effectiveness of such evaluations at preventing cumulative impacts is unknown. Similarly, the section 401 water quality certification program, which is regulated by the states of California and Oregon, applies only to activities that require a federal permit or license (i.e., 404 permit or FERC license, respectively). Because the 401 certification requirements depend on the initiation of the 404 permitting or FERC licensing process, the 401 program also does not address exclusively upland activities. Therefore, the lack of review and jurisdiction for upland activities limits the ability of the 404 and 401 regulatory programs to provide adequate protection for coho salmon and its habitat.

California Endangered Species Act

In 2005, the state of California listed coho salmon between Punta Gorda and the Oregon border as threatened. The California listing protects coho salmon from direct take, and helps to ensure that projects or activities that have incidental adverse effects to coho salmon are reviewed and take is mitigated. In connection with the California state listing, a coho salmon recovery strategy was formally approved and adopted by the California Fish and Game Commission on February 4, 2004 (CDFG 2004a). The recovery strategy includes over 700 conservation recommendations covering a wide variety of land use activities, and over 200 more related to agricultural practices within the Scott and Shasta rivers, tributaries to Klamath River. To facilitate implementation, the CDFG has integrated the recovery strategy with the Fisheries Restoration Grant Program (FRGP). Currently the recovery plan is being implemented throughout the California portion of the ESU and a 5-year progress report is under development. Limited funding and staff have impacted the state's ability to fully implement the plan in recent years.

Federal Endangered Species Act Protections

The major provisions of the Endangered Species Act of 1973, as amended,16 U.S.C. § 1531 et seq., set forth eligibility and procedural requirements for listing species as endangered or threatened, provide protections for those listed species, require Federal agencies to ensure that their actions are not likely to jeopardize listed species or result in the destruction or adverse modification of their designated critical habitat without special exemption, and create a framework for cooperation with states to conserve listed species and their habitat. The most direct mechanism for protection under the ESA is the section 9 take prohibition. Section 7(a)(1) makes it clear that Federal agencies must utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered species and threatened species. Although Federal agencies have an affirmative obligation to conserve, an agency's 7(a)(1) actions are discretionary and priorities are often obligated to other management objectives.

Section 7(a)(2) states, in part, "[e]ach Federal agency shall, in consultation with and with the assistance of the Secretary [of Interior or Commerce, as appropriate], insure that any action authorized, funded, or carried out by such agency…is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical] habitat of such species...unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section." Since the time of listing, NMFS has conducted over 1,000 consultations on the effects of Federal actions on SONCC coho salmon and their critical habitat, including major projects on the Rogue, Trinity, Klamath, and Eel rivers. Interagency consultation, including technical assistance and section 7 consultations (both informal and formal) have often reduced or eliminated adverse effects to SONCC coho salmon, their designated critical habitat, or both.

Section 10(a)(1)(B) of the ESA allows NMFS to issue permits to non-Federal parties for incidental take of listed species, as long as, among other requirements, the impacts of the taking are minimized and mitigated to the maximum extent practicable and the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild. Neither section 7(a)(2) consultations nor section 10 permits are intended to require Federal agencies or permit holders to contribute to the recovery of listed species. However, in section 7(a)(2) consultations and in issuance of section 10(a)(1)(B) permits, the action or taking must not appreciably reduce the likelihood of survival and recovery of the listed species in the wild. Further, in biological opinions, NMFS frequently provides discretionary conservation recommendations, which, if implemented, would assist the action agency in meeting its section 7(a)(1) responsibilities.

Whenever a species is listed as threatened under the federal ESA, section 4(d) authorizes the Secretary to issue regulations as he deems necessary and advisable to provide for the conservation of such species, including taking prohibition or limitation of the taking prohibition for certain identified activities.

3.2.14 Ocean Conditions

Poor ocean conditions have played a prominent role in the decline of coho salmon in California and Oregon and will greatly influence the ability to recover SONCC coho salmon. In general, coho salmon marine survival is about 10 percent (Bradford 1995), although there is a wide range in survival rates (from less than one percent to about 21 percent) depending upon population location and ocean conditions (Beamish et al. 2000, Quinn 2005). Marine survival and successful return as adults to spawn in natal streams is critically dependent on an individual's first few months at sea (Peterman 1982, Unwin 1997, Ryding and Skalski 1999, Koslow et al. 2002). In addition, large smolts have higher ocean survival than small smolts (Bilton et al. 1982, Henderson and Cass 1991, Lum 2003, Quinn 2005, Jokikokko et al. 2006, Muir et al. 2006). In addition, larger smolts produce larger adults (Lum 2003, Henderson and Cass 1991), which have higher fecundity than smaller adults (Weitkamp et al. 1995, Fleming 1996, Heinimaa and Heinimaa 2004).

The ocean upwelling process (and resulting productivity) is important to the growth and survival of juvenile salmonids in the upwelling zone off the west coast (Nickelson 1986; Fisher and Pearcy 1990; Pearcy 1992; Logerwell et al. 2003). Two aspects of upwelling are of greatest importance to juvenile salmonids during their first summer at sea: the strength of upwelling (Nickelson 1986) and the starting date of the upwelling season, also called the date of spring transition (Logerwell et al. 2003). Upwelling-supported zooplankton production correlates well with juvenile salmon survival (Ruzicka et al. 2011).

For Pacific salmon, the conditions of the waters in the California Current are a key to understanding ocean survival. Differences from year to year in both the source of waters that feed the California Current and the volume of water transported each year seem to be controlled by the phase of the Pacific Decadal Oscillation (PDO) (Jacobson et al 2012). The PDO is a spatial pattern in sea surface temperature seen across the entire Northern Pacific Ocean. When the PDO was first described by Mantua el al. (1997) it was noted that the phase of the PDO shifted on a decadal time scale. Since 1998, the phase of the PDO has oscillated with a much higher frequency of about five years. Recently the frequency of the oscillation appears to have increased again, with a two-year cool phase from 2008 to 2009 followed by one warm phase year (mid-2009 – mid 2010) and one cool year (mid-2010 -2011). Jacobson et al. (2012) has used this extreme variability to compare the response of juvenile salmon to a large variety of ocean conditions. New research suggests that the mechanistic link between PDO and salmon growth and survival is due to shifts at the base of the food chain between lipid-poor and lipid-rich plankton communities. These changes in the food chain lead to changes in feeding conditions for salmon and forage fishes (Peterson and Keister 2003; Peterson and Schwing 2003; Peterson and Hooff 2005; Hoof and Peterson 2006; Daly et al. 2010; Litz et al. 2010; Keister et al. 2011; Bi et al. 2011)

When PDO is in a negative (cold) phase, boreal, lipid-rich cold-water copepod species dominate the lower trophic levels in the California Current. When the PDO is in positive (warm) phase, warm water and lipid-poor copepod species become important in the Northern California Current and in some years dominate. Shifts in the PDO also result in other changes in the coastal food web (Jacobson et al 2012). Warm ocean conditions associated with the positive-phase PDO result in changes in the abundance of fish predators and fish prey in coastal waters of the Northern California Current. Adult and juvenile hake move up the shelf waters during warm ocean periods, resulting in increased predation on juvenile salmon (Emmett and Krutzikowsky 2008). Forage fishes (anchovy and smelts), which as juveniles are prey of juvenile salmonids, tend to be less abundant during warm ocean conditions (Emmett et al. 2006; Emmett and Sampson 2007). Thus, the PDO may affect the survival of salmon through both its effects at the base of the food web as well as on salmon predators at higher trophic levels.

Pacific salmon sustain heavy and highly variable losses in the ocean, with natural mortality rates often exceeding 90-95% (Bradford 1995). Most of this mortality is thought to occur in coastal marine ecosystems during two critical periods: an early period of predation-based mortality that occurs within the first few weeks or months of ocean entry, and a later period of starvation-based mortality that occurs following the first winter at sea (Beamish and Mahnken 2001).

Both predation- and starvation-based mortality are size-dependent (Willette et al. 2001; Hurst 2007). Therefore, ocean conditions that lead to slower growth likely increase mortality during these critical periods of marine life, thereby reducing adult returns (Pearcy 1992; Beamish et al. 2004). Slower marine growth may also reduce the ability of adult salmon to complete their spawning migration (Crossin et al. 2004). Production in freshwater and riparian ecosystems may consequently be reduced through a reduction in marine-derived nutrients (Cederholm et al. 1999, Kiffney et al. 2014). Moreover, smaller adult fish tend to produce smaller eggs and fry, which are more vulnerable to predation than larger cohorts (Ruggerone and Rogers 1993; Quinn et al. 2004). In multiple populations of coho salmon Jacobson et al (2012) found a positive and significant relationship between marine growth and adult abundance, providing strong evidence that variation in marine productivity directly controls marine abundance of salmon. Furthermore, the data suggest that estimates of juvenile salmon growth soon after ocean entry may be used to estimate adult salmon returns.

Changes in the marine environment over the past decade demonstrate the impacts that changing ocean conditions can have on coho salmon populations (Beamish et al. 2000, Logerwell et al. 2003). For at least two decades, beginning about 1977, marine productivity conditions were unfavorable for the majority of salmon populations in the Pacific Northwest. Recent data from across the range of coho salmon on the coast of California and Oregon reveal there was a 72 percent decline in returning adults in 2007/08 compared to the same cohort in 2004/05 (MacFarlane et al. 2008). The Wells Ocean Productivity Index, a measure of Central California ocean productivity, revealed poor conditions during the spring and summer of 2006, when juvenile coho salmon from the 2004/05 cohort entered the ocean (MacFarlane et al. 2008). Poor ocean productivity can be especially detrimental to coho salmon along the Oregon and California coast, because these regions lack extensive bays, straits, and estuaries which could buffer adverse oceanographic effects (Bottom et al. 1986).

3.2.15 Stochastic Pressure from Small Population Size

A recent development in the field of conservation biology is the hypothesis that random events in small populations may have a large impact on population dynamics and population persistence.

The peril that small populations face may be either deterministic (the result of systematic forces that cause population decline such as overexploitation, development, deforestation, loss of pollinators, inability to find mates, or inability to defend against predators) or stochastic (the result of random fluctuations that have no systematic direction). These forces have been shown to reduce population size, and when populations are reduced to very low densities, they can experience reduced rates of survival and reproduction (Allee 1938, Wood 1987). Over the long term, a series of unlucky generations in which there are successive declines in population size can lead to extinction even if the population is growing, on average.

Most independent populations in the SONCC coho salmon ESU have declined in numbers to below the depensation threshold and are therefore being influenced by stochastic (random natural) processes that may make recovery of the ESU more difficult than currently thought (CDFG 2004a). As natural populations get smaller, the number of interacting stochastic processes that influence the population increases. These stochastic processes can create alterations in genetics, breeding structure, and population dynamics that may interfere with recovery efforts and need to be considered when evaluating how populations within the ESU are going to respond to recovery actions. This stochastic pressure can express itself in three ways: genetic, demographic and environmental.

Genetic stochasticity refers to changes in the genetic composition of a population that are unrelated to systematic forces (selection, inbreeding, or migration, i.e., genetic drift). Genetic stochasticity can have a large impact on the genetic structure of populations, both by reducing diversity within populations and by increasing the chance that deleterious recessive alleles are expressed. When populations are at levels below depensation, stochasticity can make both population viability and survival difficult to predict, due to the random variables that are now acting on the population. These processes, when working together, can cause reduced genetic diversity in a population (or populations), further decreases in population size, or shifts in life-history traits. Reduced diversity could limit a population's ability to respond adaptively to future environmental changes. In addition, the increased frequency with which deleterious recessive alleles are expressed (because of increased homozygosity) could reduce the viability and reproductive capacity of individuals.

Demographic stochasticity refers to the variability in population growth rates arising from random differences among individuals in survival and reproduction within a season. This variability will occur even if all individuals have the same expected ability to survive and reproduce and if the expected rates of survival and reproduction don't change from one generation to the next. Even though it will occur in all populations, it is generally important only in populations that are already fairly small. Environmental stochasticity is the type of variability in population growth rates that refers to variation in birth and death rates from one season to the next in response to weather, disease, competition, predation, ocean conditions, or other factors external to the population.

In these small populations, recovery from low densities may be significantly delayed or not occur at all and the populations may suffer a decrease in population growth rate. This reduced population growth rate at low densities is also known as depensation (Liermann and Hilborn 2001). Many mechanisms can lead to depensation, and depensatory effects are usually displayed through changes in the following mechanisms: reduced probability of fertilization, impaired group dynamics, conditioning of the environment, and predator saturation (Liermann and Hilborn 2001). A population's dynamics are depensatory if the growth rate decreases along with density or abundance decreasing to low levels. Components of the life-history, such as fecundity or survival, or the mechanisms that affect these components, are called depensatory if they decrease the growth rate along with density or abundance. At extremes, these depensatory dynamics have negative population growth rates at low densities and are called critical depensation (Clark 1985). The critical density at which the per-individual growth rate becomes negative is of particular interest, since populations reduced below this density face further decline and possibly extinction (Liermann and Hilborn 2001). The ability to recognize when populations are entering or are in a depensatory state is therefore vitally important in the efforts leading to recovering a species. Recognizing when depensation is occurring has proven to be difficult; current research utilizing parametric statistical analyses is now used to help better understand the population dynamics occurring in these small populations.

Stochastic processes are likely influencing populations throughout the SONCC ESU. These processes and pressures should be taken into account when prioritizing watersheds and associated recovery actions to ensure that efforts made to recover extremely small populations are successful, and that other processes are not hindering or defeating recovery efforts. These processes, while not serious when acting alone, can become significant contributors to population instability and decline when acting synergistically with other threatening processes. It may be difficult to know when additional stochastic factors are playing a role in a population's recovery and viability, and so including, where possible, statistical population models to determine current pressures and threats is needed. Models like the Population Viability Analysis (PVA) have been shown to be extremely useful in obtaining a better understanding of the processes and pressures that are affecting small populations like those seen in the SONCC coho salmon ESU.

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4. Recovery Goals, Objectives, and Criteria

The following goals guide recovery of SONCC coho salmon as described in recovery documents from the State of Oregon, the State of California, and NMFS.

First, the populations must reach desired levels of biological viability and the recovery effort must sufficiently reduce the impact of the stresses and threats in order to warrant removal of the SONCC coho salmon ESU from the threatened and endangered species list (referred to in this plan as either delisting or ESA recovery). Section 4.1 describes the recovery goals and criteria.

Second, the States of California and Oregon seek to rebuild wild populations to reach 'broad sense recovery' to provide for sustainable fisheries and other ecological, cultural, and social benefits. Section 4.2 describes broad sense recovery goals.

4.1 ESA Recovery Goals

The goal of this recovery plan is to recover the Southern Oregon/Northern California Coast Coho Salmon (*Oncorhynchus kisutch*) ESU to the point where the species is viable and so no longer needs the protections afforded by the federal ESA and can be removed from the ESA threatened and endangered species list. A viable SONCC coho salmon ESU is naturally self-sustaining, with a low risk of extinction. Recovery of SONCC coho salmon requires a viable ESU and a sufficient reduction in the factors that contributed to the need for the protections of the ESA, which are reflected in the stresses and threats; both elements are assessed against recovery criteria. The specific recovery objectives and criteria are provided below.

Delisting criteria are objective, measurable criteria that, when met, would result in a determination by NMFS that the ESU is not endangered and is not likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The delisting criteria for biological parameters are the biological recovery criteria, and the delisting criteria that address listing factors are the stress and threat criteria. As new information emerges, NMFS may revisit the delisting criteria through the status review process, described in Chapter 6.

4.1.1 Recovery Objectives

Chapter 2 describes the biological characteristics of an ESU that is at low risk of extinction (viable). Chapter 4 describes the criteria to be met by each population to reach lower risks of extinction, and to achieve a viable ESU. Section 4.1.2 lists the biological recovery objectives and criteria that describe the desired characteristics of the populations that make up the ESU. The stress and threat criteria that describe when these factors will be sufficiently addressed are described in Section 4.1.3.

Recovery criteria can be viewed as the targets, or values, by which progress toward recovery objectives can be measured. We identify what a species' populations, habitat, stresses, and threats are expected to look like when the species is recovered so that we will be better able to determine how far the species needs to move to reach those objectives, and the actions needed to achieve each objective.

4.1.2 Biological Recovery Objectives and Criteria

Biological Recovery Objectives

NMFS developed biological objectives based on ESU and population viability metrics established by Williams et al. (2008). At the ESU level, SONCC coho salmon must demonstrate representation, redundancy, and connectivity (Williams et al. 2008). Representation relates to the genetic and life-history diversity of the ESU, which is needed to conserve its adaptive capacity. Redundancy addresses the need to have a sufficient number of populations so the ESU can withstand catastrophic events. Connectivity refers to the dispersal capacity of populations to maintain long-term demographic and genetic processes.

At the population level, biological recovery objectives are based on the viable salmonid population (VSP) parameters (McElhany et al. 2000). Each SONCC coho salmon population must achieve sufficient abundance, growth rates, spatial structure, and diversity. However, the minimum needed conditions for each population vary depending on each population’s role in recovery as described in this recovery plan (Figure 4-1). Spawner abundance is an important parameter because, all else being equal, small populations are at greater risk of extinction than larger populations. Large populations are generally better able to withstand the detrimental effects of environmental variation, genetic processes, demographic stochasticity, ecological feedback, and catastrophes than small populations (Shaffer 1981). Productivity describes the growth rate of a population. Spatial distribution is important to reduce extinction risks from genetic risks and demographic stochasticity. A population’s spatial distribution depends on habitat quality (including accessibility), population dynamics, and dispersal characteristics of individuals in the population. Genetic and life-history diversity allows species to adapt to a variety of environments that provide for the needs of the species and protect against short-term environmental change while also providing the genetic material necessary to survive environmental change.

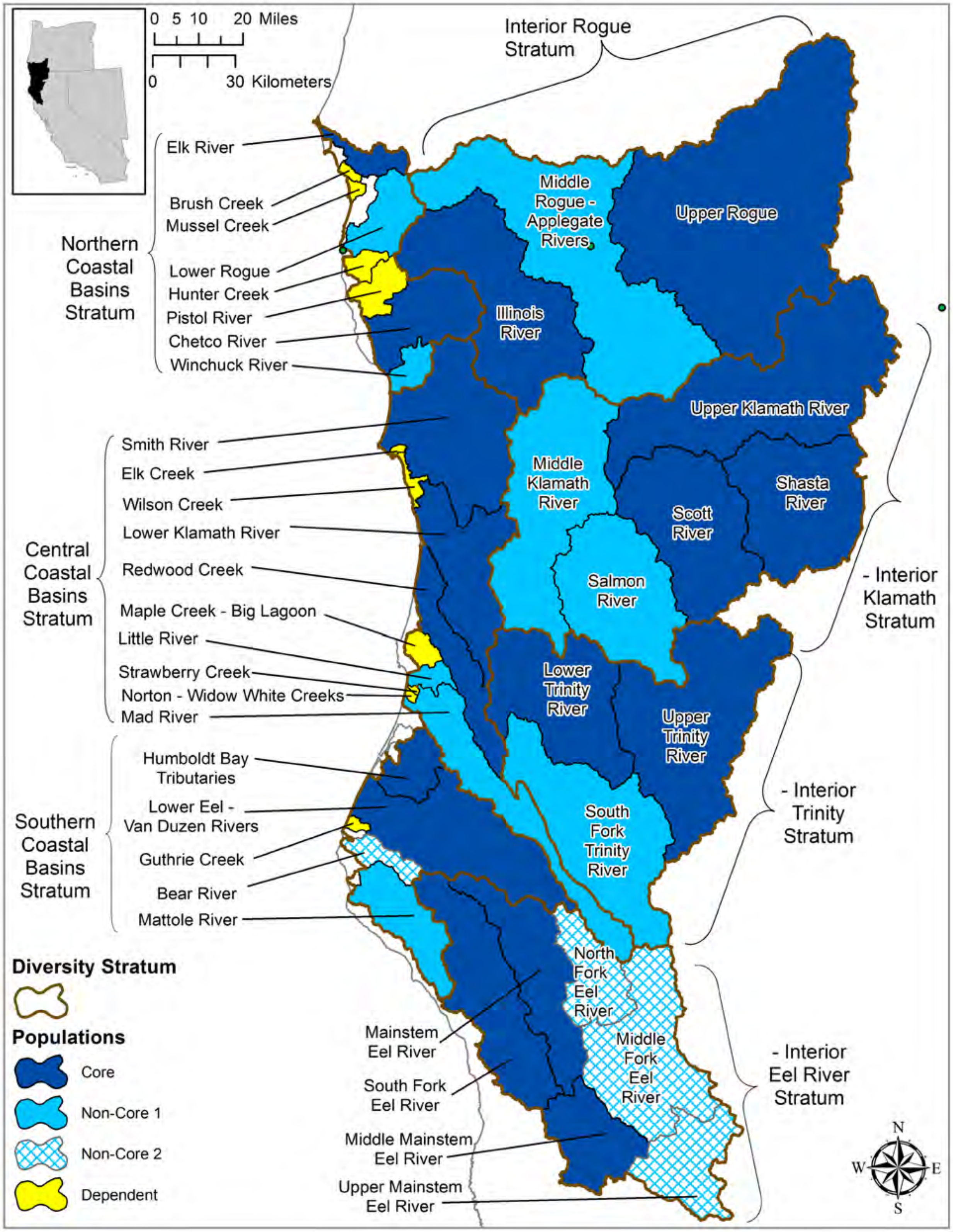

Figure 4-1. Core, non-core, and dependent populations within diversity strata of the SONCC coho salmon ESU.

Biological Recovery Criteria

The biological recovery criteria for each population type are described in Table 4-1 and the specific abundance criterion to be met by each population is shown in Table 4-2. The biological recovery criteria described in this section reflect NMFS' opinion of how to best achieve a viable ESU most quickly. **In a recovered ESU, biological recovery criteria for all four parameters (abundance, productivity, spatial structure, and diversity) must be met** [Emphasis added].

Each population plays a role in recovery, and NMFS identifies four categories of populations as described in Chapter 2: Core, Non-Core 1, Non-Core 2, and Dependent. Core populations are independent populations that are likely to respond to recovery actions and achieve a low risk of extinction[7] most quickly[8]. All but four of the remaining independent populations are categorized as "Non-Core 1". In a recovered ESU, these Non-Core 1 populations will be at least at a moderate risk of extinction. The remaining four Independent populations are categorized as "Non-Core 2", as their populations are thought to be extirpated. In a recovered ESU, Non-Core 2 and Dependent populations will support emigrants from other populations. Figure 4-1 shows the category assigned to each population. Table 4-1 and Table 4-2 describe the recovery objectives and criteria for each population category.

[7] Excluding the areas above some dams; see footnote 3 in Table 4-1.

[8] The rationale for choice of core populations is described in Appendix C.

Table 4-1. Biological recovery objectives and criteria for SONCC coho salmon. All biological recovery criteria must be met in a recovered ESU.

VSP Parameter	Population Role	Biological Recovery Objective	Biological Recovery Criteria[1]
Abundance	Core	Achieve a low risk of extinction[2]	The geometric mean of wild adults over 12 years meets or exceeds the "low risk threshold" of spawners for each core population[2,3,4]
	Non-Core 1	Achieve a moderate or low risk of extinction[2]	The annual number of wild adults is greater than or equal to four spawners per IP-km for each non-core population[2]
Productivity	Core and Non-Core 1	Population growth rate is not negative	Slope of regression of the geometric mean of wild adults over the time series ≥ zero[4]
Spatial Structure	Core and Non-Core 1	Ensure populations are widely distributed	Annual within-population juvenile distribution ≥ 80%[4] of habitat[5,6] (outside of a temperature mask[7])
	Non-Core 2 and Dependent	Achieve inter- and intra-stratum connectivity	≥ 80% of accessible habitat[4] is occupied in years[8] following spawning of cohorts that experienced high marine survival[9]
Diversity	Core and Non-Core 1	Achieve low or moderate hatchery impacts on wild fish	Proportion of hatchery-origin adults (pHOS) < 0.05
	Core and Non-Core 1	Achieve life-history diversity	Variation is present in migration timing, age structure, size and behavior. The variation in these parameters[10] is retained.

[1] All applicable criteria must be met for each population in order for the ESU to be viable.
[2] See Table 4-2 for specific spawner abundance requirements needed to meet this objective.
[3] In the Shasta River, Upper Trinity River, and Upper Rogue River populations, IP above some anthropogenic dams was excluded from the spawner target, so the low-risk threshold for these populations is based on the IP downstream of those dams.
[4] Assess for at least 12 years, striving for a coefficient of variation (CV) of 15% or less at the population level (Crawford and Rumsey 2011).
[5] Based on available rearing habitat within the watershed (Wainwright et al. 2008). For purposes of these biological recovery criteria, "available" means accessible. 80% of habitat occupied relates to a truth value of +1.0,(true: juveniles occupy a high proportion of the available rearing habitat within the watershed (p. 56, Wainwright et al. 2008).
[6] The average for each of the three year classes over the 12 year period used for delisting evaluation must each meet this criterion. Strive to detect a 15% change in distribution with 80% certainty (Crawford and Rumsey 2011).
[7] Williams et al. (2008) identified a threshold air temperature, above which juvenile coho salmon generally do not occur, and identified areas with air temperatures over this threshold. These areas are considered to be within the temperature mask.
[8] If young-of-year are sampled, sampling would occur the spring following spawning of the cohorts experiencing high marine survival. If 1+ juveniles are sampled, sampling would occur approximately 1.5 years after spawning of the cohorts experiencing high marine survival, but before outmigration to the estuary and ocean.
[9] High marine survival is defined as 10.2% for wild fish and 8% for hatchery fish; Sharr et al. 2000. If marine survival is not high, then this criterion does not apply.
[10] This variation is documented in the population profiles in Chapters 7 to 46 of this plan.

Table 4-2. The minimum number of spawners (male and female) needed in each population to meet the biological recovery criteria.

Diversity Stratum	Independent Population	Population Role	Minimum Number of Spawners[1]
Northern Coastal Basins	Elk River	Core	2,400
	Brush Creek	Dependent	None- Juv. Occupancy
	Mussel Creek	Dependent	None- Juv. Occupancy
	Lower Rogue River	Non-Core 1	320
	Hunter Creek	Dependent	None- Juv. Occupancy
	Pistol River	Dependent	None- Juv. Occupancy
	Chetco River	Core	4,500
	Winchuck River	Non-Core 1	230
Interior Rogue River	Illinois River	Core	11,800
	Middle Rogue and Applegate rivers	Non-Core 1	2,400
	Upper Rogue River	Core	13,800
Central Coastal Basins	Smith River	Core	6,800
	Elk Creek	Dependent	None- Juv. Occupancy
	Wilson Creek	Dependent	None- Juv. Occupancy
	Lower Klamath River	Core	5,900
	Redwood Creek	Core	4,900
	Maple Creek/Big Lagoon	Dependent	None- Juv. Occupancy
	Little River	Non-Core1	140
	Strawberry Creek	Dependent	None- Juv. Occupancy
	Norton/Widow White Creek	Dependent	None- Juv. Occupancy
	Mad River	Non-Core 1	550
Interior Klamath River	Middle Klamath River	Non-Core 1	450
	Upper Klamath River	Core	8,500
	Salmon River	Non-Core 1	450
	Scott River	Core	6,500
	Shasta River	Core	4,700
Interior Trinity River	Lower Trinity River	Core	3,600
	Upper Trinity River	Core	5,800
	South Fork Trinity River	Non-Core 1	970
Southern Coastal Basins	Humboldt Bay tributaries	Core	5,700
	Lower Eel and Van Duzen rivers	Core	7,900
	Guthrie Creek	Dependent	None- Juv. Occupancy
	Bear River	Non-Core 2	None- Juv. Occupancy
	Mattole River	Non-Core 1	1,000
Interior Eel River	South Fork Eel River	Core	9,300
	Mainstem Eel River	Core	2,600
	Middle Fork Eel River	Non-Core 2	None- Juv. Occupancy
	North Fork Eel River	Non-Core 2	None – Juv. Occupancy
	Middle Mainstem Eel River	Core	6,300
	Upper Mainstem Eel River	Non-Core 2	None- Juv. Occupancy

[1]See Table 4-1 for biological recovery criteria. Abundance estimates should strive for a CV of 15 percent or less at the population level (Crawford and Rumsey 2011).

High Risk Spawner Threshold

If only a single spawner were present in a 1-mile reach within a population, the salmon population as a whole would likely to face significant demographic risks such as difficulties in finding mates (Wainwright et al. 2008). Therefore, Williams et al. (2008) chose 1 spawner per mile density as the high risk (depensation) threshold and converted the density into IP-km for the SONCC coho salmon ESU, which is approximately 1 spawner per IP-km.

Moderate Risk Spawner Threshold

Because one spawner per IP-km is the depensation threshold, Williams et al. (2008) identified the minimum spawner density needed to achieve a moderate risk of extinction as any number greater than 1 adult per IP-km (Table 4-3). To provide a reasonable buffer against falling below the threshold, the abundance criterion for Non-Core 1 populations is set at four spawners per IP-km (Table 4-1). Four spawners per IP-km was chosen based on the following rationale.

Other authors have identified a number of spawners per IP-km below which depensation occurs, and these numbers of spawners are typically much higher than that chosen by Williams et al. (2008; Table 4-3). Wainwright et al. (2008) considered a population with value of 4.2 spawners/IP-km to have an uncertain probability of incurring depensation, a value similar to that of Sharr et al. (2000) and Chilcote (1999). Barrowman et al. (2003) note that there is little evidence for depensation in coho salmon, unless less than one female per kilometer of river returned to spawn. Parameter estimates for the upper 95% confidence interval presented in Barrowman et al. (2003) are given in Table 4-3. NMFS chose 4 spawners per IP-km as the moderate risk target, because according to Sharr et al. (2000), four spawners per IP-km would translate into an extinction risk of approximately 10% over four generations (Table 4-3 and Figure 4-2).

Table 4-3. Depensation levels identified by various authors. Results are standardized to IP-km.

Reference	Value below which depensation occurs
Barrowman et al. (2003) 95% Upper CI Type 2 Beverton-Holt Model	2.26 spawners/IP-km
Barrowman et al. (2003) 95% Upper CI Type 2 Logistical Hockey Stick Model	1.6 spawners/IP-km
Sharr et al. (2000)	4.2 spawners/IP-km
Chilcote (1999)	4.1 spawners/IP-km

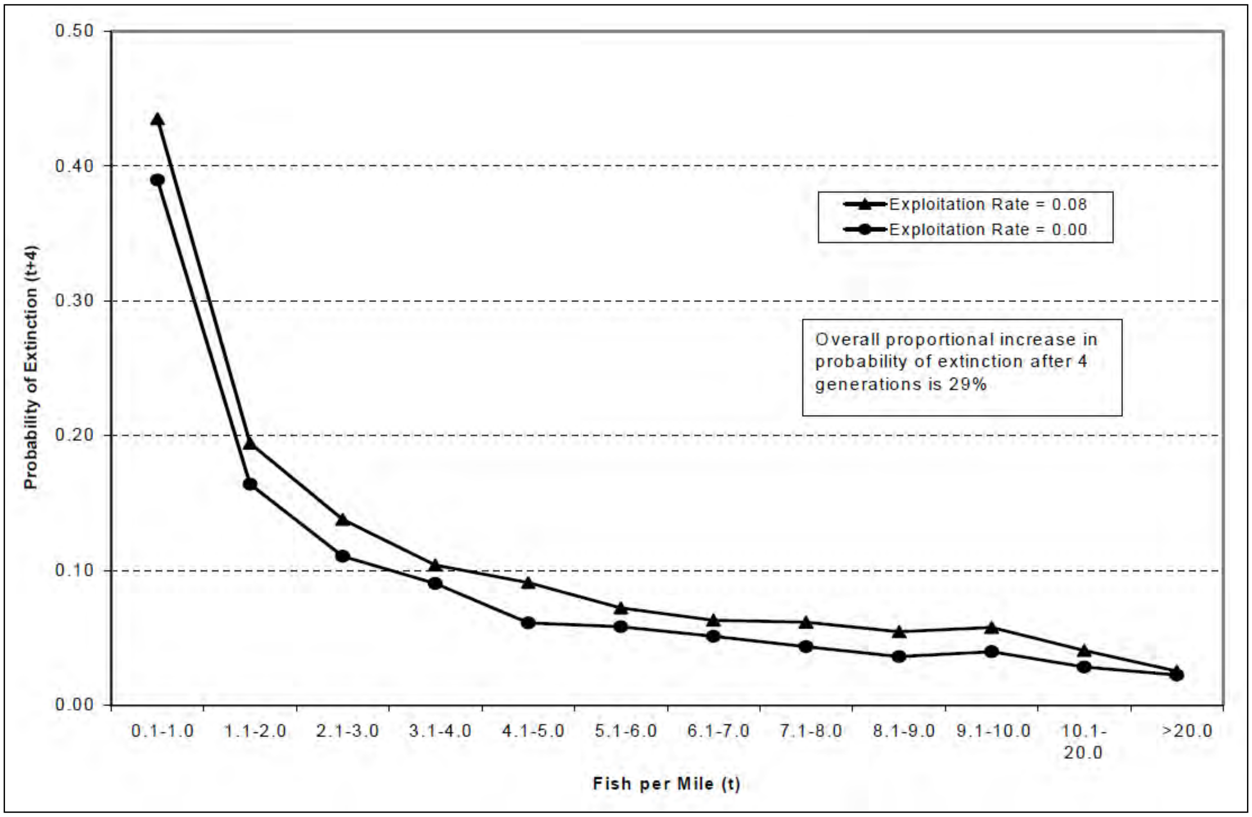

Figure 4-2. Probability of basin level extinction in four generations as a function of spawner density. For fishery exploitation rates of 0.0 and 0.8 in all Oregon coastal basins combined. Source: Sharr et al. (2000).

Low-Risk Spawner Threshold

As shown in Table 4-1, the biological recovery criterion for Core population abundance is the low-risk threshold, which is the number of IP-km multiplied by the applicable spawner density used by Williams et al. (2008; Figure 4-3). Spawner density is based primarily on Bradford et al.'s (2000) finding that an average density of 19 females/km is required to fully seed freshwater habitats with juveniles. Assuming males generally outnumber females (Jensen and Hyde 1971, Spindle et al. 1998, Holtby and Healey 1990, Nickelson 2001), Williams et al. (2008) approximated 19 females/km to be equivalent to 40 spawners/km. Because IP-km is weighted, one km of habitat averages to about 0.6 IP-km. Therefore 40 spawners/km is approximately equal to an average of 66 spawners/IP-km.

Williams et al. (2008) may have used 40 spawners/IP-km as the density to fully seed juveniles in freshwater habitat and to establish the low-risk threshold for populations, as opposed to 66 spawners/IP-km, in order to avoid overestimating the historical spawner abundance. Williams et al. (2008) decreased the spawner density requirement to a minimum of 20 spawners/IP-km for larger watersheds based on their assumption that larger populations can diverge farther from historical conditions before extinction risk is substantially increased. A population with ten times more habitat potential (i.e., IP-km >340) than the smallest population will likely require an average spawner density of half that of the smallest population (Williams et al. 2008), and populations between these two sizes required spawner densities linearly between the two reference points (Williams et al. 2008). This approach establishes a population-specific abundance that is scaled to the amount of potential habitat and avoids the use of fixed abundance criteria.

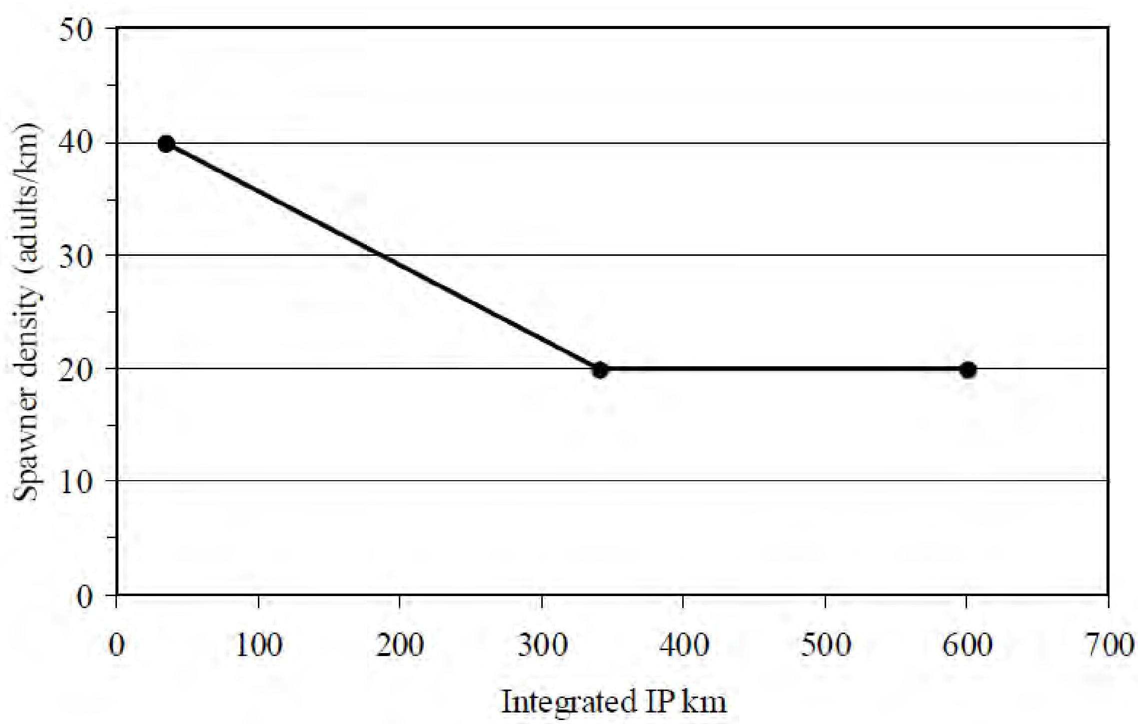

Figure 4-3. Minimum required spawning density based on amount of coho salmon IP-km (Williams et al. 2008).

Comparison of targets to historical abundance estimates

Despite efforts to not overestimate, the low risk spawner targets may appear overly ambitious when compared to current conditions. However, these targets should be viewed in the context of historical conditions. Williams et al. (2008) compared these spawner targets to historical estimates along the Oregon Coast, the Rogue River, and in the Eel River. Comparisons with these datasets suggest that the spawner targets do not overestimate the historical carrying capacities of coho salmon populations.

Using cannery records from 1892 to 1915, Meengs and Lackey (2005) estimated historical run sizes of Oregon coho salmon populations by 1) converting salmon pack data (in cases) into pounds of salmon caught (by assuming a certain constant "waste" in processing); 2) converting pounds of salmon captured into numbers of adult fish (by assuming an average weight for adult fish of 4.46 kg); 3) converting numbers of harvested salmon into an estimate of total population sizes (assuming a specific catch efficiency rate); and 4) using the five years of highest abundance in each watershed as indicative of run size. The historical abundance estimates for these Oregon coho salmon populations (Table 4-4) are well over the spawner targets derived from Williams et al.'s (2008) method. All the spawner targets were between 3% and 12% of historical estimates of abundance (Table 4-4).

Table 4-4. Comparison of abundance estimates and IP model-driven density-based abundance targets for coastal watersheds in Oregon (Williams et al. 2008). IP-km are integrated IP-km values.

Population	Historical estimates of abundance derived from cannery records (Meengs and Lackey 2005)	IP km	Estimated historical spawner density (spawners/IP km)	Projected abundance target based on MRSD (20 spawners/IP km)[a]	Projected abundance target as percent of historical estimate
Nehalam	236,000	1,116	211	22,300	9.3%
Tillamook	234,000	537	436	10,700	4.7%
Nestucca	107,000	299	358	6,800	6.4%
Siletz	122,000	310	394	6,800	5.6%
Siuslaw	547,000	902	607	18,000	3.3%
Yaquina	65,000	385	169	7,700	12.3%
Alsea	153,000	466	328	9,300	5.9%
Coquille	342,000	883	387	17,700	5.3%
Coos	161,000	552	292	11,000	6.8%

[a] – The Nestucca and Siletz populations have less than 340 IP km, therefore the MRSD values used for these calculations were 23 spawners/IP km for the Nestucca population and 22 spawners/IP km for the Siletz population.

In the Rogue River, Meengs and Lackey (2005) estimated the Rogue River had about 114,000 coho salmon during the late 1800s when land use in this watershed already included mining, water diversions, and timber harvesting (Atwood and Gray 2002 *in* Spence et al. 2008). In addition, Mullen (1981) estimated 58,000 coho salmon were harvested in the Rogue River in 1892. In order for the ESU to be recovered, the four populations in the Rogue River needs to contribute at least 28,320 spawners (Table 4-2) which is about 25 percent of Meengs and Lackey's (2005) historic estimate.

Relatively recent spawner estimates are available for the Upper Rogue River population to compare with the spawner target of 13,800 for this population (Table 4-2). As recently as 2000, the wild coho salmon spawner count at the Gold Ray Dam in the Upper Rogue River population was approximately 15,500 (ODFW 2010). Because the dam is not at the downstream-most location of the population unit, coho salmon spawners counted at the Gold Ray Dam represent only a portion of the Upper Rogue River population and the total number of coho salmon spawners in the Rogue River population is likely to be higher than the count at Gold Ray Dam for that year.

In the South Fork Eel River, the average number of coho salmon spawners counted at Benbow Dam from 1941[9] to 1950 was 14,900. Benbow Dam is located about 67 km upstream of where the South Fork Eel River enters the mainstem Eel River. Counts at this dam, consequently, represent only a portion of the South Fork Eel River population. To compare with this historic average, Williams et al. (2008) estimated the fraction of total IP-km upstream of Benbow Dam and multiplied this fraction by the overall abundance target to obtain estimates of the coho salmon spawner target upstream of Benbow Dam. The resulting coho salmon spawner target upstream of Benbow Dam is 6,836, which is about 46 percent of the average returns from 1941 to 1950.

In summary, where there are estimates of abundance of coho salmon to compare with spawner targets, the methods described in Williams et al. (2008) and any of NMFS' adjustments to Williams et al. (2008) targets do not appear to overestimate the historical carrying capacities of coho salmon populations.

Possible change to low-risk threshold

NMFS developed biological recovery criteria based on the productivity, spatial structure, and diversity components of the viability salmonid population (VSP) framework described by McElhany et al. (2000). Chapter 4 describes the biological recovery criteria for all four VSP parameters, including the low-risk threshold abundance targets identified by Williams et al. (2008). Future research is needed to determine whether the low-risk threshold abundance target could be increased or decreased if the other VSP parameters are well-estimated. Recovery actions for this research are identified in Chapter 5.

4.1.3 Stress and Threat Reduction Objectives and Criteria

Chapter 1 describes the listing factors identified when SONCC coho salmon were listed as a threatened species under the Endangered Species Act (ESA). Listing factors are those factors

[9] While records of fish counts at Benbow Dam began in 1938, 1941 is used as the starting period here to exclude hatchery influences on the spawner counts. Hatchery releases in the Eel River basin occurred from 1935 to 1938 (Williams et al. 2008).

that contributed to the decline of the species to the point where ESA protection was warranted. The possible delisting of coho salmon in the future would require that the biological recovery criteria in 4.1.2 are met. In addition, delisting would require that NMFS determine that the factors that led to the listing of SONCC coho salmon are sufficiently addressed. By establishing criteria for each of the five listing factors, the recovery plan will ensure that the underlying causes of decline have been addressed and mitigated prior to considering a species for delisting.

In order to develop criteria responsive to the listing factors, NMFS identified those stresses and threats associated with each listing factor (Table 4-5). Stresses are attributes of the ecology of a particular life stage of coho salmon that are impaired, directly or indirectly, by human activities. For example, impaired water quality, specifically high water temperature, can impair growth or kill coho salmon. Threats are activities or processes that have caused, are causing, or may cause a stress. For example, land management activities may require withdrawal of water from a river. This reduced flow can result in higher water temperature, impairing water quality and harming or killing coho salmon. The stresses and threats are described in Chapter 3, the methods used to assess them are described in Appendix B, and the results of the assessment for each population are summarized in Chapters 7 to 46.

The stress and threat reduction objectives and criteria are presented in Table 4-5, organized according to the five listing factors introduced in Chapter 3. The ratings of some stresses are informed by comparison of site-specific data to reference data values, which reflect the needed habitat conditions (Table 4-6). Appendix B describes how these indicators are used to inform the stress ranks. The indicators used in the assessment of stresses in this plan are shown in Table 4-6. Other indicators may be used instead of, or in addition to, these indicators in future assessments of stresses.

Table 4-5. Recovery objectives and criteria for stresses and threats.

Listing Factor	Stress/Threat	Recovery Objective	Recovery Criteria
A. Habitat Destruction, Modification or Curtailment	Lack of floodplain and channel structure	Habitat destruction, modification or curtailment does not limit attainment of population-specific recovery criteria	Lack of floodplain and channel structure is rated a medium or low stress[1] for all life stages of coho salmon in Core and Non-Core 1 populations based on GRTS[2] sampling of each population area.
	Altered sediment supply		Altered sediment supply is rated a medium or low stress[1] for all life stages of coho salmon in Core and Non-Core 1 populations based on GRTS[2] sampling of each population area.
	Altered hydrologic function		Altered hydrologic function is rated a medium or low stress[1] for all life stages of coho salmon in Core and Non-Core 1 populations based on GRTS[2] sampling of each population area.
	Impaired water quality		Impaired water quality is rated a medium or low stress[1] for all life stages of coho salmon in Core and Non-Core 1 populations based on GRTS[2] sampling of each population area.
	Degraded riparian forest conditions		Degraded riparian forest conditions is rated a medium or low stress[1] for all life stages of coho salmon in Core and Non-Core 1 populations based on GRTS[2] sampling of each population area.
	Barriers		Barriers do not limit access to areas determined to be necessary to attain coho salmon recovery[3].
	Impaired Estuary Function		Impaired estuarine function is rated a medium or low stress[1] for all life stages of coho salmon in Core and Non-Core 1 populations based on GRTS[2] sampling of each population area.
A. Habitat Destruction, Modification or Curtailment	Roads, Timber Harvest, Channelization, Diking, Agricultural Practices, Dams, Diversions, Mining, Gravel Extraction, and Urbanization	Threats to habitat do not limit attainment of population-specific recovery criteria	The recovery criteria listed above for all the stresses associated with Listing Factor A are met.
B. Over-utilization for commercial, recreational, scientific or educational purposes	Fisheries	Commercial, recreational and tribal fisheries impacts do not limit attainment of population-specific recovery criteria.	Commercial, recreational and tribal fisheries impacts do not, and likely will not, limit attainment of the desired status of populations relative to population-specific viability criteria. The desired status is identified in plans to manage these fisheries, and the plans are approved by NMFS.
	Collection	Collection impacts do not limit attainment of population-specific recovery criteria.	All scientific collection is authorized under Sections 10(a)(1)(a) or 4(d) of the Endangered Species Act.

Listing Factor	Stress/Threat	Recovery Objective	Recovery Criteria
C: Disease and predation	Disease	Disease does not limit attainment of population-specific recovery criteria.	Mean mortality and infection from diseases is not higher than natural background levels[4] for coho salmon juveniles in populations where disease is identified as a high or very high stress.
C: Disease and predation	Predation	Predation does not limit attainment of population-specific recovery criteria.	Predation does not, and likely will not, limit attainment of population-specific recovery criteria[5].
D: The inadequacy of existing regulatory mechanisms	Land and resource management	Regulatory mechanisms have been maintained and/or established and are being implemented in a way that allows the desired status of the ESU and its constituent populations, as defined by the biological criteria in this recovery plan, to be attained and maintained.	Regulatory programs that govern land use and resource extraction are in place, enforced, monitored, and adaptively managed adequately to ensure effective protection of coho salmon habitat, including water quality, water quantity, and stream structure and function, and do not limit the continued attainment of the biological recovery criteria in this recovery plan. Regulatory programs are in place and are being implemented, monitored, evaluated and adaptively managed adequately to manage fisheries at levels consistent with the biological recovery criteria of this recovery plan. Regulatory programs have adequate funding, prioritization, enforcement, and coordination mechanisms to ensure habitat protection and effective management of fisheries. Regulatory programs are in place and are being implemented, monitored, evaluated and adaptively managed adequately to manage the effects of climate change (e.g., management for droughts, floods, and sea level rise).
E: Other natural or man-made factors affecting continued existence	Climate change	Other natural or man-made factors must not limit attainment of population-specific recovery criteria.	Recovery criteria are met for stresses in Listing Factor A affected by climate change (altered hydrologic function, impaired water quality, degraded riparian forest conditions, impaired estuary/mainstem function, disease/predation/competition) and recovery criteria in Listing Factor D are met relating to land and resource management of climate change effects.
	Invasive species		Regulatory measures to minimize the risk of introduction of additional or spread of existing exotic species in the range of the ESU have been developed and implemented.
	Hatchery management		All hatcheries affecting SONCC coho salmon have NMFS-approved HGMPs, and the effects[6] of these hatcheries are within the levels described in the respective HGMPs.

[1] NMFS will consider the ratings of applicable indicators (Poor, Fair, Good, or Very Good) shown in Appendix B, Table B.3 in order to determine the current level of stress or threat (Very High, High, Medium, or Low). This consideration process is described in Appendix B, Section B.3.
[2] Generalized Random Tessellation Stratified technique (Stevens and Olsen 2004)
[3] Recovery action will determine which areas blocked by barriers are necessary to attain coho salmon recovery.
[4] NMFS assumes natural background levels of *C. shasta* equates to the lowest recorded mortality in coho salmon sentinel juveniles at the Beaver Creek site in the Klamath River in May and June (i.e., 10% mortality; Bartholomew 2012). These background levels will be used as the NMFS recovery criterion for this threat.
[5] Recovery actions will determine what levels of predation do not limit attainment of population-specific recovery criteria.
[6] The concept of the proportion of natural influence (PNI), developed by the Hatchery Science Review Group (HSRG 2004), may be a useful tool for limiting the risks of fitness loss in natural populations due to straying of hatchery fish.

Table 4-6. Indicators of aquatic habitat suitability for coho salmon habitat, to used to rate applicable stresses and determine if stresses are rated "medium" or "low". Adapted from Kier Associates and NMFS (2008).

Stress	Indicators	Good	Very Good
Lack of Floodplain and Channel Structure	Pool Depths	3-3.3 ft	>3.3 ft.
	Pool Frequency (length)	41-50%	>50
	Pool Frequency (area)	21-35%	>35%
	D50 (median particle size)	51-60 & 95-110 mm	60-95 mm
	LWD (key pieces[1]/100 m)	2-3	>3
	LWD <20 ft. wide[2]	54-84 pieces[3]/mi	>85 pieces[3]/mi
	LWD 20-30 ft. wide[2]	37-64 pieces[3]/mi	>65 pieces[3]/mi
	LWD >30 ft. wide[2]	34-60 pieces[3]/mi	>60 pieces[3]/mi
Altered Sediment Supply	% Sand <6.4mm (wet)	15-25%	<15%
	% Sand <6.4mm (dry)	12.9-21.5%	<12.9%
	% Fines <1mm (wet)	12-15%	<12%
	% Fines <1mm (dry)	8.9-11.1%	<8.9%
	V Star (V*)	0.15 - 0.21	<0.15
	Silt/Sand Surface (% riffle area)	12-15%	<12%
	Turbidity (FNU)[4]	120-360 hrs > 25 FNU	<120 hrs >25 FNU
	Embeddedness (%)	25-30	<25
Impaired Water Quality	pH (annual maximum)	8.25-8.5	<8.25
	D.O. (COLD) (mg/l 7-DAMin)	6.6-7.0 mg/l	>7.0 mg/L
	D.O. (SPAWN) (mg/l 7-DAMin)	10.1-11 mg/l	>11.0 mg/l
	Temperature (MWMT[5])	16-17 °C	<16 °C
	Aq Macroinverts (EPT)	19-25	>25
	Aq Macroinverts (Richness)	31-40	>40
	Aq Macroinverts (B-IBI)	60.1-80	>80
Degraded Riparian Forest Conditions	Canopy Cover (% shade)	71-80%	>80%
	Canopy Type (% Open + Hardwood)	20-30%	<20%
	Riparian Condition (conifers >36" dbh / 1000ft for 100 ft wide buffer)	125.1-200	>200
Disease	*Ceratonova shasta*	No greater than 10% mortality of sentinel coho salmon juveniles at Beaver Creek confluence in the Klamath River during May and June	

[1] Key pieces of large woody debris are pieces with a minimum diameter of 60 cm (2 feet) and a minimum length of 100 m (33 feet) (Foster et al. 2001).
[2] The number of pieces of wood in streams with a wetted width of less than 20 feet, between 20 and 30 feet, or greater than 30 feet (The Nature Conservancy 2006).
[3] Pieces of wood are defined as all wood pieces that are greater than 12 inches in diameter at 25 feet from the large end (The Nature Conservancy 2006).
[4] Formazin Nephelometric Units.
[5] Maximum weekly maximum temperature: Average of the daily maximum temperatures during the warmest 7-day period of the year.

4.2 Broad-Sense Recovery Goals

When the SONCC coho salmon ESU is recovered under the ESA and delisted, returning wild coho salmon spawners may number in the tens of thousands but may not be numerous enough to use all available spawning habitat throughout the ESU. Many streams may remain unoccupied or under-occupied by coho salmon. Tens of thousands of coho salmon may not be enough to maintain a fishery. The cultural, economic, and ecological benefits of having numerous coho salmon spawning throughout the ESU are not maximized under a scenario where only ESA recovery is achieved. While the delisting criteria need to be objective and measurable, broad-sense recovery is more open-ended.

The recovery objectives and criteria in this plan define which populations must be at low risk of extinction to delist, but other populations have the potential to achieve a low risk of extinction as well. Broad-sense recovery means maximizing the viability of all populations. The goal of broad-sense recovery is to achieve a low risk of extinction for all independent populations in the SONCC, both Core and Non-Core populations. Broad sense recovery is a long-term goal. Enhancing the abundance, spatial structure, diversity and productivity of the Non-Core and dependent populations beyond the ESA delisting criteria is not required to delist SONCC coho salmon. However, doing so will increase resiliency of SONCC coho salmon, with associated opportunities for cultural, economic, and ecological benefits.

4.2.1 Recovery Action Implementation

All 40 populations of SONCC coho salmon have a profile that summarizes available scientific data and other pertinent information, including the stresses and threats affecting that population (Chapters 7 to 46). These population profiles help guide restoration and recovery efforts for coho salmon and their habitats. Population profiles are available for stakeholders to work toward broad-sense recovery. The recovery action table in each profile includes actions needed for each population to contribute to ESU viability. ESA delisting is expected to require implementation of those recovery actions with all priorities except Broad-Sense Recovery actions (those coded BR). Implementation of BR actions, in addition to implementation of those actions necessary to provide for ESA recovery of the species/ESU, would facilitate broad-sense recovery.

4.2.2 Oregon's Broad-Sense Recovery Goals and Criteria

Oregon's broad sense recovery goal is to achieve populations of naturally produced salmon and steelhead that are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) that the ESU as a whole (a) will be self-sustaining, and (b) will provide significant ecological, cultural, and economic benefits. This recovery goal was developed under Oregon's native fish conservation policy (ODFW 2003) to fulfill the mission of the Oregon Plan for Salmon and Watersheds (State of Oregon 1997). The Oregon Plan for Salmon and Watersheds is founded on the principle that citizens throughout the region value and enjoy the substantial ecological, cultural and economic benefits that derive from having healthy, diverse populations of salmon and steelhead. The goal is consistent with ESA delisting, and is designed to achieve a level of performance for the ESU and its constituent populations that is more robust than needed to remove the ESU from ESA protection. Broad-sense recovery incorporates ESA delisting goals in the sense that ESA delisting goals would be achieved first during an extended and stepwise process of achieving broad sense recovery goals.

Oregon's broad-sense recovery goal for the SONCC coho salmon ESU has not yet been agreed upon by a public advisory committee. The goal described above was developed for other recovery plans in Oregon and will be used as a placeholder until a public advisory committee has been formed and provided guidance on the broad-sense goal for SONCC coho salmon populations in Oregon.

The State of Oregon developed broad-sense criteria that go beyond the criteria for ESU delisting. These broad-sense criteria are designed to attain population goals that will provide significant ecological, cultural, and economic benefits consistent with the Oregon Plan (State of Oregon 1997).

Oregon's broad-sense recovery criteria for salmonids are:

• All SONCC coho salmon populations have a "very low" extinction risk and are "highly viable"[10] over 100 years throughout their historical range; and

• The majority of SONCC coho salmon populations are capable of contributing social, cultural, economic and aesthetic benefits on a regular and sustainable basis.

4.2.3 California's Broad-Sense Recovery Goal

The primary purpose of the *Recovery Strategy for California Coho Salmon* (CDFG 2004a), which the California Department of Fish and Wildlife submitted to the California Fish and Game Commission in February 2004, is to recover coho salmon to the point where the regulations or other protections for coho salmon listed under the California Endangered Species Act are not necessary.

To achieve recovery of coho salmon in California, the *Recovery Strategy* lists five delisting goals and associated criteria, concerned with increasing populations and restoring suitable habitats. In addition, Goal VI of the *Recovery Strategy* seeks to reach and maintain adequate coho salmon population levels to allow for the resumption of Tribal, recreational, and commercial fisheries for coho salmon in California.

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[10] Having a "very low" extinction risk is equivalent to being "highly viable" in the parlance of population status assessment for recovery plans. A "highly viable" naturally-producing salmonid population with a "very low" extinction risk has less than a 1% probability of extinction over a 100-year period, corresponding to at least a 99% persistence probability. Probabilities result from an integrated assessment of the population's abundance, productivity, spatial structure, and diversity status.

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5. Monitoring and Adaptive Management

5.1 Information needed to delist a species

Chapter 4 describes the objective, measurable criteria by which NMFS will determine whether the SONCC coho salmon ESU should be removed from the list of threatened and endangered species. Monitoring provides information to track progress toward recovery by evaluating the species' status relative to these criteria, and to identify if the species can be delisted using the listing status decision framework (Figure 5-1). NMFS recommends the monitoring described in this chapter be carried out, and may determine that other monitoring is also appropriate and necessary.

5.1.1 Adaptive management

In addition to its role in assessing the status of coho salmon relative to recovery targets, monitoring data is essential for adaptive management. Adaptive management is the process of improving management policies and practices as conditions change. Adaptive management is an approach to natural resources policy that embodies the idea that policies are experiments; monitoring data are collected and examined so that expectations can be compared to what was observed – adaptive management is not trial and error (Lee 1993). Information is rarely complete and there is often uncertainty. What is known is researched, examined, and tested, knowledge is extended, and management is adjusted. Adaptive management requires care and consideration both before monitoring (by employing sampling designs that adequately inform decision making) and after monitoring (by using results to improve future conservation efforts).

New scientific research may provide information that may warrant adjustments to the recovery plan, implementation, or both. In addition, adaptive management for this recovery plan relies on tracking of stresses and threats and assessment of the effectiveness of restoration actions. Adaptive management guides the implementation of salmon recovery activities through repeated adjustments in strategies and actions, as information from monitoring and evaluation become available (Figure 5-2). Strategies and actions needed for recovery can evolve as effectiveness of actions increases through monitoring and evaluation. Figure 5-2 shows the steps on the road to recovery, including adaptive management.

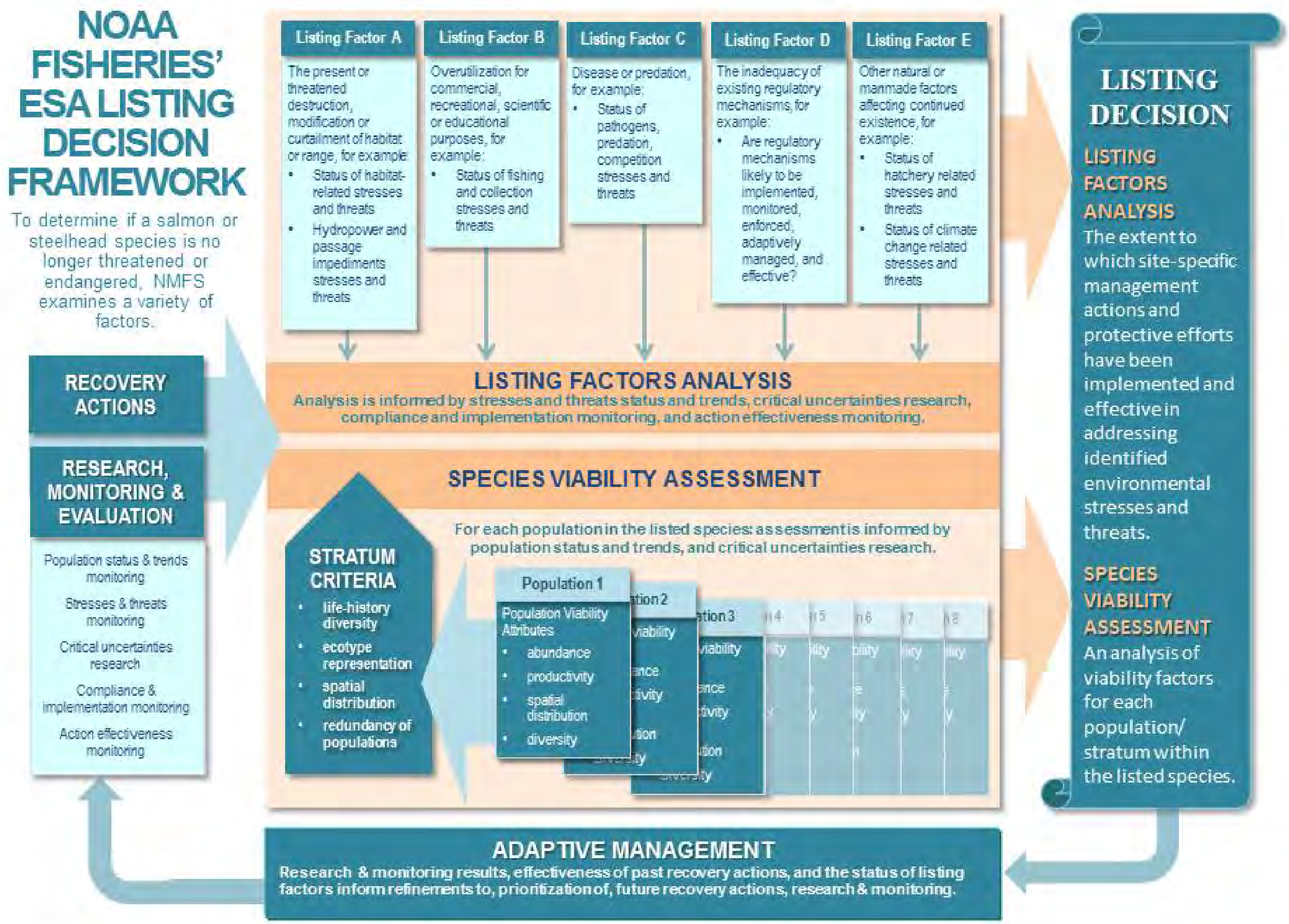

Figure 5-1. NMFS listing status decision framework.

Figure 5-2. The steps on the road to recovery.

5.2 Methods for monitoring coho salmon populations

For the purposes of describing SONCC coho salmon and its habitat, the spatial scale to be characterized is the population. Sampling at a coarser spatial scale (e.g., diversity stratum) would not provide the information needed to assess the status and trends of SONCC coho salmon populations. In addition, it is necessary to detect population changes with an appropriate level of certainty (Chapter 4); for example, spawner abundance estimates should strive to achieve a coefficient of variation (CV) of 15% or less at the population level (Crawford and Rumsey 2011).

The States of California and Oregon have established programs and methods for monitoring salmonids. Data designed to measure progress toward meeting SONCC coho salmon recovery criteria should be collected using the methods described below.

5.2.1 California's Coastal Monitoring Program

The California Department of Fish and Wildlife and the National Marine Fisheries Service designed California's Coastal Salmonid Monitoring Program (CMP) (Adams et al. 2011) to guide biological monitoring of salmonid populations in the state. The following excerpt from Adams et al. (2011) describes the overall strategy, design and methods of the monitoring plan.

The goals and objectives of the CMP are to develop broad and intensive monitoring strategies and techniques that:

1) Create a monitoring framework that includes all coho salmon, Chinook salmon and steelhead in coastal California;
2) Provide regional (ESU-level) and population abundance estimates for both status and trend of salmonid populations;
3) Estimate pro4ductivity trends from status abundance data;
4) Provide estimates of regional and population level spatial structure of coastal salmonids;
5) Consider the diversity of life-history and ecological differences in the three species of interest; and
6) Create permanent LCM [Life Cycle Monitoring] stations that will allow deeper evaluation of both freshwater and marine fish-habitat relationships and provide long-term index monitoring.

Methods for collection of adult and juvenile coho salmon data in California are described in Adams et al. (2011). California plan implementers should use these methods to collect data to be used to measure progress toward recovery.

5.2.2 Oregon Plan for Salmon and Watersheds

The Oregon Plan is a comprehensive plan to restore salmonids and the systems they rely on by combining scientifically sound actions with local watershed-based public support (State of Oregon 1997). This plan has four key elements:

1) Voluntary restoration actions by landowners, with support from local government;
2) Coordinated state and federal agency and tribal actions to support restoration efforts, implement regulatory programs, manage public lands, and promote public education and awareness;
3) Monitor watershed health, water quality, and salmon recovery to document existing conditions, track changes, and determine the impact of programs and actions.
4) Strong scientific oversight by the Independent Multidisciplinary Science Team to evaluate the plan's effectiveness, identify needed changes, and guide research investments (State of Oregon 2013).

Methods for collection of adult and juvenile coho salmon data in Oregon are described in Stevens (2002). Methods for assessment of coho salmon habitat in Oregon are described in Moore et al. (1997) and Rodgers et al. (2005). Plan implementers should use these methods to collect data to be used to measure progress toward recovery.

5.3 Population Viability

Monitoring spawner abundance and distribution, juvenile distribution, diversity, and productivity is necessary to assess progress toward recovery. The monitoring goals, purpose, and potential methods are described in Table 5-1 by population role. At a minimum, adults and juveniles should be monitored in all Core and Non-Core 1 populations, while juveniles should be monitored in all Dependent and Non-Core 2 populations. Table 5-2 shows the monitoring needed for each population. Monitoring entities should strive for spawner and juvenile data with an average coefficient of variation of 15 percent or less per population (Crawford and Rumsey 2011).

In addition to the adult and juvenile monitoring described above, life cycle monitoring (LCM) stations should be established. Adams et al. (2011) describes the utility and needed components of LCM stations. LCM stations are places where smolt and adult abundance are monitored. LCM stations are an integral component of monitoring for SONCC coho salmon. LCM stations can be used to: (1) estimate abundance of adult coho salmon and downstream migrating juveniles; (2) estimate marine and freshwater survival rates; (3) track abundance of juveniles coincident with habitat modifications, and (4) calibrate the spawning ground surveys used to estimate adult abundance, based on observations of live adults, redds, or carcasses. LCM stations should be located and designed for complete counts of smolts and adults from the entire basin or a defined portion of the basin using weirs, fences, traps, live mark/recapture techniques, sonar, or other techniques. At least one LCM station should be monitored in each diversity stratum (see Table 5-1) so that a regional estimate of freshwater survival is available for every diversity stratum, and a regional estimate of marine survival is available for every coastal diversity stratum.

Given the amount of data to be collected at LCM stations, they may serve as the focal point for evaluating the status of SONCC coho salmon populations and restoration efforts, as well as encouraging further research. LCM stations in close proximity to the ocean can be used to determine marine survival. Large rivers may not be appropriate or feasible locations for LCM stations if all coho salmon adults cannot be counted, smolt trapping efficiencies are low, or flows are too high or unsafe for operation. Alternatively, an LCM station could be established on a tributary of a large river. LCM stations are likely to be located opportunistically and at existing counting stations within each stratum.

Table 5-1. Population viability monitoring needs by population role.

Population Role	Monitoring Goal	Purpose and Methods
Core and Non-Core 1	Annually estimate number of adults	Track abundance of spawners relative to spawner targets. **Methods**: Carry out total counts, mark/recapture, or spawner surveys [Adams et al. (2011) (for California) and Stevens (2002) (for Oregon)]. Monitoring entities should strive for adult spawner data with a coefficient of variation on average of 15 percent or less per population (Crawford and Rumsey 2011).
Core and Non-Core 1	Annually monitor the spatial distribution of coho salmon adults spawning in the wild	If fish spawn and rear in a variety of freshwater habitats in a sub-basin, the population will be buffered against year-to-year environmental variations.
	Annually estimate the distribution of juvenile coho salmon	Track population productivity and spatial distribution. **Methods**: Carry out snorkel surveys [following Rodgers (2000 and 2001) in Oregon and Adams et al. (2011) in California] to determine juvenile occupancy (% area occupied) and density using GRTS technique (Stevens and Olsen 2004, Adams et al. 2011).
	Annually estimate the proportion of adults of hatchery origin	Determine extent of hatchery influence on spawners in order to assess possible impacts of domestication/hatchery selection on non-hatchery origin fish. **Methods**: During spawner counts, note whether specimen has internal or external hatchery mark.
	Periodically monitor key life-history characteristics	Document life-history diversity, which is important to understanding the long-term resilience and adaptability of SONCC coho salmon populations. **Methods**: Track characteristics such as spawner run timing, age at maturation, spawn timing, outmigration timing, smoltification timing, developmental rate, egg size, fecundity, freshwater and ocean distribution, size at maturation, and timing of ascension to natal stream.
Core with LCM station	Annually estimate the number of adults in area sampled by LCM station	Track abundance of spawners over time and, with smolt numbers, determine survival rate. **Methods**: Carry out total counts, mark/recapture, or spawner surveys [Adams et al. (2011) (for California) and Stevens (2002) (for Oregon)]. Monitoring entities should strive for adult spawner data with a coefficient of variation on average of 15 percent or less per population (Crawford and Rumsey 2011).
	Annually estimate smolt abundance in areas sampled by LCM station	Assess population productivity, and, with adult numbers, determine survival rate. **Methods**: Compare adult and smolt numbers to determine survival rate; in coastal LCMs, compare adult and smolt numbers to determine marine survival rate.
	Annually estimate marine survival	Assess influence of marine survival on abundance of coastal populations. Methods: Divide smolt abundance by spawner abundance for each coastal LCM station.
Dependent and Non-Core 2	Annually estimate juvenile occupancy	Track population productivity and spatial distribution. **Methods**: Juvenile occupancy surveys (% area occupied) and density in a spatially balanced random sampling design.

Table 5-2. Population viability monitoring actions for each population.

Stratum	Population	Population Role	Adult	Juvenile	LCM Eligible*
Northern Coastal	Elk River	Core	X	X	X
	Brush Creek	Dependent		X	
	Mussel Creek	Dependent		X	
	Lower Rogue River	Non-Core 1	X	X	
	Hunter Creek	Dependent		X	
	Pistol River	Dependent		X	
	Chetco River	Core	X	X	X
	Winchuck River	Non-Core 1	X	X	
Interior Rogue	Illinois River	Core	X	X	X
	Mid Rogue/Applegate	Non-Core 1	X	X	
	Upper Rogue River	Core	X	X	X
Central Coastal	Smith River	Core	X	X	X
	Elk Creek	Dependent		X	
	Wilson Creek	Dependent		X	
	Lower Klamath	Core	X	X	X
	Redwood Creek	Core	X	X	X
	Maple Cr./Big Lagoon	Dependent		X	
	Little River	Non-Core 1	X	X	
	Strawberry Creek	Dependent		X	
	Norton/Widow White Creek	Dependent		X	
	Mad River	Non-Core 1	X	X	
Interior Klamath	Middle Klamath	Non-Core 1	X	X	
	Upper Klamath	Core	X	X	X
	Salmon River	Non-Core 1	X	X	
	Scott River	Core	X	X	X
	Shasta River	Core	X	X	X
Interior Trinity	Lower Trinity	Core	X	X	X
	Upper Trinity	Core	X	X	X
	South Fork Trinity	Non-Core 1	X	X	
Southern Coastal	Humboldt Bay Tributaries	Core	X	X	X
	Lower Eel/Van Duzen	Core	X	X	X
	Guthrie Creek	Dependent		X	
	Bear River	Non-Core 2		X	
	Mattole River	Non-Core 1	X	X	
Interior Eel	South Fork Eel	Core	X	X	X
	Mainstem Eel	Core	X	X	X
	Middle Fork Eel	Non-Core 2		X	
	North Fork Eel	Non-Core 2		X	
	Middle Mainstem Eel	Core	X	X	X
	Upper Mainstem Eel	Non-Core 2		X	

* LCM stations should be established in at least one core population in each diversity stratum.

5.4 Research

Numerous questions remain about the best means to collect and interpret population viability and habitat data. Table 5-3 describes research needs. These research needs correspond to recovery actions listed in Table 5-9.

Table 5-3. Research needs and methods.

Research Need	Purpose and Methods
Obtain better information on the extent and distribution of spawning in each Core and Non-Core 1 population area.	Accurate expansion of survey data to population estimates requires accurate information on current population range.
Develop efficient survey designs for assessing patchily-distributed populations	Understanding factors that influence distribution will aid in the design of more precise and efficient surveys.
Consider carrying out abundance surveys in consistently occupied, higher abundance patches and spatial structure surveys outside these patches	The appropriate survey method could differ based on the distribution of the animals to be surveyed.
Further develop the spatial structure monitoring protocol outlined in Adams et al. (2011) for California	Standard protocol for documenting spatial structure should be fully developed and followed by plan implementers to ensure consistent data collection.
Determine how juvenile distribution is influenced by streamflow, temperature, and sediment barriers	Annually monitor streamflow, temperature, and sediment barriers/extent of dry areas along with juvenile spatial structure to allow formal hypothesis testing of influence of one on another.
Develop cost-effective survey designs and methods for assessing spawning populations in streams where conditions (stream size, turbidity, cover) reduce the efficacy of traditional visual survey methods	Some parts of the SONCC coho salmon ESU's range are not amenable to traditional visual spawning survey protocols due to site-specific conditions.
Develop estimator for number of redds within a sample reach.	Adult abundance is sometimes estimated based on redd observations. Redds may be obscured from view over the course of the spawning season. Estimates of the number of redds deposited over the spawning survey must account for redds that cannot be observed during the periodic surveys. **Methods**: Model the redd deposition/ obscurement process as an open population mark-recapture problem. Use flagged redd recaptures on successive surveys to estimate rate at which existing redds cannot be detected in subsequent surveys. Adjust the number of new redds observed on new survey by survival rate since last survey. Use a non-parametric bootstrap routine to estimate within-reach uncertainty in number of redds.

Research Need	Purpose and Methods
Estimate total redd construction over regional space, incorporating within- and between-sample uncertainty.	Use of a Simple Random Sample Estimator is documented in Adams et al. (2011). However, small population sample frames are likely to lead to poor estimates of uncertainty using large sample variance equations. **Methods**: Use a bootstrap routine over large sample variance estimators for small frame and sample sizes. Using the outcome of estimator for number of redds within a sample reach (see Item 7 in this table, above), develop an algorithm for generating estimates of the number of redds over a sample space including the variance at the within-reach and between reach (sample error) levels.
Estimate the number of fish from estimates of redds.	At LCM stations, immigrating adults can be intercepted and either counted directly or marked for later recapture to create a spawner population estimate. Redds can also be directly counted or a number can be estimated using mark-recapture. The number of redds can be used to estimate the number of spawners. The relationship between the number of redds and the “true” number of spawners is used to adjust regional estimates of redds for reporting of the number of spawners. This approach assumes that the LCM station relationship between redds and spawners is the same as the regional relationship. Preliminary analysis suggests large variability between LCM redd to fish relationships in California.
Determine the number of reaches that should be sampled within a population to achieve a target coefficient of variation in annual status, and determine over what time period a trend of a specified magnitude can be detected at what spatial scale given specified sample rates.	NMFS’ evaluation of salmonid viability uses the population as the fundamental unit, building up to Diversity Strata. The status of the ESU is therefore based on the status of its component populations. Based on sample frames previously constructed in California, most independent populations have between 40 and 120 stream reaches. Crawford and Rumsey (2011) recommend that spawner abundance estimates achieve a CV of 15% or less at the population level. The number of reaches to be sampled to obtain that CV in each population is unknown. **Methods**: Conduct a power analysis to determine: 1. the number of reaches that should be sampled to achieve the target CV in each population, and 2. over what time period a trend of specified magnitude can be detected at what spatial scale given specific sample rates.
Develop techniques to estimate spawner abundance in remote areas.	Some remote areas of the ESU (e.g., in the Rogue and Eel River basins) cannot be sampled using traditional methods.
Evaluate the potential to restore extirpated populations.	Several populations in the ESU appear to be extirpated or nearly so. These populations may have less potential for recovery than those that currently support coho salmon.
Research supplemental or alternative means to develop population targets.	Methods other than those used in Williams *et al.* (2008) could be effectively used to delineate populations.

Research Need	Purpose and Methods
Determine whether the abundance targets for independent populations could be decreased if other VSP parameters are well-estimated.	Williams et al. (2008) did not include criteria for spatial structure and diversity, rather abundance served as a proxy for these parameters: "The high-risk thresholds [which define the low end of the spawner density criteria] identify densities at which populations are at a heightened risk of a reduction in per capita growth rate (i.e., depensation). Populations exceeding the low-risk density thresholds [which define the high end of the spawner density criteria] are expected to inhabit a substantial portion of their historical range, which serves as a proxy indicator that resultant spatial structure and diversity will reasonably represent historical conditions (Williams et al. 2008)". This recovery plan includes criteria that explicitly measure spatial structure and diversity. If these criteria are met, the number of spawners needed could be less than that identified in Williams *et al.* (2008).
Determine how to differentiate salmonid species observed using DIDSON[11].	DIDSON is an acoustic camera which uses sonar and so is not affected by turbidity (Adams et al. 2011). DIDSON is a recommended method for counting steelhead in Southern California, but not in Northern California because when two or more salmonid species inhabit a stream, it is difficult to reliably distinguish them based on the DIDSON images (Adams et al. 2011). If salmonid species could be reliably distinguished, the DIDSON camera could be a powerful tool for tracking adult coho salmon abundance in the SONCC coho salmon ESU.
Determine whether chosen LCM locations capture existing spatial differences in marine survival due to different "marine environments".	One reason to have at least one LCM in each coastal diversity stratum is to capture the conditions in different "marine environments" across the marine range of SONCC coho salmon. The assumption that one LCM in each diversity stratum will adequately describe the effects of these "marine environments" remains untested.
Refine understanding of the accuracy of field protocols to detect juvenile occupancy.	Presence of juveniles in samples is proof of occupancy, but absence cannot be proven although the probability of absence can be determined. The frequency of "false" absences depends on the abundance and distribution of individuals, the sampling method and intensity, and the scale of sampling. This can be particularly problematic for species that are rare or patchily distributed, or as species and populations decline in abundance and distribution leading to errors in estimates that vary with habitat and environmental conditions and species abundance. **Methods**: Develop a juvenile spatial structure protocol that estimates detection probability.

[11] Dual-Frequency Identification Sonar.

Research Need	Purpose and Methods
Develop a quantitative limiting factors life cycle model.	Integrate information about the ecology of the salmon life cycle, the factors that may limit the survival of key life stages and the effects of human activities such as landscape management, habitat rehabilitation, and exploitation. Results of the model can be used to reprioritize recovery actions or identify additional actions needed to achieve SONCC coho salmon recovery.
Track ocean productivity	Compile data obtained from ocean net surveys, hatchery returns, and oceanic data collected by satellite and buoy arrays throughout the northeastern Pacific ocean.
Determine which life-history traits or other diversity parameters are the most meaningful measures of diversity, particularly in the context of future climate change impacts.	Development of meaningful measures of diversity is difficult largely because of the lack of understanding of the expression of individual life-history traits (the genetic and environmental effects) and the degree of correlation between these traits, survival, and reproduction.
Determine best approach to conduct effectiveness and validation monitoring.	Determine whether goals of effectiveness and validation monitoring can be achieved by measuring a subset of restoration actions, rather than all of them. Determine appropriate subset.

5.5 Stress and Threat Monitoring

In order to achieve recovery, the stresses and threats faced by coho salmon populations in the ESU must be sufficiently abated to facilitate the long term sustainability. The objectives for abatement of stresses and threats are as follows: (1) the stresses currently affecting SONCC coho salmon have been sufficiently reduced and (2) the threats identified at the time of listing, as well as any new threats, have been sufficiently removed or reduced.

Monitoring is needed to gauge progress toward meeting the stress and threat objectives. Monitoring needs for stresses and threats are described for each population in Table 5-4, Table 5-5, Table 5-6, and Table 5-7. Table 5-10 through Table 5-49 describe the recovery actions necessary to obtain information on these stresses and threats for each population.

An initial, comprehensive field-based habitat survey should be carried out for all populations as soon as possible (1; Table 5-6 and Table 5-7). The purpose of these surveys is to describe the current habitat conditions in each population area to inform restoration actions and for future statistical sampling of the area to support the GRTS approach. The surveys should be followed by monitoring of indicators related to those stresses ranked high or very high for each population. Such indicators should be monitored every 5 years beginning as soon as possible (3; Table 5-6 and Table 5-7). For those stresses ranked medium or low for each population, indicators should be monitored every 10 years beginning as soon as possible (4; Table 5-6 and Table 5-7). Monitoring needs for stresses are described for each population in Table 5-5 (for coastal diversity strata) and Table 5-6 (for interior diversity strata). Some stresses can cause habitat to worsen rapidly, and some of these changes in habitat could be fatal to coho salmon. For this reason, indicators for water temperature, barriers (due to sediment or dry areas), altered hydrologic function, adverse fishery-related effects, increased disease, predation, and competition, and adverse hatchery-related effects should be monitored annually for populations that rated high or very high for these stresses (2; Table 5-5 and Table 5-6). Threat monitoring is described in Table 5-7. NMFS will describe the status and trends of stresses related to particular threats, along with other identified information, as part of the status review to be completed every five years.

Table 5-4. Recommended monitoring to assess stresses associated with listing factors.

Listing Factor	Stress	Monitoring[1]
A: Habitat Destruction, Modification or Curtailment	Lack of Floodplain and Channel Structure	Habitat indicators[2] for the stresses rated *high* or *very high* should be monitored[3] every 5 years.
	Altered Sediment Supply	
	Impaired Water Quality	
	Degraded Riparian Forest Condition	
	Impaired Estuarine Function[4]	
	Barriers (due to sediment, dry areas, or high temperature)	Annually monitor the extent of barriers due to sediment or seasonally dry areas in independent populations where such barriers are identified as a *high* or *very high* stress.
	Altered Hydrologic Function	Annually monitor the hydrograph, where appropriate, in independent populations where altered hydrologic function is identified as a *high* or *very high* stress.
B: Overutilization for commercial, recreational, scientific, or educational purposes	Adverse Fishery-Related Effects	Annually estimate the commercial and recreational ocean fisheries bycatch and mortality rate for wild SONCC coho salmon. Annually estimate the in-river bycatch and tribal harvest for all rivers and streams in the SONCC recovery domain.
C: Disease or predation	Increased Disease/Predation/ Competition	Annually estimate the infection and mortality rate of juvenile coho salmon from pathogens, such as *Ceratonova shasta*, in the mainstem Klamath River at Beaver Creek during May and June
C: Disease or predation	Increased Disease/Predation/ Competition	Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin, in independent populations where predation is identified as a *high* or *very high* stress.
D: The inadequacy of existing regulatory mechanisms	All	Monitor changes in adequacy of existing regulatory mechanisms.
E: Other natural or manmade factors affecting the species' continued existence	Climate Change	Refer to monitoring associated with Impaired Hydrologic Function and Water Quality.
	Adverse Hatchery-Related Effects	Annually determine the percent of hatchery origin spawners (PHOS) in independent populations where hatchery effects are a *high* or *very high* stress.

[1]The first habitat monitoring should be comprehensive and occur as soon as possible in both freshwater and estuarine (if applicable) habitat, in order to inform restoration activities and statistical sampling of population area.
[2] A list of habitat indicators is presented in Table 4-6.
[3] Habitat monitoring will be based on GRTS (use of this method for habitat monitoring is described in Rodgers et al. (2005)).
[4] NMFS has no recommendation regarding the habitat parameters to be measured in estuaries. A recovery action to identify the appropriate estuarine parameters is included for each population where such monitoring is needed.

Table 5-5. Monitoring actions to assess stresses for each population in the coastal diversity strata.

Monitoring Action: Track indicators related to:	Northern Coastal Basins					Central Coastal Basins						Southern Coastal Basins				
	Chetco River **C**	Winchuck **NC1**	Elk River **C**	Lower Rogue **NC1**	Dependent Populations	Lower Klamath **C**	Redwood Creek **C**	Mad River **NC1**	Smith River **C**	Little River **NC1**	Dependent Populations	Humboldt Bay Tribs. **C**	Lower Eel/Van Duzen **C**	Mattole River **NC1**	Bear River **NC2**	Dependent Populations
Spawning, rearing, and migration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lack of Floodplain and Channel Structure	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
Degraded Riparian Forest Conditions	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	4
Altered Sediment Supply	4	3	4	3	3	3	3	3	4	3	3	3	3	3	3	3
Impaired Water Quality (Temperature)	2	2	2	2	2	4	2	2	2	4	2	2	2	2	2	4
Impaired Water Quality (Non-Temperature)	3	3	3	3	3	4	3	3	3	4	3	3	3	3	3	4
Altered Hydrologic Function	2	2	2	4	3	2	4	4	4	4	4	4	4	2	4	4
Impaired Estuarine Function	3	3	4	3	3	3	3	3	3	4	3	3	3	3	3	4
Adverse Fishery- and Collection-Related Effects	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Adverse Hatchery-Related Effects	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Disease/Predation/ Competition	4	4	4	4	4	4	4	4	4	4	4	4	2	4	4	4
Barriers	4	4	4	4	4	4	4	4	3	4	3	3	4	4	4	4

1 = Conduct initial comprehensive habitat survey.
2= Monitor every year.
3= Monitor applicable habitat or population indicators every five years, to begin after initial comprehensive habitat survey completed.
4= Monitor applicable habitat or population indicators every 10 years, to begin after initial comprehensive habitat survey completed.

C = core population

NC1 = non-core 1 population

NC2 = non-core 2 population

Table 5-6. Monitoring actions to assess stresses for each population in the interior diversity strata.

	Interior Rogue			Interior Klamath					Interior Trinity			Interior Eel					
Monitoring Action: Track indicators related to:	Illinois River **C**	Upper Rogue **C**	Mid Rogue/ Applegate **NC1**	Upper Klamath **C**	Shasta River **C**	Scott River **C**	Salmon River **NC1**	Middle Klamath **NC1**	South Fork Trinity **NC1**	Upper Trinity **C**	Lower Trinity **C**	South Fork Eel River **C**	Middle Mainstem Eel **C**	Mainstem Eel **C**	Upper Mainstem Eel **NC2**	Middle Fork Eel **NC2**	North Fork Eel **NC2**
Spawning, rearing, and migration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lack of Floodplain and Channel Structure	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Degraded Riparian Forest Conditions	3	3	3	3	3	3	3	4	3	4	4	3	3	3	3	3	3
Altered Sediment Supply	3	3	3	3	4	3	4	3	3	4	3	3	3	3	3	3	3
Impaired Water Quality	3	3	3	3	3	3	4	3	3	4	4	3	3	4	3	4	3
Altered Hydrologic Function	2	2	2	2	2	2	4	2	2	2	2	2	2	2	4	4	3
Impaired Estuarine Function	3	3	3	3	3	3	4	3	4	4	4	3	3	3	4	3	3
Adverse Fishery-Related Effects	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Adverse Hatchery Related Effects	4	4	4	2	2	4	4	4	2	2	2	4	4	4	4	4	4
Disease/ Predation/ Competition	4	2	2	2	2	2	4	2	4	2	4	2	2	2	2	2	2
Barriers	3	3	3	3	4	4	4	3	3	3	4	3	4	4	3	4	4

1 = Conduct initial comprehensive habitat survey.
2 = Monitor applicable habitat or population indicators every year, to begin as soon as possible.
3 = Monitor applicable habitat or population indicators every five years, to begin as soon as possible.
4= Monitor applicable habitat or population indicators every 10 years, to begin after initial comprehensive habitat survey completed.

C = core population

NC1 = non-core 1 population

NC2 = non-core 2 population

Table 5-7. Monitoring for threats rated high or very high, with associated listing factors.

Listing Factor[1]	**Threat**	**Monitoring**[2]
A: The present or threatened destruction, modification, or curtailment of the species' habitat or range	Roads	Describe the status and trend of related stresses[3]. Describe status and trends of road treatments and road density.
	Timber Harvest	Describe the status and trend of related stresses[3].
	Dams/Diversion	Describe the status and trend of related stresses[3].
	Road-Stream Crossing Barriers	Describe status and trends of identified fish passage barriers[3].
	High Intensity Fire	Describe trends in occurrence of high-intensity fire as well as trends in change of related stresses[3].
	Agricultural Practices	Describe the status and trend of related stresses[3].
	Channelization/ Diking	Evaluate the status and trend of related stresses[3]. Describe new channelization/diking and changes to existing channelization/diking.
	Urban/Residential /Industrial Development	Evaluate the status and trend of related stresses[3]. Describe new development and changes to existing development.
	Mining/Gravel Extraction	Evaluate the status and trend of related stresses[3]. Describe any new mining or gravel extraction.
B: Over-utilization for commercial, recreational, scientific or educational purposes	Fishing and Collecting	Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon. Recreational fishing in freshwater and marine habitats should be assessed through development of Fisheries Monitoring and Evaluation Plans specifically designed to monitor and track catch and mortality of wild and hatchery coho salmon. Annually estimate the in-river bycatch and tribal harvest for all rivers and streams in SONCC recovery domain.
D: The inadequacy of existing regulatory mechanisms[4]	All	Monitor changes in adequacy of existing regulatory mechanisms.
E: Other natural or manmade factors affecting the species' continued existence	Climate Change	Evaluate the status and trend of related stresses[3].
	Hatcheries	Evaluate the status and trend of related stresses[3]. Describe status of HGMP development and implementation.
	Invasive Non-Native Alien Species	Evaluate the status and trend of abundance and occurrence of invasive, non-predatory species that may adversely affect SONCC coho salmon.

[1] Listing Factor C is not included in this table because disease and predation are considered stresses, and the preceding three tables describe monitoring actions to assess stresses.
[2] For each population with this threat rated as high or very high (Chapters 7 to 46), describe status at least once every five years during NMFS' status review of the SONCC coho salmon ESU.
[3] See Table 3-2 to determine related stresses for each threat.
[4] Timber harvest and dams/diversions should also be evaluated under this listing factor.

5.6 Limiting Factors Modeling

A quantitative limiting factors life cycle model is designed to integrate information about the ecology of the salmon life cycle, the factors that may limit the survival of key life stages, and human activities such as landscape management, habitat rehabilitation, and exploitation. Modeling limiting factors may provide insight into what elements of the habitat, or which life stages of coho salmon, are acting as roadblocks to recovery. Models can validate assumptions on which recovery actions are most essential to achieve recovery as well as identify factors which may have been overlooked. As recovery actions are implemented, limiting factors may change. Periodic use of and updates to the limiting factors models that are validated with habitat surveys may help recovery practitioners redirect efforts where they are most needed.

Typically these models associate fish abundance (density) and survival with each habitat type at important life stages. Both carrying capacity and density-independent survival are affected by habitat quantity and quality. Limiting habitat analyses at the basin-level are conducted using this life-stage specific approach. Two potential approaches are simplified limiting factor models and dynamic life cycle models. Both approaches are based on the salmon life cycle, and assess current and historical habitat conditions in a basin to estimate how habitat changes may have altered salmon abundance or survival at different life stages. However, the approaches differ in two main respects. First, each approach emphasizes different parameters driving life stage-to-life stage survivorship. Simplified limiting factors models focus on changes in capacity at each freshwater life stage and treat density-independent stage-to-stage survival as constants. The dynamic life cycle model incorporates both capacity and survival through the use of stage to stage stock-recruitment relationships, and estimates population abundance or other VSP parameters via iterative simulations.

An example of a simplified limiting factors model for coho salmon in Oregon coastal streams is the Habitat Limiting Factors Model (HLFM v7; Nickelson 1998). This model relies upon habitat typing information to determine total area of the various habitat types. The analyst then multiplies the area of each habitat by habitat-specific coho salmon density to estimate potential abundance. This process is done for each life stage/season using life-history-specific density values.

An example of a dynamic life cycle model is RIPPLE developed by Stillwater Sciences and UC Berkley (Dietrich and Ligon 2009). RIPPLE couples geomorphic information with biological and aquatic habitat data. Analysts are expected to ask questions such as “what is the expected population response to increasing the capacity or productivity (survival) of habitat in ‘X’ portion of the stream?” Additionally, the analyst could compare the abundance of fish at any given stage to the intrinsic potential of the basin and the current status of the habitat within the basin.

Such modeling efforts have implications for identifying habitats that may limit recovery of populations. They can provide a transparent framework to: (1) relate habitat to capacity and survival; (2) estimate stage specific abundance from a basin’s intrinsic potential; (3) apply knowledge of the current state of the habitat to stage specific capacity, survival and abundance; (4) identify model assumptions and parameters that can dramatically alter predictions of population responses to habitat changes; (5) indicate which life stages may be most sensitive to habitat change regardless of the assumptions about density dependence and therefore shift the focus of restoration efforts; and (6) identify parameter and model uncertainties that substantially alter conclusions about which habitats limit recovery. Such analyses motivate critical research to identify and characterize poorly understood habitats, their effects on salmon abundance and survival, and the extent to which they have been modified.

Development of a limiting factors model in one or more SONCC coho salmon populations is identified as a research need (Table 5-3).

5.7 Assessing Restoration Actions

The restoration of physical habitat is one of the fundamental strategies used to achieve recovery. Therefore, the effectiveness of certain habitat restoration activities in achieving the desired habitat improvements should be identified, as well as the change or response in coho salmon populations. Three types of monitoring can be employed to evaluate restoration actions: implementation, effectiveness, and validation. Each type serves a unique purpose.

5.7.1 Implementation Monitoring

Implementation monitoring is designed to assess whether restoration projects are carried out as planned (MacDonald et al. 1991), according to the intended purpose and design. For example, implementation monitoring would be used to determine whether a barrier replacement was carried out according to the planned design.

5.7.2 Effectiveness Monitoring

Effectiveness monitoring is used to determine whether restoration actions result in the expected physical effect. For instance, effectiveness monitoring could be used to assess the short-term structural integrity (e.g., instream structure anchoring) and physical objectives (e.g., scouring due to instream structure placement) of implemented restoration actions. Much of this can be done through on-site observations. Effectiveness monitoring of restoration actions has two parts: (1) pre-treatment site characterization for establishing the conditions prior to restoration and (2) post-treatment monitoring to determine if the restoration is having the intended effects.

5.7.3 Validation Monitoring

Validation monitoring is designed to assess whether an anticipated biological response actually occurred. Validation monitoring can range from measuring short-term response (1 to 3 years) of coho salmon to restoration actions implemented at the project level (e.g., successful passage through a former barrier). In addition, validation monitoring may evaluate the long term response of coho salmon populations to the cumulative basin restoration.

Implementation monitoring should occur in conjunction with restoration actions, while effectiveness and validation monitoring are appropriate for a subset of restoration actions[12]. Many effectiveness or validation monitoring efforts should be undertaken in the same area where intense biological sampling occurs. Careful planning and implementation of restoration

[12] Chapter 5 contains a research recovery action to accomplish this.

activities within the same areas as LCMs will allow for these analyses to be conducted with little additional costs for status or biological information.

An accurate evaluation of the effectiveness of a restoration action requires a clear statement of the desired effect of the project on the environment. Restoration objectives should be expressed as quantifiable changes in environmental conditions. For example, if installation of an in-stream structure is intended to improve rearing habitat, the desired changes could be expressed in terms of pool frequency, in-stream cover, or some other measurable environmental characteristic. The objectives should be stated as desired outcomes (e.g., 50 percent of reach length in pools). If objectives are vague, it will be difficult to evaluate effectiveness (Harris et. al 2005).

It may be difficult or impossible to detect how much of a biological response is due to a restoration action, as opposed to other influences. Validation monitoring may be confounded by other potentially limiting factors or variables that are not addressed by the restoration action. Similarly, single project restoration actions may not have enough impact to see a measurable response at the basin scale (MacDonald et al. 1991). Therefore, validation monitoring may be best for restoration actions that result in a quick response to the quality of instream salmonid habitat, such as instream habitat and fish passage improvement projects. Validation monitoring of other restoration actions should occur as part of an intensively monitored watershed, or IMW. IMWs are intensive watershed-scale research and monitoring efforts. A project level effectiveness monitoring study might include a single restoration action implemented in one location. In contrast, an IMW would look at an entire suite of restoration actions at a larger watershed scale and attempt to determine how these combined restoration actions would affect physical and biological conditions (OWEB 2014). IMWs are used to evaluate assumptions about what should be done to improve habitat and resulting fish response. IMWs also allow evaluation of critical uncertainties for the limiting factors models. Monitoring efforts conducted in IMW may find that using the Before-After-Control-Impact (BACI) approach (Stewart-Oaten et al. 1986) will provide the most useful information to evaluate biological and physical response to restoration activities. BACI study designs are often used to determine if a restoration action had the intended effect. The spatial and temporal scale of both the treatment and response must be carefully considered for this type of design to be informative. For example, a large road decommissioning project may not reduce sediment delivery for a number of years after project implementation. Road decommissioning may have a short term negative effect on sediment delivery. The spatial scale might be considered a reach, stream, or basin while the temporal scale of response might be 10 years or more.

5.8 Database Management

As research and monitoring actions are carried out, a great deal of data will be generated. Data on the VSP parameters, stresses and threats, restoration actions, and other pertinent monitoring and adaptive management elements are expected to be collected into one or more electronic databases that will be accessible to conservation partners. Standards for data collection methods and calculations (for example, population estimates) should be developed with resource agencies and tribes to ensure data quality and consistency.

Table 5-8. Population names and associated Population ID codes to be used in conjunction with Table 5-9 to describe population-specific research actions.

Population Name	**Population ID**		**Population Name**	**Population ID**
Bear River	BeaR		Middle Mainstem Eel River	MMER
Brush Creek	BruC		Middle Rogue/Applegate R.	MRAR
Chetco River	CheR		Mussel Creek	MusC
Elk Creek	ElkC		North Fork Eel River	NFER
Elk River	ElkR		Norton/Widow White Creek	NWWC
Guthrie Creek	GutC		Pistol River	PisR
Humboldt Bay Tribs.	HBT		Redwood Creek	RedC
Hunter Creek	HunC		Salmon River	SalR
Illinois River	IllR		Scott River	ScoR
Lower Eel/Van Duzen R.	LEVR		South Fork Eel River	SFER
Little River	LitR		South Fork Trinity River	SFTR
Lower Klamath River	LKR		Shasta River	ShaR
Lower Rogue River	LRR		Smith River	SmiR
Lower Trinity River	LTR		Strawberry Creek	StrC
Mad River	MadR		Upper Klamath River	UKR
Maple Creek	MapC		Upper Mainstem Eel River	UMER
Mattole River	MatR		Upper Rogue River	URR
Mainstem Eel River	MER		Upper Trinity River	UTR
Middle Fork Eel River	MFER		Wilson Creek	WilC
Middle Klamath River	MKR		Winchuck River	WinR

Table 5-9. Implementation schedule for research-related recovery actions. Use in conjunction with Table 5-8 to determine appropriate Action ID and Step ID. For example, if use of SONCC.Exam.27.1.1 is desired in the Chetco River, the code to use would be SONCC.CheR.27.1.1. Priority is described in Section 6.6.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-Exam.29.2.17	Research	No	Determine best means to collect and interpret habitat data	Collect data using standard, consistent protocols	All	3d
SONCC-Exam.29.2.17.1	*Develop standards for data collection methods and calculations*					
SONCC-Exam.29.2.17.2	*Apply standards for data collection and calculations*					
SONCC-Exam.29.2.25	Research	No	Determine best means to collect and interpret habitat data	Determine best approach to conduct effectiveness and validation monitoring	All	3d
SONCC-Exam.29.2.25.1	*Determine whether goals of effectiveness and validation monitoring can be achieved by measuring a subset of restoration actions, rather than all of them. Determine appropriate subset.*					
SONCC-Exam.29.2.24	Research	No	Determine best means to collect and interpret habitat data	Track ocean productivity	All	3d
SONCC-Exam.29.2.24.1	*Compile data obtained from ocean net surveys, hatchery returns, and oceanic data collected by satellite and buoy arrays throughout the northeastern Pacific ocean.*					
SONCC-Exam.29.1.1	Research	No	Determine best means to collect and interpret population viability data	Assess patchily-distributed populations	All	3d
SONCC-Exam.29.1.1.1	*Understand factors that influence distribution of coho salmon*					
SONCC-Exam.29.1.1.2	*Develop survey design which considers factors that influence distribution of coho salmon to best assess patchily-distributed populations. Consider carrying out abundance surveys in consistently occupied, higher abundance patches and spatial structures*					
SONCC-Exam.29.1.18	Research	No	Determine best means to collect and interpret population viability data	Compile monitoring data into common databases	All	3d
SONCC-Exam.29.1.18.1	*Collect monitoring data into one or more electronic databases accessible to conservation partners*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-Exam.29.1.5	Research	No	Determine best means to collect and interpret population viability data	Determine accuracy of field protocols to detect juvenile occupancy and refine if needed	All	3d
SONCC-Exam.29.1.5.1		*Develop a juvenile spatial structure protocol that estimates detection probability*				
SONCC-Exam.29.1.5.2		*If detection probability is too low, refine protocol to obtain higher probability of detection*				
SONCC-Exam.29.1.4	Research	No	Determine best means to collect and interpret population viability data	Determine how to differentiate salmonid species observed using DIDSON.	Anywhere that DIDSON units are used to count salmonids	3d
SONCC-Exam.29.1.4.1		*Obtain data from DIDSON in areas where more than one species of salmonid are present*				
SONCC-Exam.29.1.4.2		*Develop method to differentiate different salmonid species using DIDSON images*				
SONCC-Exam.29.1.11	Research	No	Determine best means to collect and interpret population viability data	Determine needed number of reaches to sample, and needed time period over which to sample, to obtain target coefficient of variation and magnitude of trend	All	3d
SONCC-Exam.29.1.11.1		*Conduct a power analysis to determine the number of reaches that should be sampled to achieve the target coefficient of variation in each population*				
SONCC-Exam.29.1.11.2		*Conduct a power analysis to determine, given specified sample rates, over what time period a trend of specified magnitude can be detected and at what spatial scale*				
SONCC-Exam.29.1.2	Research	No	Determine best means to collect and interpret population viability data	Determine potential for recovery of populations	Populations which are extirpated or nearly extirpated	3d
SONCC-Exam.29.1.2.1		*Develop analytical tool to determine probability of recovery populations at different population sizes*				
SONCC-Exam.29.1.13	Research	No	Determine best means to collect and interpret population viability data	Determine whether chosen LCM locations capture existing spatial differences in marine survival due to different "marine environments"	Coastal LCM stations and adjacent ocean habitat	3d
SONCC-Exam.29.1.13.1		*Determine marine survival rates at coastal LCMs*				
SONCC-Exam.29.1.13.2		*Identify different "marine environments" which affect coho salmon survival*				
SONCC-Exam.29.1.13.3		*Determine whether chosen LCM locations capture different "marine environments"*				
SONCC-Exam.29.1.3	Research	No	Determine best means to collect and interpret population viability data	Determine whether the abundance targets for independent populations could be decreased if other parameters (spatial structure, diversity, productivity) were well-estimated	All	3d
SONCC-Exam.29.1.3.1		*Apply measures of spatial structure, diversity, and productivity to populations in the SONCC coho salmon ESU*				
SONCC-Exam.29.1.3.2		*Determine whether abundance targets for populations could be reduced*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-Exam.29.1.10	Research	No	Determine best means to collect and interpret population viability data	Determine whether the relationship between the number of redds and number of spawners is the same at Life Cycle Monitoring stations compared to elsewhere in the ESU.	All	3d
SONCC-Exam.29.1.10.1		*Determine the relationship between the number of redds and number of spawners at locations other than where LCMs are located*				
SONCC-Exam.29.1.10.2		*Compare the relationship between the number of redds and number of spawners at these alternative locations to the relationship found at LCMs*				
SONCC-Exam.29.1.8	Research	No	Determine best means to collect and interpret population viability data	Develop estimator for number of redds within a sample reach by modeling the redd deposition/obscurement process as an open population mark-recapture problem	All	3d
SONCC-Exam.29.1.8.1		*Use flagged redd recaptures on successive surveys to estimate rate at which existing redds cannot be detected in subsequent surveys*				
SONCC-Exam.29.1.8.2		*Adjust the number of new redds observed on new survey by survival rate since last survey*				
SONCC-Exam.29.1.8.3		*Use a non-parametric bootstrap routine to estimate within-reach uncertainty in number of redds*				
SONCC-Exam.29.1.6	Research	No	Determine best means to collect and interpret population viability data	Develop protocol for monitoring spatial structure	All areas in California	3d
SONCC-Exam.29.1.6.1		*Further develop the protocol for spatial structure described in Adams et al. 2011*				
SONCC-Exam.29.1.7	Research	No	Determine best means to collect and interpret population viability data	Develop survey designs and methods for assessing populations	Streams where traditional visual survey methods are not effective due to factors such as stream size, turbidity, and cover	3d
SONCC-Exam.29.1.7.1		*Identify factors (such as stream size, turbidity, and cover) which reduce efficacy of traditional visual survey methods*				
SONCC-Exam.29.1.7.2		*Develop survey designs and methods which account for identified factors*				
SONCC-Exam.29.1.7.3		*Carry out both new survey designs and methods, and traditional visual survey methods, in the same stream*				
SONCC-Exam.29.1.12	Research	No	Determine best means to collect and interpret population viability data	Estimate spawner abundance in remote areas	All	3d
SONCC-Exam.29.1.12.1		*Develop techniques to estimate spawner abundance in remote areas*				
SONCC-Exam.29.1.12.2		*Identify remote areas for which new techniques should be used*				
SONCC-Exam.29.1.12.3		*Estimate spawner abundance in remote areas using new techniques*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-Exam.29.1.9	Research	No	Determine best means to collect and interpret population viability data	Estimate total redd construction over regional space, incorporating within- and between-sample uncertainty.	All	3d
SONCC-Exam.29.1.9.1	*Use a bootstrap routine over large sample variance estimators for small sample frames and small sample sizes*					
SONCC-Exam.29.1.9.2	*Using the outcome the estimator for number of redds within a sample reach obtained in previous action step, develop algorithm for generating estimates of the number of redds within a sample space including the variation at the within-reach and between-reach levels*					
SONCC-Exam.29.3.20	Research	No	Improve understanding of SONCC coho salmon	Determine best means to develop population targets	All	3d
SONCC-Exam.29.3.20.1	*Research supplemental or alternative means to develop population targets*					
SONCC-Exam.29.3.20.2	*If appropriate, utilize supplemental or alternative means to develop population targets.*					
SONCC-Exam.29.3.23	Research	No	Improve understanding of SONCC coho salmon	Determine extent to which restoration actions result in the expected physical effect, and whether an anticipated biological response to actions occurred	All	3d
SONCC-Exam.29.3.23.1	*Determine subset of restoration actions for which effectiveness and validation monitoring should occur*					
SONCC-Exam.29.3.14	Research	No	Improve understanding of SONCC coho salmon	Ensure passage to areas sufficient for recovery	All	3d
SONCC-Exam.29.3.14.1	*Determine which areas blocked by barriers are necessary to attain coho salmon recovery*					
SONCC-Exam.29.3.15	Research	No	Improve understanding of SONCC coho salmon	Ensure predation does not limit attainment of recovery	All	3d
SONCC-Exam.29.3.15.1	*Determine what levels of predation do not limit attainment of population-specific recovery criteria*					
SONCC-Exam.29.3.22	Research	No	Improve understanding of SONCC coho salmon	Measure diversity of SONCC coho salmon populations	All	3d
SONCC-Exam.29.3.22.1	*Determine which life-history traits or other diversity parameters are the most meaningful measures of diversity, particularly in the context of future climate change impacts*					
SONCC-Exam.29.3.22.2	*Measure those life-history traits or other diversity parameters that are most meaningful measures of diversity*					
SONCC-Exam.29.3.16	Research	No	Improve understanding of SONCC coho salmon	Obtain better information on the extent and distribution of spawning in each Core and Non-Core 1 population area	All	3d
SONCC-Exam.29.3.16.1	*Develop methods to assess extent and distribution of spawning*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-Exam.29.3.21	Research	No	Improve understanding of SONCC coho salmon	Understand factors limiting recovery of SONCC coho salmon	All	3d
SONCC-Exam.29.3.21.1	*Develop a quantitative limiting factors life cycle model*					
SONCC-Exam.29.3.21.2	*Utilize quantitative limiting factors life cycle model to better understand factors limiting SONCC coho salmon in particular populations.*					
SONCC-Exam.29.3.19	Research	No	Improve understanding of SONCC coho salmon	Understand how juvenile distribution is influenced by environmental factors	All	3d
SONCC-Exam.29.3.19.1	*Determine how juvenile distribution is influenced by streamflow, temperature, and sediment barriers*					
SONCC-Exam.29.3.19.2	*Incorporate understanding into juvenile distribution survey methods.*					

Table 5-10. Monitoring-related recovery actions for Bear River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-BeaR.27.2.17	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-BeaR.27.2.17.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-BeaR.27.2.17.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-BeaR.27.2.18	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-BeaR.27.2.18.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-BeaR.27.2.19	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-BeaR.27.2.19.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-BeaR.27.2.21	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-BeaR.27.2.21.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-BeaR.27.2.22	Monitor	No	Track habitat condition	Monitor stream temperature	Population wide	3d
SONCC-BeaR.27.2.22.1	*Continue stream temperature monitoring at established locations*					
SONCC-BeaR.27.2.24	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-BeaR.27.2.24.1	*Determine best indicators of estuarine condition*					
SONCC-BeaR.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-BeaR.27.2.29.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-BeaR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-BeaR.27.2.30.1	*Identify habitat condition of the estuary*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-BeaR.27.2.35	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-BeaR.27.2.35.1	*Measure water temperature continuously during the summer period*					
SONCC-BeaR.27.1.15	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-BeaR.27.1.15.1	*Conduct presence/absence surveys for juveniles*					
SONCC-BeaR.27.1.16	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-BeaR.27.1.16.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-BeaR.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-BeaR.27.1.23.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-BeaR.27.1.23.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-BeaR.27.4.34	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-BeaR.27.4.34.1	*Describe the status and trends of road treatments and road density at least once every five years*					

Table 5-11. Monitoring-related recovery actions for Brush Creek.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-BruC.27.2.8	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-BruC.27.2.8.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-BruC.27.2.8.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-BruC.27.2.13	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-BruC.27.2.13.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-BruC.27.2.14	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-BruC.27.2.14.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-BruC.27.2.25	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	Population wide	3d
SONCC-BruC.27.2.25.1	*Annually monitor the extent of barriers due to sediment or seasonally dry areas*					
SONCC-BruC.27.1.12	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-BruC.27.1.12.1	*Conduct presence/absence surveys for juveniles*					
SONCC-BruC.27.1.15	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-BruC.27.1.15.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-BruC.27.1.15.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-BruC.27.1.24	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-BruC.27.1.24.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon*					
SONCC-BruC.27.4.21	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-BruC.27.4.21.1	*Describe the status and trends of road treatments and road density at least once every five years*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-BruC.27.4.22	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-BruC.27.4.22.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-BruC.27.4.23	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-BruC.27.4.23.1		*Describe new urban/residential/industrial development and changes to development at least once every five years*				

Table 5-12. Monitoring-related recovery actions for Chetco River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.27.2.25	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-CheR.27.2.25.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-CheR.27.2.25.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-CheR.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-CheR.27.2.26.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-CheR.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-CheR.27.2.27.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-CheR.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-CheR.27.2.28.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-CheR.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-CheR.27.2.29.1	*Continuously measure the hydrograph*					
SONCC-CheR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-CheR.27.2.30.1	*Identify habitat condition of the estuary*					
SONCC-CheR.27.2.34	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-CheR.27.2.34.1	*Measure water temperature continuously during the summer period*					
SONCC-CheR.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-CheR.27.2.35.1	*Identify habitat condition of the estuary*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-CheR.27.2.40	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-CheR.27.2.40.1		*Determine best indicators of estuarine condition*				
SONCC-CheR.27.2.57	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	Population wide	3d
SONCC-CheR.27.2.57.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				
SONCC-CheR.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-CheR.27.1.21.1		*Determine annual abundance of adult coho salmon*				
SONCC-CheR.27.1.22	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-CheR.27.1.22.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-CheR.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-CheR.27.1.23.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-CheR.27.1.24	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-CheR.27.1.24.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-CheR.27.1.38	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-CheR.27.1.38.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-CheR.27.1.38.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-CheR.27.1.39	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Measure VSP parameters of coho salmon in remote areas		3d
SONCC-CheR.27.1.39.1		*Develop techniques to estimate abundance, productivity, spatial structure, and diversity in remote areas.*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-CheR.27.1.52	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-CheR.27.1.52.1		*Conduct presence/absence surveys for juveniles*				
SONCC-CheR.27.4.53	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-CheR.27.4.53.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-CheR.27.4.54	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-CheR.27.4.54.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-CheR.27.4.55	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-CheR.27.4.55.1		*Describe new urban/residential/industrial development and changes to development at least once every five years*				
SONCC-CheR.27.4.56	Monitor	No	Track threat	Describe mining/gravel extraction threat	Population wide	3d
SONCC-CheR.27.4.56.1		*Describe any new mining or gravel extraction and any changes to existing mining and gravel extraction at least once every five years*				

Table 5-13. Monitoring-related recovery actions for Elk Creek.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkC.27.2.22	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-ElkC.27.2.22.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-ElkC.27.2.22.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-ElkC.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-ElkC.27.2.24.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-ElkC.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-ElkC.27.1.23.1	*Conduct presence/absence surveys for juveniles*					
SONCC-ElkC.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-ElkC.27.1.25.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-ElkC.27.1.25.2	*If appropriate, modify population types and targets using revised methodology*					

Table 5-14. Monitoring-related recovery actions for Elk River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkR.27.2.23	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-ElkR.27.2.23.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-ElkR.27.2.23.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-ElkR.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-ElkR.27.2.24.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-ElkR.27.2.25	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-ElkR.27.2.25.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-ElkR.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-ElkR.27.2.26.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-ElkR.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-ElkR.27.2.27.1	*Continuously measure the hydrograph*					
SONCC-ElkR.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-ElkR.27.2.32.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-ElkR.27.2.34	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-ElkR.27.2.34.1	*Determine best indicators of estuarine condition*					
SONCC-ElkR.27.1.20	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-ElkR.27.1.20.1	*Determine annual abundance of adult coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ElkR.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-ElkR.27.1.21.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-ElkR.27.1.22	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-ElkR.27.1.22.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-ElkR.27.1.31	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-ElkR.27.1.31.1		*Conduct presence/absence surveys for juveniles*				
SONCC-ElkR.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-ElkR.27.1.33.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-ElkR.27.1.33.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-ElkR.27.1.44	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-ElkR.27.1.44.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-ElkR.27.4.42	Monitor	No	Track threat	Describe threat of road-stream crossing barriers	Population wide	3d
SONCC-ElkR.27.4.42.1		*Describe any new road-stream crossing barriers and any changes to existing road-stream crossing barriers at least once every five years*				
SONCC-ElkR.27.4.43	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-ElkR.27.4.43.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

Table 5-15. Monitoring-related recovery actions for Guthrie Creek.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-GutC.27.2.5	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-GutC.27.2.5.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-GutC.27.2.5.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-GutC.27.2.7	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-GutC.27.2.7.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-GutC.27.1.6	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-GutC.27.1.6.1	*Conduct presence/absence surveys for juveniles*					
SONCC-GutC.27.1.8	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-GutC.27.1.8.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-GutC.27.1.8.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-GutC.27.1.16	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-GutC.27.1.16.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-GutC.27.4.15	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-GutC.27.4.15.1	*Describe the status and trends of road treatments and road density at least once every five years*					

Table 5-16. Monitoring-related recovery actions for Humboldt Bay Tributaries.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HBT.27.2.28	Monitor	No	Track habitat condition	Develop an instream sediment monitoring plan	Tributary streams; tidally influenced habitat of Arcata sub-basin; non-natal rearing habitat	3d
SONCC-HBT.27.2.28.1	*Develop an in-stream sediment monitoring plan and establish monitoring stations*					
SONCC-HBT.27.2.29	Monitor	No	Track habitat condition	Monitor stream temperature	Population wide	3d
SONCC-HBT.27.2.29.1	*Conduct stream temperature monitoring at established stations, and establish additional stations in lower watershed to assess diel fluctuations in habitat availability*					
SONCC-HBT.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-HBT.27.2.34.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-HBT.27.2.34.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-HBT.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-HBT.27.2.35.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-HBT.27.2.36	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-HBT.27.2.36.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-HBT.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-HBT.27.2.37.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-HBT.27.2.38	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-HBT.27.2.38.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-HBT.27.2.39	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-HBT.27.2.39.1	*Identify habitat condition of the estuary*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-HBT.27.2.42	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-HBT.27.2.42.1		*Determine best indicators of estuarine condition*				
SONCC-HBT.27.2.48	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	All IP habitat	3d
SONCC-HBT.27.2.48.1		*Assess barriers limiting coho salmon distribution*				
SONCC-HBT.27.1.30	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-HBT.27.1.30.1		*Determine annual abundance of adult coho salmon*				
SONCC-HBT.27.1.31	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-HBT.27.1.31.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-HBT.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-HBT.27.1.32.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-HBT.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-HBT.27.1.33.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-HBT.27.1.41	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-HBT.27.1.41.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-HBT.27.1.41.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-HBT.27.1.52	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-HBT.27.1.52.1		*Conduct presence/absence surveys for juveniles*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-HBT.27.4.49	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-HBT.27.4.49.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-HBT.27.4.50	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-HBT.27.4.50.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-HBT.27.4.51	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-HBT.27.4.51.1		*Describe new urban/residential/industrial development and changes to development at least once every five years*				

Table 5-17. Monitoring-related recovery actions for Hunter Creek.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HunC.27.2.9	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-HunC.27.2.9.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-HunC.27.2.9.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-HunC.27.2.19	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-HunC.27.2.19.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-HunC.27.2.20	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-HunC.27.2.20.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-HunC.27.2.22	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-HunC.27.2.22.1	*Determine best indicators of estuarine condition*					
SONCC-HunC.27.2.33	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-HunC.27.2.33.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-HunC.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-HunC.27.2.34.1	*Identify habitat condition of the estuary*					
SONCC-HunC.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-HunC.27.2.35.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-HunC.27.2.36	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-HunC.27.2.36.1	*Measure water temperature continuously during the summer period*					
SONCC-HunC.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	Population wide	3d
SONCC-HunC.27.2.37.1	*Annually monitor the extent of barriers due to sediment or seasonally dry areas*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-HunC.27.1.18	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-HunC.27.1.18.1		*Conduct presence/absence surveys for juveniles*				
SONCC-HunC.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-HunC.27.1.21.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-HunC.27.1.21.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-HunC.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-HunC.27.1.32.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-HunC.27.4.29	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-HunC.27.4.29.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-HunC.27.4.30	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-HunC.27.4.30.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-HunC.27.4.31	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-HunC.27.4.31.1		*Describe new urban/residential/industrial development and changes to development at least once every five years*				

Table 5-18. Monitoring-related recovery actions for Illinois River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-IIIR.27.2.25	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-IIIR.27.2.25.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-IIIR.27.2.25.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-IIIR.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-IIIR.27.2.26.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-IIIR.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-IIIR.27.2.27.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-IIIR.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-IIIR.27.2.28.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-IIIR.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-IIIR.27.2.29.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-IIIR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-IIIR.27.2.30.1	*Continuously measure the hydrograph*					
SONCC-IIIR.27.2.58	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-IIIR.27.2.58.1	*Measure water temperature continuously during the summer period*					
SONCC-IIIR.27.2.59	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	Population wide	3d
SONCC-IIIR.27.2.59.1	*Assess barriers limiting distribution of coho salmon*					
SONCC-IIIR.27.2.60	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-IIIR.27.2.60.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-IIIR.27.2.61	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-IIIR.27.2.61.1	*Identify habitat condition of the estuary*					
SONCC-IIIR.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-IIIR.27.1.21.1	*Determine annual abundance of adult coho salmon*					
SONCC-IIIR.27.1.22	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-IIIR.27.1.22.1	*Install and annually operate a life cycle monitoring (LCM) station*					
SONCC-IIIR.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-IIIR.27.1.23.1	*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*					
SONCC-IIIR.27.1.24	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-IIIR.27.1.24.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-IIIR.27.1.39	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-IIIR.27.1.39.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-IIIR.27.1.39.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-IIIR.27.1.40	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Measure VSP parameters of coho salmon in remote areas	Population wide	3d
SONCC-IIIR.27.1.40.1	*Develop techniques to estimate abundance, productivity, spatial structure, and diversity in remote areas.*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-IIIR.27.1.62	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-IIIR.27.1.62.1		*Conduct presence/absence surveys for juveniles*				
SONCC-IIIR.27.4.54	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-IIIR.27.4.54.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-IIIR.27.4.55	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-IIIR.27.4.55.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-IIIR.27.4.56	Monitor	No	Track threat	Describe mining/gravel extraction threat	Population wide	3d
SONCC-IIIR.27.4.56.1		*Describe any new mining or gravel extraction and any changes to existing mining and gravel extraction at least once every five years*				
SONCC-IIIR.27.4.57	Monitor	No	Track threat	Describe threat of road-stream crossing barriers	Population wide	3d
SONCC-IIIR.27.4.57.1		*Describe any new road-stream crossing barriers and any changes to existing road-stream crossing barriers at least once every five years*				
SONCC-IIIR.27.4.63	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-IIIR.27.4.63.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

Table 5-19. Monitoring-related recovery actions for Little River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LitR.27.2.16	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-LitR.27.2.16.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-LitR.27.2.16.2		*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*				
SONCC-LitR.27.2.17	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-LitR.27.2.17.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-LitR.27.2.18	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-LitR.27.2.18.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-LitR.27.2.19	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-LitR.27.2.19.1		*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*				
SONCC-LitR.27.1.13	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-LitR.27.1.13.1		*Determine annual abundance of adult coho salmon*				
SONCC-LitR.27.1.14	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-LitR.27.1.14.1		*Conduct presence/absence surveys for juveniles*				
SONCC-LitR.27.1.15	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-LitR.27.1.15.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LitR.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-LitR.27.1.23.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-LitR.27.1.23.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-LitR.27.4.26	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-LitR.27.4.26.1		*Describe the status and trends of road treatments and road density at least once every five years*				

Table 5-20. Monitoring-related recovery actions for Lower Eel/Van Duzen Rivers.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-LEVR.27.2.30.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-LEVR.27.2.30.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-LEVR.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-LEVR.27.2.31.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-LEVR.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-LEVR.27.2.32.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-LEVR.27.2.33	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-LEVR.27.2.33.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-LEVR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-LEVR.27.2.34.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-LEVR.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-LEVR.27.2.35.1	*Identify habitat condition of the estuary*					
SONCC-LEVR.27.2.41	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-LEVR.27.2.41.1	*Determine best indicators of estuarine condition*					
SONCC-LEVR.27.2.58	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-LEVR.27.2.58.1	*Measure water temperature continuously during the summer period*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LEVR.27.2.59	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-LEVR.27.2.59.1		*Identify instream flow needs for coho salmon*				
SONCC-LEVR.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-LEVR.27.1.26.1		*Determine annual abundance of adult coho salmon*				
SONCC-LEVR.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-LEVR.27.1.27.1		*Conduct presence/absence surveys for juveniles*				
SONCC-LEVR.27.1.28	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-LEVR.27.1.28.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-LEVR.27.1.29	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3d
SONCC-LEVR.27.1.29.1		*Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin*				
SONCC-LEVR.27.1.29.2		*Identify the status and trend of invasive species*				
SONCC-LEVR.27.1.39	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-LEVR.27.1.39.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-LEVR.27.1.40	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-LEVR.27.1.40.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-LEVR.27.1.40.2		*If appropriate, modify population types and targets using revised methodology*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LEVR.27.1.61	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-LEVR.27.1.61.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-LEVR.27.4.54	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-LEVR.27.4.54.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-LEVR.27.4.55	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-LEVR.27.4.55.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-LEVR.27.4.56	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-LEVR.27.4.56.1		*Describe new urban/residential/industrial development and changes to development at least once every five years*				
SONCC-LEVR.27.4.57	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-LEVR.27.4.57.1		*Describe status and trend of abundance and distribution of invasive species annually*				
SONCC-LEVR.27.4.60	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-LEVR.27.4.60.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

Table 5-21. Monitoring-related recovery actions for Lower Klamath River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LKR.27.2.33	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-LKR.27.2.33.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-LKR.27.2.33.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-LKR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-LKR.27.2.34.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-LKR.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-LKR.27.2.35.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-LKR.27.2.36	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-LKR.27.2.36.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-LKR.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-LKR.27.2.37.1	*Continuously measure the hydrograph*					
SONCC-LKR.27.2.37.2	*Identify instream flow needs for coho salmon*					
SONCC-LKR.27.2.38	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-LKR.27.2.38.1	*Identify habitat condition of the estuary*					
SONCC-LKR.27.2.44	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-LKR.27.2.44.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LKR.27.1.29	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-LKR.27.1.29.1		*Determine annual abundance of adult coho salmon*				
SONCC-LKR.27.1.30	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-LKR.27.1.30.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-LKR.27.1.31	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-LKR.27.1.31.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-LKR.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-LKR.27.1.32.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-LKR.27.1.32.2		*Annually estimate the in-river tribal harvest of wild/natural SONCC coho salmon*				
SONCC-LKR.27.1.42	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Disease'	All IP habitat	3d
SONCC-LKR.27.1.42.1		*Annually estimate the infection and mortality rate of juvenile coho salmon from pathogens, such as Ceratonova shasta and Parvicapsula minibicornis*				
SONCC-LKR.27.1.43	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-LKR.27.1.43.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-LKR.27.1.43.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-LKR.27.1.49	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-LKR.27.1.49.1		*Conduct presence/absence surveys for juveniles*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LKR.27.4.47	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-LKR.27.4.47.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-LKR.27.4.48	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-LKR.27.4.48.1	*Describe new channelization/diking and changes to channelization/diking at least once every five years*					

Table 5-22. Monitoring-related recovery actions for Lower Rogue River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LRR.27.2.19	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-LRR.27.2.19.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-LRR.27.2.19.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-LRR.27.2.20	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-LRR.27.2.20.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-LRR.27.2.21	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-LRR.27.2.21.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-LRR.27.2.22	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-LRR.27.2.22.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-LRR.27.2.23	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-LRR.27.2.23.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-LRR.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-LRR.27.2.24.1	*Identify habitat condition of the estuary*					
SONCC-LRR.27.2.31	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-LRR.27.2.31.1	*Determine best indicators of estuarine condition*					
SONCC-LRR.27.2.42	Monitor	No	Track habitat condition	Track water temperature	Population wide	3d
SONCC-LRR.27.2.42.1	*Measure water temperature continuously during the summer period*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LRR.27.1.16	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-LRR.27.1.16.1		*Determine annual abundance of adult coho salmon*				
SONCC-LRR.27.1.17	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-LRR.27.1.17.1		*Conduct presence/absence surveys for juveniles*				
SONCC-LRR.27.1.18	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-LRR.27.1.18.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-LRR.27.1.28	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-LRR.27.1.28.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-LRR.27.1.30	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-LRR.27.1.30.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-LRR.27.1.30.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-LRR.27.4.39	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-LRR.27.4.39.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-LRR.27.4.40	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-LRR.27.4.40.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-LRR.27.4.41	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-LRR.27.4.41.1		*Describe new urban/residential/industrial development and changes to development at least once every five years*				
SONCC-LRR.27.4.43	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-LRR.27.4.43.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

Table 5-23. Monitoring-related recovery actions for Lower Trinity River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LTR.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-LTR.27.2.24.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-LTR.27.2.24.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-LTR.27.2.25	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-LTR.27.2.25.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-LTR.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-LTR.27.2.26.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-LTR.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-LTR.27.2.27.1	*Continuously measure the hydrograph*					
SONCC-LTR.27.2.27.2	*Identify instream flow needs for coho salmon*					
SONCC-LTR.27.1.20	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-LTR.27.1.20.1	*Determine annual abundance of adult coho salmon*					
SONCC-LTR.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-LTR.27.1.21.1	*Install and annually operate a life cycle monitoring (LCM) station*					
SONCC-LTR.27.1.22	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-LTR.27.1.22.1	*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LTR.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-LTR.27.1.23.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-LTR.27.1.23.2	*Annually estimate the in-river tribal harvest of wild/natural SONCC coho salmon*					
SONCC-LTR.27.1.34	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-LTR.27.1.34.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-LTR.27.1.34.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-LTR.27.1.41	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Hatchery Management'	All IP habitat	3d
SONCC-LTR.27.1.41.1	*Annually determine the percent of hatchery origin spawners (PHOS), percent of natural origin spawners (PNOS), and the proportion of natural influence (PNI)*					
SONCC-LTR.27.1.45	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-LTR.27.1.45.1	*Conduct presence/absence surveys for juveniles*					
SONCC-LTR.27.4.42	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-LTR.27.4.42.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-LTR.27.4.43	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-LTR.27.4.43.1	*Describe new channelization/diking and changes to channelization/diking at least once every five years*					
SONCC-LTR.27.4.44	Monitor	No	Track threat	Describe threat of hatcheries	Population wide	3d
SONCC-LTR.27.4.44.1	*Describe status of development and implementation of applicable HGMPs at least one every five years*					

Table 5-24. Monitoring-related recovery actions for Mad River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MadR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-MadR.27.2.30.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-MadR.27.2.30.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-MadR.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-MadR.27.2.31.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-MadR.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-MadR.27.2.32.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-MadR.27.2.33	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MadR.27.2.33.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-MadR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-MadR.27.2.34.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-MadR.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-MadR.27.2.35.1	*Identify habitat condition of the estuary*					
SONCC-MadR.27.2.40	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-MadR.27.2.40.1	*Determine best indicators of estuarine condition*					
SONCC-MadR.27.2.45	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-MadR.27.2.45.1	*Measure water temperature continuously during the summer period*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MadR.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-MadR.27.1.25.1		*Determine annual abundance of adult coho salmon*				
SONCC-MadR.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-MadR.27.1.26.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-MadR.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track surrogate for genetic diversity	Mad River Hatchery	3d
SONCC-MadR.27.1.27.1		*Describe annual ratio of naturally-produced fish to hatchery-produced fish spawned for hatchery production*				
SONCC-MadR.27.1.28	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-MadR.27.1.28.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-MadR.27.1.29	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Hatchery Management'	Population wide	3d
SONCC-MadR.27.1.29.1		*Annually determine the percent of hatchery origin spawners (PHOS), percent of natural origin spawners (PNOS), and the proportion of natural influence (PNI)*				
SONCC-MadR.27.1.38	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-MadR.27.1.38.1		*Conduct presence/absence surveys for juveniles*				
SONCC-MadR.27.1.39	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-MadR.27.1.39.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-MadR.27.1.39.2		*If appropriate, modify population types and targets using revised methodology*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MadR.27.4.42	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-MadR.27.4.42.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-MadR.27.4.43	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-MadR.27.4.43.1	*Describe new channelization/diking and changes to channelization/diking at least once every five years*					
SONCC-MadR.27.4.44	Monitor	No	Track threat	Describe mining/gravel extraction threat	Population wide	3d
SONCC-MadR.27.4.44.1	*Describe any new mining or gravel extraction and any changes to existing mining and gravel extraction at least once every five years*					

Table 5-25. Monitoring-related recovery actions for Mainstem Eel River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MER.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-MER.27.2.27.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-MER.27.2.27.2		*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*				
SONCC-MER.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-MER.27.2.28.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-MER.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MER.27.2.29.1		*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*				
SONCC-MER.27.2.40	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-MER.27.2.40.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-MER.27.2.41	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-MER.27.2.41.1		*Measure the indicators, pH, D.O., temperature, and aquatic insects*				
SONCC-MER.27.2.42	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-MER.27.2.42.1		*Continuously measure the hydrograph*				
SONCC-MER.27.2.42.2		*Identify instream flow needs for coho salmon*				
SONCC-MER.27.2.43	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-MER.27.2.43.1		*Identify habitat condition of the estuary*				
SONCC-MER.27.2.47	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-MER.27.2.47.1		*Determine best indicators of estuarine condition*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MER.27.2.48	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-MER.27.2.48.1		*Measure water temperature continuously during the summer period*				
SONCC-MER.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-MER.27.1.23.1		*Determine annual abundance of adult coho salmon*				
SONCC-MER.27.1.24	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-MER.27.1.24.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-MER.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-MER.27.1.25.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-MER.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3d
SONCC-MER.27.1.26.1		*Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin*				
SONCC-MER.27.1.26.2		*Identify the status and trend of invasive species*				
SONCC-MER.27.1.30	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-MER.27.1.30.1		*Conduct presence/absence surveys for juveniles*				
SONCC-MER.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-MER.27.1.32.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-MER.27.1.32.2		*If appropriate, modify population types and targets using revised methodology*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MER.27.1.50	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-MER.27.1.50.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-MER.27.4.44	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-MER.27.4.44.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-MER.27.4.45	Monitor	No	Track threat	Describe threat of high intensity fire	Population wide	3d
SONCC-MER.27.4.45.1		*Describe trends in occurrence of high intensity fire at least once every five years*				
SONCC-MER.27.4.46	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-MER.27.4.46.1		*Describe status and trend of abundance and distribution of invasive species annually*				
SONCC-MER.27.4.49	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-MER.27.4.49.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

Table 5-26. Monitoring-related recovery actions for Maple Creek/Big Lagoon.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MapC.27.2.17	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-MapC.27.2.17.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-MapC.27.2.17.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-MapC.27.2.18	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-MapC.27.2.18.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-MapC.27.2.19	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MapC.27.2.19.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-MapC.27.2.20	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-MapC.27.2.20.1	*Identify habitat condition of the estuary*					
SONCC-MapC.27.2.23	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-MapC.27.2.23.1	*Determine best indicators of estuarine condition*					
SONCC-MapC.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-MapC.27.2.24.1	*Continuously measure the hydrograph*					
SONCC-MapC.27.2.24.2	*Identify instream flow needs for coho salmon*					
SONCC-MapC.27.1.15	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-MapC.27.1.15.1	*Conduct presence/absence surveys for juveniles*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MapC.27.1.16	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-MapC.27.1.16.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-MapC.27.1.22	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	BR
SONCC-MapC.27.1.22.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-MapC.27.1.22.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-MapC.27.4.25	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-MapC.27.4.25.1		*Describe the status and trends of road treatments and road density at least once every five years*				

Table 5-27. Monitoring-related recovery actions for Mattole River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-MatR.27.2.28.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-MatR.27.2.28.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-MatR.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-MatR.27.2.29.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-MatR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-MatR.27.2.30.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-MatR.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MatR.27.2.31.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-MatR.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-MatR.27.2.32.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-MatR.27.2.33	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-MatR.27.2.33.1	*Continuously measure the hydrograph*					
SONCC-MatR.27.2.33.2	*Identify instream flow needs for coho salmon*					
SONCC-MatR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-MatR.27.2.34.1	*Identify habitat condition of the estuary*					
SONCC-MatR.27.2.38	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-MatR.27.2.38.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MatR.27.2.53	Monitor	No	Track habitat condition	Track water temperature	Population wide	3d
SONCC-MatR.27.2.53.1	*Measure water temperature continuously during the summer period*					
SONCC-MatR.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-MatR.27.1.25.1	*Determine annual abundance of adult coho salmon*					
SONCC-MatR.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-MatR.27.1.26.1	*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*					
SONCC-MatR.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-MatR.27.1.27.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-MatR.27.1.36	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-MatR.27.1.36.1	*Conduct presence/absence surveys for juveniles*					
SONCC-MatR.27.1.37	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-MatR.27.1.37.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-MatR.27.1.37.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-MatR.27.4.50	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-MatR.27.4.50.1	*Describe new urban/residential/industrial development and changes to development at least once every five years*					
SONCC-MatR.27.4.51	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-MatR.27.4.51.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-MatR.27.4.52	Monitor	No	Track threat	Describe threat of high intensity fire	Population wide	3d
SONCC-MatR.27.4.52.1	*Describe trends in occurrence of high intensity fire at least once every five years*					

Table 5-28. Monitoring-related recovery actions for Middle Fork Eel River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MFER.27.2.18	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-MFER.27.2.18.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-MFER.27.2.18.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-MFER.27.2.19	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-MFER.27.2.19.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-MFER.27.2.20	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MFER.27.2.20.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-MFER.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-MFER.27.2.26.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-MFER.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MFER.27.2.27.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-MFER.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-MFER.27.2.28.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-MFER.27.2.30	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-MFER.27.2.30.1	*Measure water temperature continuously during the summer period*					
SONCC-MFER.27.2.36	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-MFER.27.2.36.1	*Identify habitat condition of the estuary*					
SONCC-MFER.27.2.37	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-MFER.27.2.37.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MFER.27.1.16	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-MFER.27.1.16.1	*Conduct presence/absence surveys for juveniles*					
SONCC-MFER.27.1.17	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-MFER.27.1.17.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-MFER.27.1.17.2	*Annually estimate the in-river tribal harvest of wild/natural SONCC coho salmon*					
SONCC-MFER.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3d
SONCC-MFER.27.1.21.1	*Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin*					
SONCC-MFER.27.1.21.2	*Identify the status and trend of invasive species*					
SONCC-MFER.27.1.24	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-MFER.27.1.24.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-MFER.27.1.24.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-MFER.27.4.31	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-MFER.27.4.31.1	*Annually monitor the extent of barriers due to sediment or seasonally dry areas*					
SONCC-MFER.27.4.32	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-MFER.27.4.32.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-MFER.27.4.33	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-MFER.27.4.33.1	*Describe new channelization/diking and changes to channelization/diking at least once every five years*					
SONCC-MFER.27.4.34	Monitor	No	Track threat	Describe threat of high intensity fire	Population wide	3d
SONCC-MFER.27.4.34.1	*Describe trends in occurrence of high intensity fire at least once every five years*					
SONCC-MFER.27.4.35	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-MFER.27.4.35.1	*Describe status and trend of abundance and distribution of invasive species annually*					

Table 5-29. Monitoring-related recovery actions for Middle Mainstem Eel River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MMER.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-MMER.27.2.27.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-MMER.27.2.27.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-MMER.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-MMER.27.2.28.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-MMER.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-MMER.27.2.29.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-MMER.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MMER.27.2.30.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-MMER.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-MMER.27.2.31.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-MMER.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-MMER.27.2.32.1	*Continuously measure the hydrograph*					
SONCC-MMER.27.2.32.2	*Identify instream flow needs for coho salmon*					
SONCC-MMER.27.2.45	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-MMER.27.2.45.1	*Identify habitat condition of the estuary*					
SONCC-MMER.27.2.46	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-MMER.27.2.46.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MMER.27.2.47	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-MMER.27.2.47.1		*Measure water temperature continuously during the summer period*				
SONCC-MMER.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-MMER.27.1.23.1		*Determine annual abundance of adult coho salmon*				
SONCC-MMER.27.1.24	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-MMER.27.1.24.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-MMER.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-MMER.27.1.25.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-MMER.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3d
SONCC-MMER.27.1.26.1		*Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin*				
SONCC-MMER.27.1.26.2		*Identify the status and trend of invasive species*				
SONCC-MMER.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-MMER.27.1.33.1		*Conduct presence/absence surveys for juveniles*				
SONCC-MMER.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-MMER.27.1.35.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-MMER.27.1.35.2		*If appropriate, modify population types and targets using revised methodology*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MMER.27.1.49	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-MMER.27.1.49.1	*Install and annually operate a life cycle monitoring (LCM) station*					
SONCC-MMER.27.4.41	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-MMER.27.4.41.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-MMER.27.4.42	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-MMER.27.4.42.1	*Describe new channelization/diking and changes to channelization/diking at least once every five years*					
SONCC-MMER.27.4.43	Monitor	No	Track threat	Describe threat of high intensity fire	Population wide	3d
SONCC-MMER.27.4.43.1	*Describe trends in occurrence of high intensity fire at least once every five years*					
SONCC-MMER.27.4.44	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-MMER.27.4.44.1	*Describe status and trend of abundance and distribution of invasive species annually*					
SONCC-MMER.27.4.48	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-MMER.27.4.48.1	*Annually monitor the extent of barriers due to sediment or seasonally dry areas*					

Table 5-30. Monitoring-related recovery actions for Middle Rogue/Applegate Rivers.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.27.2.23	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-MRAR.27.2.23.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-MRAR.27.2.23.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-MRAR.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-MRAR.27.2.24.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-MRAR.27.2.25	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-MRAR.27.2.25.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-MRAR.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MRAR.27.2.26.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-MRAR.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-MRAR.27.2.27.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-MRAR.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-MRAR.27.2.28.1	*Continuously measure the hydrograph*					
SONCC-MRAR.27.2.28.2	*Identify instream flow needs for coho salmon*					
SONCC-MRAR.27.2.58	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-MRAR.27.2.58.1	*Identify habitat condition of the estuary*					
SONCC-MRAR.27.2.59	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-MRAR.27.2.59.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MRAR.27.2.61	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-MRAR.27.2.61.1		*Measure water temperature continuously during the summer period*				
SONCC-MRAR.27.1.20	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-MRAR.27.1.20.1		*Determine annual abundance of adult coho salmon*				
SONCC-MRAR.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-MRAR.27.1.21.1		*Conduct presence/absence surveys for juveniles*				
SONCC-MRAR.27.1.22	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-MRAR.27.1.22.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-MRAR.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-MRAR.27.1.33.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-MRAR.27.1.36	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-MRAR.27.1.36.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-MRAR.27.1.36.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-MRAR.27.4.52	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-MRAR.27.4.52.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-MRAR.27.4.53	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-MRAR.27.4.53.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.27.4.54	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-MRAR.27.4.54.1	*Describe new urban/residential/industrial development and changes to development at least once every five years*					
SONCC-MRAR.27.4.55	Monitor	No	Track threat	Describe mining/gravel extraction threat	Population wide	3d
SONCC-MRAR.27.4.55.1	*Describe any new mining or gravel extraction and any changes to existing mining and gravel extraction at least once every five years*					
SONCC-MRAR.27.4.56	Monitor	No	Track threat	Describe threat of road-stream crossing barriers	Population wide	3d
SONCC-MRAR.27.4.56.1	*Describe any new road-stream crossing barriers and any changes to existing road-stream crossing barriers at least once every five years*					
SONCC-MRAR.27.4.60	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-MRAR.27.4.60.1	*Describe status and trend of abundance and distribution of invasive species annually*					
SONCC-MRAR.27.4.62	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-MRAR.27.4.62.1	*Annually monitor the extent of barriers due to sediment or seasonally dry areas*					

Table 5-31. Monitoring-related recovery actions for Middle Klamath River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MKR.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-MKR.27.2.37.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-MKR.27.2.37.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-MKR.27.2.38	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-MKR.27.2.38.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-MKR.27.2.39	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MKR.27.2.39.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-MKR.27.2.40	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-MKR.27.2.40.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-MKR.27.2.41	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-MKR.27.2.41.1	*Continuously measure the hydrograph*					
SONCC-MKR.27.2.41.2	*Identify instream flow needs for coho salmon*					
SONCC-MKR.27.2.47	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	All IP habitat	3d
SONCC-MKR.27.2.47.1	*Assess barriers limiting distribution of coho salmon*					
SONCC-MKR.27.2.48	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-MKR.27.2.48.1	*Identify habitat condition of the estuary*					
SONCC-MKR.27.2.49	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-MKR.27.2.49.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MKR.27.2.50	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-MKR.27.2.50.1		*Measure water temperature continuously during the summer period*				
SONCC-MKR.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate survival of juvenile coho salmon	Population wide	3d
SONCC-MKR.27.1.32.1		*Develop comprehensive PIT tagging and retrieval project that assesses habitat use and survival*				
SONCC-MKR.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-MKR.27.1.33.1		*Determine annual abundance of adult coho salmon*				
SONCC-MKR.27.1.34	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-MKR.27.1.34.1		*Conduct presence/absence surveys for juveniles*				
SONCC-MKR.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-MKR.27.1.35.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-MKR.27.1.36	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Disease'	Population wide	3d
SONCC-MKR.27.1.36.1		*Annually estimate the infection and mortality rate of juvenile coho salmon from pathogens, such as Ceratonova shasta and Parvicapsula minibicornis*				
SONCC-MKR.27.1.44	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-MKR.27.1.44.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-MKR.27.1.44.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-MKR.27.4.46	Monitor	No	Track threat	Describe threat of high intensity fire	Population wide	3d
SONCC-MKR.27.4.46.1		*Describe trends in occurrence of high intensity fire at least once every five years*				
SONCC-MKR.27.4.51	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-MKR.27.4.51.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

Table 5-32. Monitoring-related recovery actions for Mussel Creek.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MusC.27.2.10	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-MusC.27.2.10.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-MusC.27.2.10.2		*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*				
SONCC-MusC.27.2.13	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-MusC.27.2.13.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-MusC.27.2.14	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-MusC.27.2.14.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-MusC.27.2.16	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-MusC.27.2.16.1		*Determine best indicators of estuarine condition*				
SONCC-MusC.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-MusC.27.2.27.1		*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*				
SONCC-MusC.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-MusC.27.2.28.1		*Identify habitat condition of the estuary*				
SONCC-MusC.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-MusC.27.2.29.1		*Continuously measure the hydrograph*				
SONCC-MusC.27.2.29.2		*Identify instream flow needs for coho salmon*				
SONCC-MusC.27.1.12	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-MusC.27.1.12.1		*Conduct presence/absence surveys for juveniles*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MusC.27.1.15	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-MusC.27.1.15.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-MusC.27.1.15.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-MusC.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-MusC.27.1.26.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-MusC.27.4.23	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-MusC.27.4.23.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-MusC.27.4.24	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-MusC.27.4.24.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-MusC.27.4.25	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-MusC.27.4.25.1		*Describe new urban/residential/industrial development and changes to development at least once every five years*				
SONCC-MusC.27.4.30	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-MusC.27.4.30.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

Table 5-33. Monitoring-related recovery actions for North Fork Eel River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NFER.27.2.24	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-NFER.27.2.24.1	*Determine best indicators of estuarine condition*					
SONCC-NFER.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-NFER.27.2.37.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-NFER.27.2.37.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-NFER.27.2.12	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-NFER.27.2.12.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-NFER.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	Population wide	3d
SONCC-NFER.27.2.27.1	*Annually monitor the extent of barriers due to sediment or seasonally dry areas*					
SONCC-NFER.27.2.13	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-NFER.27.2.13.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-NFER.27.2.17	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-NFER.27.2.17.1	*Identify habitat condition of the estuary*					
SONCC-NFER.27.2.19	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-NFER.27.2.19.1	*Continuously measure the hydrograph*					
SONCC-NFER.27.2.19.2	*Identify instream flow needs for coho salmon*					
SONCC-NFER.27.2.18	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-NFER.27.2.18.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-NFER.27.2.16	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-NFER.27.2.16.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-NFER.27.2.28	Monitor	No	Track habitat condition	Track ocean productivity	Population wide	3d
SONCC-NFER.27.2.28.1		*Compile and analyze data obtained from ocean net surveys, hatchery returns, satellites and buoy arrays in the ocean*				
SONCC-NFER.27.2.26	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-NFER.27.2.26.1		*Measure water temperature continuously during the summer period*				
SONCC-NFER.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-NFER.27.1.25.1		*Conduct presence/absence surveys for juveniles*				
SONCC-NFER.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-NFER.27.1.23.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon*				
SONCC-NFER.27.1.14	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3d
SONCC-NFER.27.1.14.1		*Identify the status and trend of invasive species*				
SONCC-NFER.27.4.20	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-NFER.27.4.20.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-NFER.27.4.21	Monitor	No	Track threat	Describe threat of high intensity fire	Population wide	3d
SONCC-NFER.27.4.21.1		*Describe trends in occurrence of high severity fire at least once every five years*				
SONCC-NFER.27.4.22	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-NFER.27.4.22.1		*Describe status and trend of abundance and distribution of invasive species annually*				

Table 5-34. Monitoring-related recovery actions for Norton/Widow White Creeks.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NWWC.27.2.6	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-NWWC.27.2.6.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-NWWC.27.2.6.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-NWWC.27.2.11	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-NWWC.27.2.11.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-NWWC.27.2.12	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-NWWC.27.2.12.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-NWWC.27.1.10	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-NWWC.27.1.10.1	*Conduct presence/absence surveys for juveniles*					
SONCC-NWWC.27.1.13	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-NWWC.27.1.13.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-NWWC.27.1.13.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-NWWC.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-NWWC.27.1.21.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-NWWC.27.4.17	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-NWWC.27.4.17.1	*Describe the status and trends of road treatments and road density at least once every five years*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NWWC.27.4.18	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-NWWC.27.4.18.1	*Describe new channelization/diking and changes to channelization/diking at least once every five years*					
SONCC-NWWC.27.4.19	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-NWWC.27.4.19.1	*Describe new urban/residential/industrial development and changes to development at least once every five years*					
SONCC-NWWC.27.4.20	Monitor	No	Track threat	Describe threat of road-stream crossing barriers	Population wide	3d
SONCC-NWWC.27.4.20.1	*Describe any new road-stream crossing barriers and any changes to existing road-stream crossing barriers at least once every five years*					

Table 5-35. Monitoring-related recovery actions for Pistol River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-PisR.27.2.13	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-PisR.27.2.13.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-PisR.27.2.13.2		*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*				
SONCC-PisR.27.2.15	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-PisR.27.2.15.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-PisR.27.2.16	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-PisR.27.2.16.1		*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*				
SONCC-PisR.27.2.18	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-PisR.27.2.18.1		*Determine best indicators of estuarine condition*				
SONCC-PisR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-PisR.27.2.30.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-PisR.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-PisR.27.2.31.1		*Identify habitat condition of the estuary*				
SONCC-PisR.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-PisR.27.2.32.1		*Continuously measure the hydrograph*				
SONCC-PisR.27.2.32.2		*Identify instream flow needs for coho salmon*				
SONCC-PisR.27.2.33	Monitor	No	Track habitat condition	Track water temperature	Population wide	3d
SONCC-PisR.27.2.33.1		*Measure water temperature continuously during the summer period*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-PisR.27.1.14	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-PisR.27.1.14.1		*Conduct presence/absence surveys for juveniles*				
SONCC-PisR.27.1.17	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-PisR.27.1.17.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-PisR.27.1.17.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-PisR.27.1.29	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-PisR.27.1.29.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-PisR.27.4.27	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-PisR.27.4.27.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-PisR.27.4.28	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-PisR.27.4.28.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-PisR.27.4.34	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-PisR.27.4.34.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

Table 5-36. Monitoring-related recovery actions for Redwood Creek.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-RedC.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-RedC.27.2.26.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-RedC.27.2.26.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-RedC.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-RedC.27.2.27.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-RedC.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-RedC.27.2.28.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-RedC.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-RedC.27.2.29.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-RedC.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-RedC.27.2.30.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-RedC.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-RedC.27.2.31.1	*Identify habitat condition of the estuary*					
SONCC-RedC.27.2.35	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	2a
SONCC-RedC.27.2.35.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-RedC.27.2.44	Monitor	No	Track habitat condition	Continue long-term monitoring	Population wide	3b
SONCC-RedC.27.2.44.1		*Continue long term channel response and channel stability studies by the NPS.*				
SONCC-RedC.27.2.44.2		*Continue long term monitoring by the USGS and NPS of discharge and sediment transport at the Orick and O'Kane gaging stations on Redwood Creek to support monitoring of the CWA section 303d listing as sediment impaired.*				
SONCC-RedC.27.2.44.3		*Continue long term stream temperature monitoring of mainstem Redwood Creek and select tributaries by the NPS to support the CWA section 303d listing as temperature impaired*				
SONCC-RedC.27.2.50	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-RedC.27.2.50.1		*Measure water temperature continuously during the summer period*				
SONCC-RedC.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3b
SONCC-RedC.27.1.23.1		*Determine annual abundance of adult coho salmon*				
SONCC-RedC.27.1.24	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-RedC.27.1.24.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-RedC.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-RedC.27.1.25.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-RedC.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-RedC.27.1.33.1		*Conduct presence/absence surveys for juveniles*				
SONCC-RedC.27.1.34	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-RedC.27.1.34.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-RedC.27.1.34.2		*If appropriate, modify population types and targets using revised methodology*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-RedC.27.1.43	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Continue long-term monitoring	Population wide	3b
SONCC-RedC.27.1.43.1		*Continue long-term smolt abundance monitoring.*				
SONCC-RedC.27.1.51	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-RedC.27.1.51.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-RedC.27.4.47	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-RedC.27.4.47.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-RedC.27.4.48	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-RedC.27.4.48.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-RedC.27.4.49	Monitor	No	Track threat	Describe mining/gravel extraction threat	Population wide	3d
SONCC-RedC.27.4.49.1		*Describe any new mining or gravel extraction and any changes to existing mining and gravel extraction at least once every five yea*				

Table 5-37. Monitoring-related recovery actions for Salmon River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SalR.27.2.18	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-SalR.27.2.18.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-SalR.27.2.18.2		*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*				
SONCC-SalR.27.2.21	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-SalR.27.2.21.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-SalR.27.2.22	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-SalR.27.2.22.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-SalR.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	Population wide	3d
SONCC-SalR.27.2.28.5		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				
SONCC-SalR.27.1.15	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-SalR.27.1.15.1		*Determine annual abundance of adult coho salmon*				
SONCC-SalR.27.1.16	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-SalR.27.1.16.1		*Conduct presence/absence surveys for juveniles*				
SONCC-SalR.27.1.17	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-SalR.27.1.17.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SalR.27.1.19	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-SalR.27.1.19.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-SalR.27.1.24	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-SalR.27.1.24.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-SalR.27.1.24.2		*If appropriate, modify population types and targets using revised methodology*				

Table 5-38. Monitoring-related recovery actions for Scott River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ScoR.27.2.36	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-ScoR.27.2.36.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-ScoR.27.2.36.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-ScoR.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-ScoR.27.2.37.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-ScoR.27.2.38	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-ScoR.27.2.38.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-ScoR.27.2.39	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-ScoR.27.2.39.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-ScoR.27.2.40	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-ScoR.27.2.40.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-ScoR.27.2.41	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-ScoR.27.2.41.1	*Continuously measure the hydrograph*					
SONCC-ScoR.27.2.41.2	*Identify instream flow needs for coho salmon*					
SONCC-ScoR.27.2.53	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-ScoR.27.2.53.1	*Measure water temperature continuously during the summer period*					
SONCC-ScoR.27.2.55	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-ScoR.27.2.55.1	*Identify habitat condition of the estuary*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ScoR.27.2.56	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-ScoR.27.2.56.1		*Determine best indicators of estuarine condition*				
SONCC-ScoR.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Evaluate impacts to coho salmon from specific restoration project types	Population wide	3d
SONCC-ScoR.27.1.32.1		*Develop a monitoring program that evaluates impacts to coho salmon from tailing pile removal, rock weir installation, and floodplain restoration projects*				
SONCC-ScoR.27.1.32.2		*Implement monitoring program, guided by the plan*				
SONCC-ScoR.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-ScoR.27.1.33.1		*Determine annual abundance of adult coho salmon*				
SONCC-ScoR.27.1.34	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-ScoR.27.1.34.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-ScoR.27.1.34.2		*Develop comprehensive PIT tagging and retrieval project that assesses habitat use and survival*				
SONCC-ScoR.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-ScoR.27.1.35.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-ScoR.27.1.45	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-ScoR.27.1.45.1		*Conduct presence/absence surveys for juveniles*				
SONCC-ScoR.27.1.47	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-ScoR.27.1.47.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-ScoR.27.1.47.2		*If appropriate, modify population types and targets using revised methodology*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ScoR.27.1.57	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-ScoR.27.1.57.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-ScoR.27.4.51	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-ScoR.27.4.51.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-ScoR.27.4.52	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-ScoR.27.4.52.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-ScoR.27.4.54	Monitor	No	Track threat	Describe threat of high intensity fire	Population wide	3d
SONCC-ScoR.27.4.54.1		*Describe trends in occurrence of high intensity fire at least once every five years*				

Table 5-39. Monitoring-related recovery actions for Shasta River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ShaR.27.2.40	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-ShaR.27.2.40.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-ShaR.27.2.40.2		*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*				
SONCC-ShaR.27.2.41	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-ShaR.27.2.41.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-ShaR.27.2.42	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-ShaR.27.2.42.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-ShaR.27.2.43	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-ShaR.27.2.43.1		*Measure the indicators, pH, D.O., temperature, and aquatic insects*				
SONCC-ShaR.27.2.44	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-ShaR.27.2.44.1		*Continuously measure the hydrograph*				
SONCC-ShaR.27.2.44.2		*Identify instream flow needs*				
SONCC-ShaR.27.2.52	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'		3d
SONCC-ShaR.27.2.52.1		*Track habitat indicators related to the stress 'Barriers'*				
SONCC-ShaR.27.2.57	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-ShaR.27.2.57.1		*Identify habitat condition of the estuary*				
SONCC-ShaR.27.2.58	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-ShaR.27.2.58.1		*Determine best indicators of estuarine condition*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ShaR.27.2.60	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-ShaR.27.2.60.1	*Measure water temperature continuously during the summer period*					
SONCC-ShaR.27.1.37	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-ShaR.27.1.37.1	*Determine annual abundance of adult coho salmon*					
SONCC-ShaR.27.1.38	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-ShaR.27.1.38.1	*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*					
SONCC-ShaR.27.1.38.2	*Develop comprehensive PIT tagging and retrieval project that assesses habitat use and survival*					
SONCC-ShaR.27.1.39	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-ShaR.27.1.39.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-ShaR.27.1.47	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-ShaR.27.1.47.1	*Conduct presence/absence surveys for juveniles*					
SONCC-ShaR.27.1.49	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-ShaR.27.1.49.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-ShaR.27.1.49.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-ShaR.27.1.61	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-ShaR.27.1.61.1	*Install and annually operate a life cycle monitoring (LCM) station*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ShaR.27.4.54	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-ShaR.27.4.54.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-ShaR.27.4.55	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-ShaR.27.4.55.1	*Describe new channelization/diking and changes to channelization/diking at least once every five years*					
SONCC-ShaR.27.4.56	Monitor	No	Track threat	Describe threat of hatcheries	Population wide	3d
SONCC-ShaR.27.4.56.1	*Describe status of development and implementation of applicable HGMPs at least one every five years*					
SONCC-ShaR.27.4.59	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-ShaR.27.4.59.1	*Describe status and trend of abundance and distribution of invasive species annually*					

Table 5-40. Monitoring-related recovery actions for Smith River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-SmiR.27.2.28.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-SmiR.27.2.28.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-SmiR.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-SmiR.27.2.29.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-SmiR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-SmiR.27.2.30.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-SmiR.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	All IP habitat	3d
SONCC-SmiR.27.2.31.1	*Identify habitat condition of the estuary*					
SONCC-SmiR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	All IP habitat	3d
SONCC-SmiR.27.2.34.1	*Assess barriers limiting distribution of coho salmon*					
SONCC-SmiR.27.2.36	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-SmiR.27.2.36.1	*Determine best indicators of estuarine condition*					
SONCC-SmiR.27.2.43	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-SmiR.27.2.43.1	*Measure water temperature continuously during the summer period*					
SONCC-SmiR.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-SmiR.27.1.25.1	*Determine annual abundance of adult coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SmiR.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-SmiR.27.1.26.1		*Conduct presence/absence surveys for juveniles*				
SONCC-SmiR.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	BR
SONCC-SmiR.27.1.27.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-SmiR.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	BR
SONCC-SmiR.27.1.33.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-SmiR.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	BR
SONCC-SmiR.27.1.35.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-SmiR.27.1.35.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-SmiR.27.1.45	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-SmiR.27.1.45.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-SmiR.27.4.41	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-SmiR.27.4.41.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-SmiR.27.4.42	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-SmiR.27.4.42.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-SmiR.27.4.44	Monitor	No	Track threat	Describe threat of road-stream crossing barriers	Population wide	3d
SONCC-SmiR.27.4.44.1		*Describe any new road-stream crossing barriers and any changes to existing road-stream crossing barriers at least once every five years*				

Table 5-41. Monitoring-related recovery actions for South Fork Eel River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFER.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-SFER.27.2.37.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-SFER.27.2.37.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-SFER.27.2.38	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-SFER.27.2.38.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-SFER.27.2.39	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-SFER.27.2.39.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-SFER.27.2.40	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-SFER.27.2.40.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-SFER.27.2.41	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-SFER.27.2.41.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-SFER.27.2.42	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-SFER.27.2.42.1	*Continuously measure the hydrograph*					
SONCC-SFER.27.2.42.2	*Identify instream flow needs for coho salmon*					
SONCC-SFER.27.2.56	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-SFER.27.2.56.1	*Identify habitat condition of the estuary*					
SONCC-SFER.27.2.57	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-SFER.27.2.57.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SFER.27.2.59	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-SFER.27.2.59.1		*Measure water temperature continuously during the summer period*				
SONCC-SFER.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-SFER.27.1.32.1		*Determine annual abundance of adult coho salmon*				
SONCC-SFER.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-SFER.27.1.33.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-SFER.27.1.34	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-SFER.27.1.34.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-SFER.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-SFER.27.1.35.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-SFER.27.1.36	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3d
SONCC-SFER.27.1.36.1		*Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin*				
SONCC-SFER.27.1.36.2		*Identify the status and trend of invasive species*				
SONCC-SFER.27.1.44	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-SFER.27.1.44.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-SFER.27.1.44.2		*If appropriate, modify population types and targets using revised methodology*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SFER.27.1.58	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-SFER.27.1.58.1		*Conduct presence/absence surveys for juveniles*				
SONCC-SFER.27.4.52	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-SFER.27.4.52.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-SFER.27.4.53	Monitor	No	Track threat	Describe threat of high intensity fire	Population wide	3d
SONCC-SFER.27.4.53.1		*Describe trends in occurrence of high intensity fire at least once every five years*				
SONCC-SFER.27.4.54	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-SFER.27.4.54.1		*Describe status and trend of abundance and distribution of invasive species annually*				
SONCC-SFER.27.4.55	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	All IP habitat	3d
SONCC-SFER.27.4.55.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				
SONCC-SFER.27.4.60	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-SFER.27.4.60.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

Table 5-42. Monitoring-related recovery actions for South Fork Trinity River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-SFTR.27.2.34.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-SFTR.27.2.34.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-SFTR.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-SFTR.27.2.35.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-SFTR.27.2.36	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-SFTR.27.2.36.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-SFTR.27.2.37	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-SFTR.27.2.37.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-SFTR.27.2.38	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-SFTR.27.2.38.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-SFTR.27.2.39	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-SFTR.27.2.39.1	*Continuously measure the hydrograph*					
SONCC-SFTR.27.2.39.2	*Identify instream flow needs*					
SONCC-SFTR.27.2.49	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	All IP habitat	3d
SONCC-SFTR.27.2.49.1	*Assess barriers limiting distribution of coho salmon*					
SONCC-SFTR.27.2.53	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-SFTR.27.2.53.1	*Measure water temperature continuously during the summer period*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.27.1.31	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-SFTR.27.1.31.1	*Determine annual abundance of adult coho salmon*					
SONCC-SFTR.27.1.32	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-SFTR.27.1.32.1	*Conduct presence/absence surveys for juveniles*					
SONCC-SFTR.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-SFTR.27.1.33.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-SFTR.27.1.43	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-SFTR.27.1.43.1	*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*					
SONCC-SFTR.27.1.45	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-SFTR.27.1.45.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-SFTR.27.1.45.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-SFTR.27.1.50	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Hatchery Management'	All IP habitat	3d
SONCC-SFTR.27.1.50.1	*Annually determine the percent of hatchery origin spawners (PHOS), percent of natural origin spawners (PNOS), and the proportion of natural influence (PNI)*					
SONCC-SFTR.27.4.51	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-SFTR.27.4.51.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-SFTR.27.4.52	Monitor	No	Track threat	Describe threat of hatcheries	Population wide	3d
SONCC-SFTR.27.4.52.1	*Describe status of development and implementation of applicable HGMPs at least one every five years*					

Table 5-43. Monitoring-related recovery actions for Strawberry Creek.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-StrC.27.2.11	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-StrC.27.2.11.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-StrC.27.2.11.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-StrC.27.2.17	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-StrC.27.2.17.1	*Determine best indicators of estuarine condition*					
SONCC-StrC.27.2.20	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	All IP habitat	3d
SONCC-StrC.27.2.20.1	*Assess barriers limiting distribution of coho salmon*					
SONCC-StrC.27.2.21	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-StrC.27.2.21.1	*Identify habitat condition of the estuary*					
SONCC-StrC.27.2.22	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-StrC.27.2.22.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-StrC.27.2.23	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-StrC.27.2.23.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-StrC.27.1.15	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-StrC.27.1.15.1	*Conduct presence/absence surveys for juveniles*					
SONCC-StrC.27.1.16	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-StrC.27.1.16.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-StrC.27.1.16.2	*If appropriate, modify population types and targets using revised methodology*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-StrC.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-StrC.27.1.27.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-StrC.27.4.25	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-StrC.27.4.25.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-StrC.27.4.26	Monitor	No	Track threat	Describe threat of road-stream crossing barriers	Population wide	3d
SONCC-StrC.27.4.26.1		*Describe any new road-stream crossing barriers and any changes to existing road-stream crossing barriers at least once every five years*				

Table 5-44. Monitoring-related recovery actions for Upper Klamath River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.27.2.42	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-UKR.27.2.42.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-UKR.27.2.42.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-UKR.27.2.43	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-UKR.27.2.43.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-UKR.27.2.44	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-UKR.27.2.44.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-UKR.27.2.45	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-UKR.27.2.45.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-UKR.27.2.46	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-UKR.27.2.46.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-UKR.27.2.47	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-UKR.27.2.47.1	*Continuously measure the hydrograph*					
SONCC-UKR.27.2.47.2	*Identify instream flow needs*					
SONCC-UKR.27.2.56	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-UKR.27.2.56.1	*Identify habitat condition of the estuary*					
SONCC-UKR.27.2.57	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-UKR.27.2.57.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-UKR.27.2.59	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-UKR.27.2.59.1		*Measure water temperature continuously during the summer period*				
SONCC-UKR.27.1.34	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate survival of juvenile coho salmon	Population wide	3d
SONCC-UKR.27.1.34.1		*Develop comprehensive PIT tagging and retrieval project that assesses habitat use and survival*				
SONCC-UKR.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-UKR.27.1.35.1		*Determine annual abundance of adult coho salmon*				
SONCC-UKR.27.1.36	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-UKR.27.1.36.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-UKR.27.1.37	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-UKR.27.1.37.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-UKR.27.1.38	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track surrogate for genetic diversity	Iron Gate Hatchery	3d
SONCC-UKR.27.1.38.1		*Describe annual ratio of naturally-produced fish to hatchery-produced fish spawned for hatchery production*				
SONCC-UKR.27.1.39	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-UKR.27.1.39.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-UKR.27.1.40	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Disease'	Population wide	3d
SONCC-UKR.27.1.40.1		*Annually estimate the infection and mortality rate of juvenile coho salmon from pathogens, such as Ceratonova shasta and Parvicapsula minibicornis*				
SONCC-UKR.27.1.41	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Hatchery Management'	Population wide	3d
SONCC-UKR.27.1.41.1		*Annually determine the percent of hatchery origin spawners (PHOS), percent of natural origin spawners (PNOS), and the proportion of natural influence (PNI)*				
SONCC-UKR.27.1.50	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-UKR.27.1.50.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-UKR.27.1.50.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-UKR.27.1.58	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-UKR.27.1.58.1		*Conduct presence/absence surveys for juveniles*				
SONCC-UKR.27.4.52	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-UKR.27.4.52.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-UKR.27.4.53	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-UKR.27.4.53.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-UKR.27.4.54	Monitor	No	Track threat	Describe threat of hatcheries	Population wide	3d
SONCC-UKR.27.4.54.1		*Describe status of development and implementation of applicable HGMPs at least one every five years*				
SONCC-UKR.27.4.55	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	All IP habitat	3d
SONCC-UKR.27.4.55.1		*Assess barriers limiting distribution of coho salmon*				

Table 5-45. Monitoring-related recovery actions for Upper Mainstem Eel River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-UMER.27.2.24.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-UMER.27.2.24.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-UMER.27.2.25	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-UMER.27.2.25.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-UMER.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-UMER.27.2.26.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-UMER.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-UMER.27.2.27.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-UMER.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-UMER.27.2.28.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-UMER.27.2.40	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	All IP habitat	3d
SONCC-UMER.27.2.40.1	*Assess barriers limiting distribution of coho salmon*					
SONCC-UMER.27.2.41	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-UMER.27.2.41.1	*Identify habitat condition of the estuary*					
SONCC-UMER.27.2.42	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-UMER.27.2.42.1	*Measure water temperature continuously during the summer period*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-UMER.27.2.43	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-UMER.27.2.43.1		*Continuously measure the hydrograph*				
SONCC-UMER.27.2.43.2		*Identify instream flow needs for coho salmon*				
SONCC-UMER.27.2.48	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-UMER.27.2.48.1		*Identify habitat condition of the estuary*				
SONCC-UMER.27.2.49	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-UMER.27.2.49.1		*Determine best indicators of estuarine condition*				
SONCC-UMER.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-UMER.27.1.21.1		*Conduct presence/absence surveys for juveniles*				
SONCC-UMER.27.1.22	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-UMER.27.1.22.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-UMER.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	Population wide	3d
SONCC-UMER.27.1.23.1		*Annually estimate the density of non-native predators, such as the Sacramento pikeminnow in the Eel River basin*				
SONCC-UMER.27.1.23.2		*Identify the status and trend of invasive species*				
SONCC-UMER.27.1.31	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-UMER.27.1.31.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-UMER.27.1.31.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-UMER.27.4.44	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-UMER.27.4.44.1		*Assess barriers limiting distribution of coho salmon*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.27.4.45	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-UMER.27.4.45.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-UMER.27.4.46	Monitor	No	Track threat	Describe threat of high intensity fire	Population wide	3d
SONCC-UMER.27.4.46.1	*Describe trends in occurrence of high intensity fire at least once every five years*					
SONCC-UMER.27.4.47	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-UMER.27.4.47.1	*Describe status and trend of abundance and distribution of invasive species annually*					

Table 5-46. Monitoring-related recovery actions for Upper Rogue River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.27.2.30	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-URR.27.2.30.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-URR.27.2.30.2	*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*					
SONCC-URR.27.2.31	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-URR.27.2.31.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-URR.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-URR.27.2.32.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-URR.27.2.33	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-URR.27.2.33.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-URR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-URR.27.2.34.1	*Measure the indicators, pH, D.O., temperature, and aquatic insects*					
SONCC-URR.27.2.35	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-URR.27.2.35.1	*Continuously measure the hydrograph*					
SONCC-URR.27.2.55	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-URR.27.2.55.1	*Identify habitat condition of the estuary*					
SONCC-URR.27.2.56	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-URR.27.2.56.1	*Determine best indicators of estuarine condition*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-URR.27.2.58	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-URR.27.2.58.1		*Measure water temperature continuously during the summer period*				
SONCC-URR.27.1.25	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-URR.27.1.25.1		*Determine annual abundance of adult coho salmon*				
SONCC-URR.27.1.26	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-URR.27.1.26.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-URR.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track surrogate for genetic diversity	Cole Rivers Hatchery	3d
SONCC-URR.27.1.27.1		*Describe annual ratio of naturally-produced fish to hatchery-produced fish used to produce hatchery fish*				
SONCC-URR.27.1.28	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-URR.27.1.28.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-URR.27.1.29	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Hatchery Management'	Population wide	3d
SONCC-URR.27.1.29.1		*Annually determine the percent of hatchery origin spawners (PHOS), percent of natural origin spawners (PNOS), and the proportion of natural influence (PNI)*				
SONCC-URR.27.1.38	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-URR.27.1.38.1		*Conduct presence/absence surveys for juveniles*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.27.1.41	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-URR.27.1.41.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-URR.27.1.41.2	*If appropriate, modify population types and targets using revised methodology*					
SONCC-URR.27.1.60	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-URR.27.1.60.1	*Install and annually operate a life cycle monitoring (LCM) station*					
SONCC-URR.27.4.51	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-URR.27.4.51.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-URR.27.4.52	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-URR.27.4.52.1	*Describe new channelization/diking and changes to channelization/diking at least once every five years*					
SONCC-URR.27.4.53	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-URR.27.4.53.1	*Describe new urban/residential/industrial development and changes to development at least once every five years*					
SONCC-URR.27.4.54	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	All IP habitat	3d
SONCC-URR.27.4.54.1	*Assess barriers limiting distribution of coho salmon*					
SONCC-URR.27.4.57	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-URR.27.4.57.1	*Describe status and trend of abundance and distribution of invasive species annually*					
SONCC-URR.27.4.59	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	All IP habitat	3d
SONCC-URR.27.4.59.1	*Annually monitor the extent of barriers due to sediment or seasonally dry areas*					

Table 5-47. Monitoring-related recovery actions for Upper Trinity River.

Action ID	Target	Key LF	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UTR.27.2.32	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-UTR.27.2.32.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-UTR.27.2.32.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-UTR.27.2.33	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-UTR.27.2.33.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-UTR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-UTR.27.2.34.1	*Continuously measure the hydrograph*					
SONCC-UTR.27.2.34.2	*Identify instream flow needs for coho salmon*					
SONCC-UTR.27.2.46	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Barriers'	All IP habitat	3d
SONCC-UTR.27.2.46.1	*Assess barriers limiting distribution of coho salmon*					
SONCC-UTR.27.1.27	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-UTR.27.1.27.1	*Determine annual abundance of adult coho salmon*					
SONCC-UTR.27.1.28	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-UTR.27.1.28.1	*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*					
SONCC-UTR.27.1.29	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track surrogate for genetic diversity	Trinity River Hatchery	3d
SONCC-UTR.27.1.29.1	*Describe annual ratio of naturally-produced fish to hatchery-produced fish spawned for hatchery production*					

Action ID	Target	Key LF	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-UTR.27.1.30	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-UTR.27.1.30.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-UTR.27.1.31	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Hatchery Management'	Population wide	3d
SONCC-UTR.27.1.31.1		*Annually determine the percent of hatchery origin spawners (PHOS), percent of natural origin spawners (PNOS), and the proportion of natural influence (PNI)*				
SONCC-UTR.27.1.40	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-UTR.27.1.40.1		*Conduct presence/absence surveys for juveniles*				
SONCC-UTR.27.1.42	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-UTR.27.1.42.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-UTR.27.1.42.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-UTR.27.1.48	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the threat 'Invasive Species'	All IP habitat	3d
SONCC-UTR.27.1.48.1		*Identify the status and trend of invasive species*				
SONCC-UTR.27.1.53	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Develop survival estimates	Site to be determined	3d
SONCC-UTR.27.1.53.1		*Install and annually operate a life cycle monitoring (LCM) station*				
SONCC-UTR.27.4.49	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-UTR.27.4.49.1		*Describe the status and trends of road treatments and road density at least once every five years*				

Action ID	Target	Key LF	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UTR.27.4.50	Monitor	No	Track threat	Describe threat of road-stream crossing barriers	Population wide	3d
SONCC-UTR.27.4.50.1	*Describe any new road-stream crossing barriers and any changes to existing road-stream crossing barriers at least once every five years*					
SONCC-UTR.27.4.51	Monitor	No	Track threat	Describe threat of hatcheries	Population wide	3d
SONCC-UTR.27.4.51.1	*Describe status of development and implementation of applicable HGMPs at least one every five years*					
SONCC-UTR.27.4.52	Monitor	No	Track threat	Describe threat of invasive species	Population wide	3d
SONCC-UTR.27.4.52.1	*Describe status and trend of abundance and distribution of invasive species annually*					

Table 5-48. Monitoring-related recovery actions for Wilson Creek.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WilC.27.2.8	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-WilC.27.2.8.1	*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*					
SONCC-WilC.27.2.8.2	*Measure indicators for spawning and rearing habitat once every 15 years, sub-sampling using GRTS technique*					
SONCC-WilC.27.2.15	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-WilC.27.2.15.1	*Measure the indicators, pool depth, pool frequency, D50, and LWD*					
SONCC-WilC.27.2.16	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-WilC.27.2.16.1	*Measure the indicators, canopy cover, canopy type, and riparian condition*					
SONCC-WilC.27.2.17	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-WilC.27.2.17.1	*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*					
SONCC-WilC.27.1.9	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Assess coho habitat use	Unnamed creeks south of Crescent City	3d
SONCC-WilC.27.1.9.1	*Assess coho population use of tributaries and other small streams on RNSP lands*					
SONCC-WilC.27.1.9.2	*Assess coho population use of tributaries and other small streams on private lands*					
SONCC-WilC.27.1.12	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-WilC.27.1.12.1	*Conduct presence/absence surveys for juveniles*					
SONCC-WilC.27.1.13	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-WilC.27.1.13.1	*Develop supplemental or alternate means to set population types and targets*					
SONCC-WilC.27.1.13.2	*If appropriate, modify population types and targets using revised methodology*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WilC.27.1.20	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-WilC.27.1.20.1	*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*					
SONCC-WilC.27.4.18	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-WilC.27.4.18.1	*Describe the status and trends of road treatments and road density at least once every five years*					
SONCC-WilC.27.4.19	Monitor	No	Track threat	Describe mining/gravel extraction threat	Population wide	3d
SONCC-WilC.27.4.19.1	*Describe any new mining or gravel extraction and any changes to existing mining and gravel extraction at least once every five years*					

Table 5-49. Monitoring-related recovery actions for Winchuck River.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-WinR.27.2.24	Monitor	No	Track habitat condition	Track habitat indicators related to spawning, rearing, and migration	Population wide	3d
SONCC-WinR.27.2.24.1		*Measure indicators for spawning and rearing habitat. Conduct a comprehensive survey*				
SONCC-WinR.27.2.24.2		*Measure indicators for spawning and rearing habitat once every 10 years, sub-sampling using GRTS technique*				
SONCC-WinR.27.2.25	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Lack of Floodplain and Channel Structure'	All IP habitat	3d
SONCC-WinR.27.2.25.1		*Measure the indicators, pool depth, pool frequency, D50, and LWD*				
SONCC-WinR.27.2.26	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Degraded Riparian Forest Condition'	All IP habitat	3d
SONCC-WinR.27.2.26.1		*Measure the indicators, canopy cover, canopy type, and riparian condition*				
SONCC-WinR.27.2.27	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Altered Sediment Supply'	All IP habitat	3d
SONCC-WinR.27.2.27.1		*Measure the indicators, % sand, % fines, V Star, silt/sand surface, turbidity, embeddedness*				
SONCC-WinR.27.2.28	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Water Quality'	All IP habitat	3d
SONCC-WinR.27.2.28.1		*Measure the indicators, pH, D.O., temperature, and aquatic insects*				
SONCC-WinR.27.2.29	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Estuarine Function'	Estuary	3d
SONCC-WinR.27.2.29.1		*Identify habitat condition of the estuary*				
SONCC-WinR.27.2.34	Monitor	No	Track habitat condition	Track habitat indicators related to the stress 'Impaired Hydrologic Function'	All IP habitat	3d
SONCC-WinR.27.2.34.1		*Continuously measure the hydrograph*				
SONCC-WinR.27.2.34.2		*Identify instream flow needs for coho salmon*				
SONCC-WinR.27.2.52	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	3d
SONCC-WinR.27.2.52.1		*Determine best indicators of estuarine condition*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-WinR.27.2.53	Monitor	No	Track habitat condition	Track water temperature	All IP habitat	3d
SONCC-WinR.27.2.53.1		*Measure water temperature continuously during the summer period*				
SONCC-WinR.27.1.21	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate abundance	Population wide	3d
SONCC-WinR.27.1.21.1		*Determine annual abundance of adult coho salmon*				
SONCC-WinR.27.1.22	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Estimate juvenile spatial distribution	Population wide	3d
SONCC-WinR.27.1.22.1		*Conduct presence/absence surveys for juveniles*				
SONCC-WinR.27.1.23	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track indicators related to the stress 'Fishing and Collecting'	Population wide	3d
SONCC-WinR.27.1.23.1		*Annually estimate the commercial and recreational fisheries bycatch and mortality rate for wild SONCC coho salmon.*				
SONCC-WinR.27.1.33	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Track life-history diversity	Population wide	3d
SONCC-WinR.27.1.33.1		*Describe annual variation in migration timing, age structure, habitat occupied, and behavior*				
SONCC-WinR.27.1.35	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Refine methods for setting population types and targets	Population wide	3d
SONCC-WinR.27.1.35.1		*Develop supplemental or alternate means to set population types and targets*				
SONCC-WinR.27.1.35.2		*If appropriate, modify population types and targets using revised methodology*				
SONCC-WinR.27.1.36	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Evaluate the potential to restore extirpated independent populations	Population wide	3d
SONCC-WinR.27.1.36.1		*Evaluate the potential to restore extirpated independent populations*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-WinR.27.1.51	Monitor	No	Track population abundance, spatial structure, productivity, or diversity	Describe threat of invasive species	Population wide	3d
SONCC-WinR.27.1.51.1		*Describe status and trend of abundance and distribution of invasive species annually*				
SONCC-WinR.27.4.48	Monitor	No	Track threat	Describe road threat	Population wide	3d
SONCC-WinR.27.4.48.1		*Describe the status and trends of road treatments and road density at least once every five years*				
SONCC-WinR.27.4.49	Monitor	No	Track threat	Describe channelization/diking threat	Population wide	3d
SONCC-WinR.27.4.49.1		*Describe new channelization/diking and changes to channelization/diking at least once every five years*				
SONCC-WinR.27.4.50	Monitor	No	Track threat	Describe threat of development	Population wide	3d
SONCC-WinR.27.4.50.1		*Describe new urban/residential/industrial development and changes to development at least once every five years*				
SONCC-WinR.27.4.54	Monitor	No	Track threat	Track indicators related to the threat 'Barriers'	Population wide	3d
SONCC-WinR.27.4.54.1		*Annually monitor the extent of barriers due to sediment or seasonally dry areas*				

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6. Implementation Program

6.1 Phased Approach to Recovery

Recovery of the SONCC coho salmon ESU will occur by rebuilding each population so that it can eventually serve its needed role. The recovery strategy, to be applied on a population-by-population basis, has two phases. In Phase I, the goal for Core and Non-Core 1 populations is to prevent extinction by rebuilding spawner numbers to above depensation, and the goal for Dependent and Non-Core 2 populations is to build capacity to support strays by restoring habitat to support all life stages. Once a population achieves the goal for Phase I, its goal changes to that for Phase II. In Phase II, the goal for each independent population is to rebuild the number of spawners to those levels needed for a recovered ESU. The goal for each dependent and Non-Core 2 population in Phase II is to build juvenile occupancy to needed levels. **Table 6-1**shows each population's current phase of recovery and status relative to depensation or habitat.

Table 6-1. Current phase of recovery and status of each population.

Population	Phase of Recovery	
	Current Phase of Recovery	Status
Elk River	Extinction prevention	Likely below depensation
Brush Creek	Building capacity	Insufficient habitat to support all life stages
Mussel Creek	Building capacity	Insufficient habitat to support all life stages
Lower Rogue River	Extinction prevention	Likely below depensation
Hunter Creek	Building capacity	Insufficient habitat to support all life stages
Pistol Creek	Building capacity	Insufficient habitat to support all life stages
Chetco River	Extinction prevention	Likely below depensation
Winchuck River	Extinction prevention	Likely below depensation
Smith River	Extinction prevention	Likely below depensation
Elk Creek	Building capacity	Insufficient habitat to support all life stages
Wilson Creek	Building capacity	Insufficient habitat to support all life stages
Lower Klamath River	Extinction prevention	Likely below depensation
Redwood Creek	Extinction prevention	Likely below depensation
Maple Creek/Big Lagoon	Building capacity	Insufficient habitat to support all life stages
Little River	Rebuilding	Likely above depensation
Strawberry Creek	Building capacity	Insufficient habitat to support all life stages
Norton/Widow White Creek	Building capacity	Insufficient habitat to support all life stages
Mad River	Extinction prevention	Likely below depensation
Humboldt Bay tributaries	Rebuilding	Likely above depensation
Lower Eel/Van Duzen Rivers	Extinction prevention	Likely below depensation
Guthrie Creek	Building capacity	Insufficient habitat to support all life stages
Bear River	Building capacity	Insufficient habitat to support all life stages
Mattole River	Extinction prevention	Likely below depensation
Illinois River	Rebuilding	Likely above depensation
Middle Rogue/Applegate Rivers	Rebuilding	Likely above depensation
Upper Rogue River	Rebuilding	Likely above depensation
Middle Klamath River	Rebuilding	Likely above depensation

Population	Phase of Recovery	
Upper Klamath River	Extinction prevention	Likely below depensation
Shasta River	Extinction prevention	Likely below depensation
Scott River	Rebuilding	Likely above depensation
Salmon River	Extinction prevention	Likely below depensation
Lower Trinity River	Extinction prevention	Likely below depensation
South Fork Trinity River	Extinction prevention	Likely below depensation
Upper Trinity River	Rebuilding	Likely above depensation
Mainstem Eel River	Extinction prevention	Likely below depensation
North Fork Eel River	Building capacity	Insufficient habitat to support all life stages
Middle Mainstem Eel River	Extinction prevention	Likely below depensation
Upper Mainstem Eel River	Building capacity	Insufficient habitat to support all life stages
Middle Fork Eel River	Building capacity	Insufficient habitat to support all life stages
South Fork Eel River	Rebuilding	Likely above depensation

6.2 Recovery Action Themes

The seven diversity strata in the SONCC Coho Salmon ESU share stresses and threats which must be reduced to allow for SONCC coho salmon to recover. Many of the stresses and threats can be addressed with recovery actions. Recovery actions are designed to both address acute issues and restore processes which create and maintain coho salmon habitat. Recovery actions should focus on areas where coho salmon currently persist, and on unoccupied areas of suitable habitat, to maximize the chance of preserving existing coho salmon. The best available information on coho salmon distribution is described in Chapters 7 through 46. Recovery actions that are common to multiple coho salmon populations are organized into the following themes. See the recovery actions at the end of Chapters 7 through 46 to determine which themes apply to particular populations of interest.

6.2.1 Flow

Stream flow quantity, quality, and timing are insufficient across much of the ESU. Insufficient flows contribute to problems with water quality in many populations. Instream flow criteria should be established. Flows should be restored, through actions such as reducing the number of unpermitted diversions, encouraging water conservation, streamlining water leasing and instream dedication processes, and improving timber, grazing, and irrigation practices. The current timing and volume of flow should be assessed in the Eel, Klamath, Trinity, and Rogue Rivers, and dams and diversions should be operated so that the timing and volume of flow better approximates natural conditions.

6.2.2 Floodplain and Channel Structure

Floodplain and channel structure is insufficient for all populations. Habitat should be reconnected and restored. Large wood or other structure should be added to streams. Off-channel ponds, wetlands, and side channels should be restored or connected to the channel, possibly by reintroducing beavers. Levees and dikes should be removed, set back, or reconfigured and the natural channel form and floodplain connectivity re-established. Mature forests should be established along streams to increase the potential for large woody debris by improving timber harvest practices, planting conifers, releasing conifers from competition with hardwoods, and establishing a healthy fire regime.

6.2.3 Estuaries

In coastal basins, estuaries have been disconnected from their floodplains by major highways or levees, drained or filled, or converted to freshwater. Restoration of the hydrologic function of estuaries is necessary to provide tidal habitat used by rearing juvenile coho salmon, and to restore passage to needed habitat upstream of the estuary. The tidal exchange of water should be increased by setting back or removing levees and improving or removing tide gates. Tidal channels, wetlands, sloughs, and the estuary should be connected. Channelized reaches should be restored by restoring passage and habitat complexity. Remaining estuarine habitat needed for recovery should be protected from development, dredging, or filling.

6.2.4 Dams

In the Klamath and Trinity rivers, dams block access to large amounts of habitat needed to produce coho salmon. Dams also disrupt ecosystem functions in these rivers by impeding sediment transport and degrading water quality. For the Upper Klamath River, the recovery strategy and actions include removing four Klamath Hydroelectric Project (Project) dams on the mainstem of the Klamath River as provided in the Klamath Hydroelectric Settlement Agreement or constructing and operating fishways prescribed by NMFS for Project relicensing. On the Trinity River, recovery actions include studying the feasibility of fish passage at Lewiston and Trinity dams and providing fish passage accordingly. If habitat above dams becomes accessible, it should be restored.

6.2.5 Hatcheries

The ecological and genetic impacts of fish produced by the Trinity River Hatchery and Iron Gate Hatchery should be reduced. Hatchery and genetic management plans should be developed for every hatchery in the ESU.

Some populations of coho salmon are so small that they suffer from effects of low population size which increase the possibility of population extirpation. Enhancement programs such as captive broodstock, rescue rearing, or conservation hatcheries should be considered and, if appropriate, employed to support coho salmon populations in the Mainstem Eel River, Middle Mainstem Eel River, Mattole River, and Shasta River.

6.2.6 Disease and Non-Native Species

An assessment of all means possible to disrupt the life cycle of the *C. shasta* parasite should be completed and a plan developed and implemented in the Upper Klamath River based on the results of the assessment. A plan should be developed and implemented to reduce the number of warm-water non-native fish in the Interior Rogue and Interior Klamath basins. In the Interior Trinity stratum, brown trout should be eradicated. Throughout the Eel River, Sacramento pikeminnow abundance should be substantially reduced.

6.2.7 Fishing

Fisheries should be managed such that they do not limit attainment of population-specific viability criteria for the SONCC coho salmon ESU.

6.2.8 Altered Sediment Supply

To reduce fine sediment delivery to streams, roads should be upgraded, maintained, or decommissioned, slopes stabilized, and timber harvest and grazing practices improved.

6.3 Benefits of Recovery

Healthy salmon and steelhead populations provide significant economic, societal, and environmental benefits. Communities, businesses, jobs, and cultures have been built around salmonids on the West Coast.

Monetary investments in watershed restoration projects can promote the economic vitality in a myriad of ways. The largest economic returns resulting from recovered salmon and steelhead populations are associated with sport and commercial fishing. For example, the California commercial and recreational salmon fisheries are estimated to generate a total of $118-279 million in income annually (University of the Pacific 2010), and provide roughly two to three thousand jobs. These figures will increase as salmon runs increase, providing both economic gains and more commercial and recreational fishing opportunities. With a revived sport and commercial fishery, these substantial economic gains and the creation of jobs would be realized across the SONCC coho salmon ESU range, most notably for river communities and coastal counties.

The economy also will be stimulated through the employment of workers needed to implement recovery projects. Habitat restoration projects stimulate job creation at a level comparable to traditional infrastructure investments such as mass transit, roads, or water projects (Nielsen-Pincus and Moseley 2010). Every dollar invested in watershed restoration projects travels through the state's economy. Design, implementation, and maintenance of habitat restoration projects require hiring consultants, contractors, employees, and field crews, and purchasing equipment, goods and services. People hired to carry out such projects spend their wages on goods and services in their local communities. In Oregon, 90% of investments in habitat restoration have been shown to stay in the state (Nielsen-Pincus and Moseley 2010).

Based on studies that examined streams in Colorado and salmonid restoration in the Columbia River Basin (Washington, Oregon and Idaho), the San Joaquin River (California), and the Elwha River (Washington), the value of salmonid recovery could be significantly larger than the fiscal or socioeconomic costs of recovery (CDFG 2004a). Importantly, the general model for viewing cost versus benefits should be viewed in terms of long-term benefits derived from short-term costs. Recovery actions taken for a particular listed salmonid are likely to also benefit other listed salmonids that occur in the same area, thus increasing the cost effectiveness of the actions.

Habitats restored to properly functioning conditions offer enhanced resource values and provide substantial non-monetary benefits for human communities. These benefits include: improving and protecting the quality of important surface and ground water supplies, reducing damage from flooding resulting from floodplain development, reducing expenditures on bank stabilization and flood control actions, and reducing the incidence of high severity fire. Restoring and maintaining healthy watersheds also enhances important human uses of aquatic habitats, including outdoor recreation, ecological education, field-based research, aesthetic benefits, and the preservation of tribal and cultural heritage.

Salmonid recovery is an investment and opportunity to diversify and strengthen the economy while enhancing the quality of life for present and future generations. The dollars necessary to recover salmonids should be made available without delay such that the suite of benefits can begin to accrue as soon as possible.

6.4 Achieving Recovery

Even with NMFS and other Federal agencies doing all within their authority and resources to achieve recovery of SONCC coho salmon, recovery will likely not occur without involvement by other entities. Federal agencies have neither the funds nor the authority to bring about all the actions necessary to sufficiently improve the condition of this species. Partnerships are a critical component of SONCC coho salmon recovery: partnerships between private landowners, tribes, and local, state, and federal government agencies; between non-governmental organizations and landowners; and between federal, state, and local agencies. A recovered ESU can provide ecosystem, recreation, and economic benefits to communities. All of these entities have a common interest in bringing healthy coho salmon populations and their ecosystems back to California and Oregon's coasts. Anyone who has an interest in the recovery of a listed species is a conservation partner. Conservation Partners Conservation partners are essential to the implementation and success of the recovery plan. NMFS looks forward to working with our conservation partners to recover the SONCC coho salmon ESU. Conservation partners may be individuals, groups, government or non-government organizations, industry, or tribes. A list of known conservation partners can be found in Appendix E.

6.5 Implementation Schedule

The last tables in Chapters 7 through 46 list the population-specific recovery actions that make up the SONCC coho salmon Recovery Program, including the recovery action number, recovery action step number, target, strategy, recovery action, action step, area, priority, and whether the action addresses a key limiting stress or threat. Appendix F lists the recovery action step number, potential lead agency and estimated cost for each action. Together, the tables in Chapters 7 through 46 and Appendix F make up the implementation schedule. A portion of an example implementation schedule is shown in Figure 6-1.

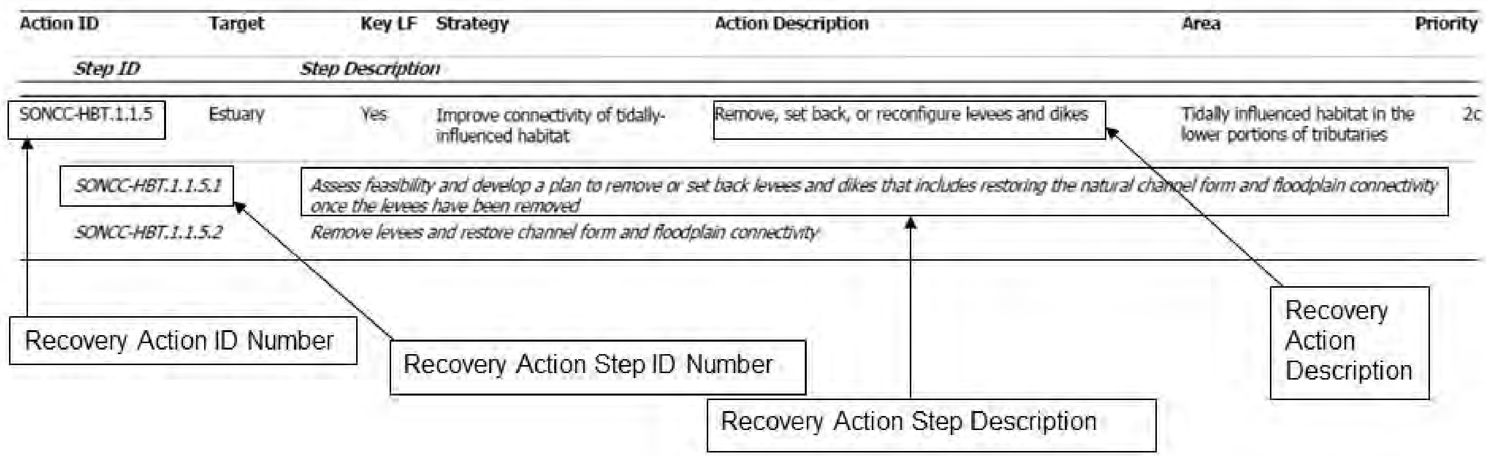

Figure 6-1. Example implementation schedule with selected elements labeled.

The fields in the recovery action tables found at the end of each population profile (Chapters 7 to 46) provides a unique ID number for each recovery action and recovery action step, information about which stress or threat each is meant to address, the purpose of the action, the particular action to be completed and the steps needed to complete it, the location where the action should be completed, the priority assigned to each action, and whether the action addresses a key limiting stress or threat. Additional fields, including cost and potential lead, are shown in Appendix F.

6.5.1 Recovery Action ID Number

A unique recovery action number is assigned to every recovery action to facilitate reference to the recovery action. For example, in the recovery action number SONCC-HBT.2.2, “SONCC” refers to the ESU, “HBT” refers to the population (in this case "Humboldt Bay Tributaries"), the first “2” is the strategy ID number (see Table 6-2), and the second “2” refers to the recovery action.

6.5.2 Recovery Action Step ID Number

The recovery action step ID number is a unique identifier assigned to each step of a particular recovery action to facilitate reference to a particular recovery action step number. It consists of the Recovery Action Number, with an additional number which refers to the sequential order of the action step (i.e., 1, 2, 3, or 4). For example, in SONCC-HBT.2.2.1, the “1” refers to the action step, in this case the first in a sequence of steps.

6.5.3 Target

The target is the primary stress or threat the recovery action is designed to address (e.g., the strategy “Sediment” is meant to address the stress “Altered sediment supply”).

shows the target ID number, the target, and the stress or threat addressed by that target. For example, in SONCC-HBT-2.2.1, the target is Floodplain and Channel Structure. Note that a recovery action may address more than one stress or threat, and therefore more than one target. However, only one target is associated with each recovery action in the implementation schedule.

Table 6-2. Stress or threat addressed by each target.

Strategy ID Number*	Target	Stress or Threat Addressed
1	Estuary	Impaired Estuarine Function
2	Floodplain and Channel Structure	Lack of Floodplain and Channel Structure
3	Hydrology	Impaired Hydrologic Function
5	Passage	Barriers
7	Riparian	Degraded Riparian Forest Conditions
8	Sediment	Altered Sediment Supply
10	Water Quality	Impaired Water Quality
12	Agricultural Practices	Agricultural Practices
13	Channelization/Diking	Channelization/Diking
14	Invasive, Non-native Species	Invasive, Non-native Species
16	Fishing/Collecting	Adverse Fishery-Related Effects
17	Hatcheries	Adverse Hatchery-Related Effects
19	Timber Harvest	Timber Harvest
22	Urban, Residential, Industrial Development	Urban, Residential, Industrial Development
23	Road-Stream Crossing Barriers	Road-Stream Crossing Barriers
26	Low Population Dynamics	Not applicable
27	Monitor	Not applicable
28	Roads	Roads
29	Research	Not applicable
30	Disease, Predation, Competition	Disease, Predation, Competition
*Gaps in strategy ID numbers reflect categories not used for SONCC plan but used for other recovery plans in California.		

6.5.4 Strategy

The strategy describes the purpose of the recovery action: To increase, reduce, or maintain particular characteristics of the stress (e.g., reduce delivery of sediment to streams).

6.5.5 Recovery Action

Action to be completed (e.g., reduce road-stream hydrologic connection).

6.5.6 Action Step

Steps to accomplish action (e.g., assess and prioritize road-stream connection, and identify appropriate treatments to meet strategy; decommission roads, guided by assessment). The action steps describe the actions to be taken to accomplish the recovery action and strategy.

6.5.7 Area

Location where action should be completed (e.g., all tributaries of the alluvial coastal plain downstream of Rock Creek, Indian Creek, and Bagley Creek, especially the Butler Creek watershed). Complementary actions were often created for recovery actions that had area identified as "population wide." The complementary actions will describe the area as, "area where fish would benefit immediately." Complementary actions that benefit fish immediately will have a higher priority than those described as population wide.

6.5.8 Priority

Each recovery action has been assigned a priority number, which is explained in Section 6.7.

6.5.9 Key Limiting Stress or Key Limiting Threat

Some recovery actions address key limiting stresses or key limiting threats - those stresses and threats that have the greatest impact on current population viability. Key limiting stresses and threats are explained in Section 6.5.9, and are identified for each population in its respective population profile (Chapters 7 through 46). If a recovery action addresses a key limiting stress or key limiting threat for a given population, this field will read "Yes". If not, it will read "No". Whether or not an action addresses a key limiting stress or threat factors in to the priority assigned to that action.

6.6 Developing Conservation Plans for Recovery Action Implementation

In general, the SONCC Coho Recovery Plan avoids describing overly prescriptive actions within individual watersheds so that conservation partners can develop the best strategies to obtain the associated objectives. Typically, a multi-stepped process is described to help managers achieve these goals. First, a proper assessment will help identify and prioritize locations for restoration. Second, an implementation or conservation plan will determine a strategy for abating the stress or threat through recovery actions. Third, actions can be implemented under the guidance of the plan. In some cases, a simplified assessment or plan may suffice in instances where effects and treatment are obvious (e.g., cows are walking in the stream, action is to build fences).

Below is an example of a multi-stepped action found in the Smith River population profile:

Strategy: Improve wood recruitment, bank stability, shading, and food subsidies
Action: Improve grazing practices

Action Steps:

SONCC-SmiR.7.1.7.1	Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement
SONCC-SmiR.7.1.7.2	Develop grazing management plan to meet objective
SONCC-SmiR.7.1.7.3	Plant vegetation to stabilize stream bank
SONCC-SmiR.7.1.7.4	Fence livestock out of riparian zones
SONCC-SmiR.7.1.7.5	Remove instream livestock watering sources

The development of a conservation plan or restoration strategy is a critical phase of restoration and when done correctly, will help ensure goals are met and desired conditions are attained. The following provides guidelines for developing conservation/restoration plans for some of the most frequently described recovery actions:

Strategy: Reduce delivery of sediment to streams
Action: Reduce road-stream hydrologic connection

A road assessment for a watershed should identify which roads are primary sources for sediment in the stream network. Assessments should include the identification of road surfaces (native material, gravel, paved, etc.), condition of the road and drainage features, and potential for sediment delivery (distance to the stream, eroding cut slopes, etc.).

If possible, the treatment plan should first prioritize the restoration of those roads delivering the most sediment to streams, and identify the actions necessary to reduce sediment delivery. Roads may need to be decommissioned by pulling out culverts or locking gates, or could be completely removed by re-contouring the hill slope to mimic a natural state. In other cases, roads may only need to be upgraded to solve the majority of sediment delivery problems. Roads surfaced with native materials typically contribute the majority of fines (USFS 2004). An assessment may find that it is only necessary to surface native roads with gravel, crown the road surfaces to discourage erosion of the surface, or improve drainage features. Treatment plans should include a long term maintenance schedule and monitoring plan if necessary. The California Department of Fish and Game's California Salmonid Stream Habitat Restoration Manual (CDFG 2010a) includes instructions for how to carry out an upslope erosion inventory and how to control sediment inputs.

Strategy: Improve wood recruitment, bank stability, shading, and food subsidies
(or) Reduce sediment delivery to streams
Action: Improve grazing practices

After an assessment is completed, which evaluates the contribution of livestock to sediment delivery and riparian degradation, a grazing management plan can be developed to reduce the stresses to SONCC coho salmon. Actions included in a plan may include fencing livestock outside of the riparian corridor, moving water sources upslope so animals are not in the stream, and planting new vegetation alongside the stream. The Natural Resources Conservation Service (NRCS) can provide resources for plan development including appropriate BMPs. For example, NRCS (2013) describes specifications for sustainable grazing practices, how to improve conditions of riparian forests and water resources, and how to develop a monitoring plan.

Strategy: Increase channel complexity
Action: Increase LWD, boulders, or other instream structure
(or) Construct off-channel ponds, alcoves, backwater habitat, or old stream oxbows

Instream structure

An assessment of channel complexity may consider such factors as amount and size of LWD present, depth of pools, and frequency of pools. A plan to increase instream structure may describe locations where addition of instream structure/habitat would be most beneficial, and ideally would prioritize those locations. The plan could also describe, for each location, how the instream structure would be added and the type and size of structural material (e.g., wood, boulders). For coastal California, the preferred wood type is redwood or Douglas fir which have a life expectancy of 25-50 years once fallen from the tree. Deciduous trees have a higher rate of decay and may only last 5-10 years. A LWD plan should consider adding wood with a root wad attached to add stability and complexity to the structure. Log structures may range from a single log to very complex engineered log structures. Log structures may be unanchored and allowed to move with high stream flows or be anchored in place. Consideration should be given to downstream infrastructure such as roads and homes. In addition, the plan should consider opportunities for obtaining wood or other structural material, and whether the available wood or other structural material is sized appropriately for the watershed. "Section 5.1.2 Side Channel/Off Channel Habitat Restoration" in the Washington Department of Fish and Wildlife Stream Habitat Restoration Guidelines 2004 (Saldi-Caromile et al. 2004) provides additional details regarding large wood construction projects.

Off-channel habitat

An assessment of a watershed may note opportunities for improved connection of the channel to the floodplain. A preliminary look at aerial photographs will help identify old or abandoned channel features such as oxbows and side channels that can be reconnected. Types of side-channel or off-channel restoration may include:

- Connection of abandoned side channel or pond habitats to restore fish access.
- Connection of adjacent ponds, remnants from aggregate excavation.
- Connection of oxbow lakes on floodplains that have been isolated from the meandering channel by river management schemes, or channel incision.
- Creation or re-connection of side channel or off-channel habitat with self-sustaining channels.
- Improvement of hydrologic connection between floodplains and main channels.

Restoration projects in this category may require removal or breaching of levees and dikes, channel and pond excavation, creating temporary access roads, constructing wood or rock tailwater control structures, and construction of LWD habitat features.

A plan for creating off channel habitat may consider water supply (channel flow/overland flow/groundwater), water quality and reliability, risk of channel change, and channel and hydraulic grade. Ideally, a project will not require regular maintenance. Anticipated maintenance should be described and planned for. The use of appropriately designed LWD structures may function as water level control structures or could redirect flow to help maintain channel features. Additionally, a plan may consider details such as site constraints and project limits, risk to infrastructure or other properties due to increased flow through a project channel, and descriptions of how the off-channel feature is anticipated to change and adjust over time. Saldi-Caromile et al. 2004 is a good reference document for designing off channel habitat features.

Strategy: Improve flow timing or volume
Action: Improve irrigation practices

**(or)	Improve water management techniques**
**(or)	Increase instream flows**
**(or)	Reduce diversions**
**(or)	Store water under a forbearance agreement for flow augmentation**

An assessment of flow may consider factors such as the extent of current illegal diversions, an evaluation of current instream flows, and a description of current water management techniques. An assessment should also consider the coho salmon life stage that will benefit from additional flow and how it will benefit (e.g., lower temperature for rearing, improve spawning habitat, improve migration corridor) as well as what length of stream reach will be affected by the increased flow. A plan to increase instream flows or reduce diversions would identify the means by which such changes would be accomplished, possibly with a prioritized list of the areas most in need of increased flow, or the illegal diversions having the most impact on flow. Water conservation projects should provide for a more efficient use of water extracted from the stream and result in increased flows that benefit aquatic species. Water conservation measures may include off-channel water storage, changes in the timing or source of water supply, moving points of diversion, irrigation ditch lining, piping, stock-water systems, and agricultural tailwater recovery/management systems.

Water conservation projects that use water storage tanks may consider filling them through rainwater catchment or by surface or groundwater flow. A project plan may consider establishment of water storage tanks using a forbearance agreement for at least 10 years, which will provide temporal and quantitative assurances for pumping activities that result in less water withdrawal during the summer low flow period. Water storage capacity for the water diversion forbearance period should be of sufficient capacity to provide for all water needs during that time period. For example, if the no-pump period is 105 days (August to November), the diverters must have enough storage to cover any domestic, irrigation, or livestock needs during that time.

Strategy: Improve access
Action: Remove structural barrier

Structural barriers may include permanent, flash board, or seasonal push up dams. An assessment of a structural barrier should identify the life stages of coho salmon which are blocked by the barrier and characteristics of the barrier (e.g., height, size of jump pool, gradient). An assessment may also include amount and characteristics of the sediment that will be released by removing the dam.

A small dam removal plan may include engineered designs for the upstream channel that minimizes negative effects (e.g., scour, down cutting) to downstream habitat. The plan may include excavation of sediment, diversion of water during dam removal, and seasonal timing windows for construction. CDFW's Habitat Restoration Manual (CDFG 2010a) provides additional information about how to remove small dams.

Strategy: Improve wood recruitment, bank stability, shading, and food subsidies
Action: Increase conifer riparian vegetation

An assessment of riparian forests should identify regions where the most degraded conditions occur such as those areas with little or no vegetation, limited conifer abundance, and regions of small sized or crowded conifers. A silvicultural prescription should prioritize regions with the most degraded forests conditions and those immediately adjacent to fish habitat. Prescriptions may include planting conifers, protecting riparian zones with the use of buffers, thinning small conifers to encourage faster growth in others, or removing exotic species such as Himalayan blackberries that prevent the establishment of new conifers. The NRCS can provide resources about how to manage riparian forests, including suggestions for buffer sizes which may be variable depending on the size of the stream (NRCS 2013). Additionally, NRCS and other resources such as Fischer and Fischenich (2000)'s Design Recommendations for Riparian Corridors and Vegetated Buffer Strips can provide information about how to successfully plant vegetation, exclude foraging animals, and control competing vegetation. CDFG (2010a) describes how to manage forests to improve wood recruitment, stabilize banks, and manage for shade.

Strategy: Increase channel complexity
Action: Increase beaver abundance

A beaver conservation plan could significantly enhance coho habitat in watersheds, but must consider issues associated with relocation of beavers and landowner conflicts. It is preferable for a plan to follow an "Educate-Mitigate-Relocate" type strategy. A conservation plan should first focus on education and outreach to landowners, detailing the benefits of beaver to the health of our ecosystems (see Chapter 3, Lack of Floodplain and Channel Structure and Climate Change). Because it is preferable to encourage beavers to stay in their chosen habitats, mitigation and technical assistance to landowners dealing with beavers should be a strong focus in any conservation plan. Tools such as tree cages, sand painting for trees, piping through dams to control flooding, and culvert exclusion devices such as beaver deceivers can help restoration groups assist landowners in beaver conflicts prior to removal of the beaver. Finally, relocation or reintroduction of beaver may be considered as a last resort. If no beavers are currently present in a watershed, a feasibility study should be carried out to determine whether beavers could be successful. A ranking scheme for watersheds and stream reaches should be developed to guide relocation efforts and may include factors such as stream gradient, food resources, protective cover, and landownership. Strong guidelines and methods should be developed prior to relocating or reintroducing beaver to an area. The Methow Beaver Project in Washington State provides extensive detail regarding relocation methods for beavers and meeting restoration objectives (Woodruff 2013), while Swales and Pollock (in review) provides a review of California regulations for trapping and relocating beaver.

Conservation plans may also include restoration projects that utilize beaver engineering skills to create coho salmon habitat and restore hydrologic function to streams. A restoration project may include techniques for construction of beaver dam analogues that will simulate the effects of beaver dams both for the purposes of creating habitat suitable for beaver and for creating the beneficial effects of beaver dams in locations that beaver are unlikely to occupy in the near future. Pollock et al. (2012) details methods and monitoring protocols in one example of this type of restoration.

Strategy: Improve water quality
Action: Reduce contaminants

When developing a watershed scale pesticide management plan, it's important to start with an inventory of potential pesticide use in the watershed. Determine if pesticides come from urban development such as lawn care and gardening, if they are associated with agriculture, or both. Pesticide use and selection often differs depending upon the area treated, although similar pesticide classes (e.g. pyrethroid insecticides) or active ingredients (e.g. glyphosate) may be used in both urban and agricultural uses. After areas of potential pesticide use and discharge into local waterbodies have been identified, management objectives can be defined. Pesticide management plans should have an educational and technical assistance component that assists landowners in preventing or minimizing their chemical input to streams.

There are numerous resources available on-line for use when developing a watershed scale or site specific pesticide management plan. For urban areas or rural developments (e.g. housing or infrastructure development in a rural area), a manual that gives development techniques and practices considered to be "low impact development" for storm water quality should also be consulted. Typical best management practices for these urban areas, in addition to careful pesticide selection and application techniques, include installation of vegetated filter strips and grassy swales for filtering storm water that may carry pesticide residues from a site. Maintaining, improving or expanding buffer zones between pesticide application areas and streams is also a common practice. Infiltration of storm water or site drainage is often useful for preventing the discharge of non-mobile products to water bodies. More developed areas can often use detention basins to settle out sediments contaminated with pesticide residues, or infrastructure-specific areas such as inlet filters or wet vaults.

NMFS encourages the development of smaller scale pesticide management plans at the stream reach or even individual ownership level. In many cases, it may be impracticable to wait for or to rely upon the development of a watershed-wide plan. The principals and most BMPs expressed in the preceding paragraphs are valid for site-specific planning. Many municipalities in California are covered under State-issued discharge permits which require the organizations to work with their citizens to reduce pesticide discharges. Local jurisdictions (e.g. cities, counties) should be consulted to see if they have developed, or can access, programs or materials that will aid in this process. There are also many existing programs for agricultural landowners. The University of California Cooperative Extension system has organized and conducts many programs targeted to reducing nonpoint source pollution from agriculture, including pesticide pollution, with many geared toward particular cropping systems. There are additional, non-profit based programs freely available as well, such as Fish Friendly Farming and Fish Friendly Ranching programs.

6.7 Recovery Action Priority

Conservation partners should consider the priority of a recovery action when choosing recovery actions to implement. Table 6-3 describes the prioritization system NMFS used to assign priorities to recovery actions for Core and Non-Core 1 populations. Table 6-4 is the system used for recovery actions for Dependent and Non-Core 2 populations. The numeric parts of the priorities (i.e., 1, 2, and 3) are defined by Conditions 1, 2, and 3 in Table 6-3 and Conditions 1 and 2 in Table 6-4. These conditions are based on language from NMFS guidelines (NMFS 1990), which is designed to prioritize those actions that are necessary to prevent extinction of the ESU, or to prevent a significant negative impact to the ESU short of extinction, over all other actions needed to achieve ESU recovery. Condition 7 in Table 6.3, and Condition 5 in Table 6-4, are based on Oregon's "broad-sense recovery goals". Actions meeting either of these conditions would contribute to broad-sense recovery goals but are not necessary to provide for ESA recovery of the ESU. The a, b, c and d parts of the priorities are defined by Conditions 6, 5, and 4, respectively, in Table 6-3 and Conditions 3 and 4 in Table 6-4. Priorities with the letter d are defined by meeting Condition 2 or 3 but not 4, 5 and 6 in Table 6-2 or meeting Condition 1 or 2 but not 3 or 4 in Table 6-3. NMFS used these conditions to consider several important factors: 1. If an action addresses a key limiting stress or threat and so would help resolve an identified population bottleneck; 2. If an action will benefit coho salmon immediately because they are already present in or near the action area; and 3. If the number of spawners in a population is below the depensation threshold.

Table 6-3. Prioritization system for Core and Non-Core 1 populations.

Condition		Priority[1]									
		1	2a	2b	2c	2d	3a	3b	3c	3d	BR
1	Action needed to prevent extinction of ESU by 1. Preventing extirpation of one or more independent populations or 2. Making a significant difference to multiple limiting factors in many of the populations in the ESU, meaningfully decreasing the extinction risk for much of the ESU.	x									
2	Action needed to prevent significant decline[2] in habitat or population in any population.		x	x	x	x					
3	Action needed to achieve recovery of the ESU but does not meet Condition 1 or 2.						x	x	x	x	
4	Action addresses key limiting stress or key limiting threat OR benefits[3] coho salmon immediately[4].			x	x			x	x		
5	Population below depensation based on the lowest three consecutive years from 2001 to 2012.		x	x			x	x			
6	Action addresses key limiting stress or key limiting threat AND benefits[3] coho immediately[4].		x				x				
7	Action not needed to achieve ESA recovery but would contribute to broad-sense recovery (BR) goals.										x

[1]To qualify for a priority, an action must meet all the conditions marked for the priority.
[2]Examples of "prevent significant decline": Prevent loss of one or more year classes; prevent abundance from falling below the depensation threshold; prevent direct mortality of coho salmon; make habitat available which is necessary for population to build above depensation threshold; prevent loss of a critical life-history requirement (e.g., summer rearing habitat, migratory habitat); and prevent the loss of occupied habitat.
[3] "Benefit" means the action will significantly improve likelihood of survival of coho salmon. Improvement in likelihood in survival may occur at any life-history stage (e.g., increased growth leads to fish being larger when enters ocean, improving likelihood of survival in ocean).
[4] "Immediately" means coho salmon from the subject population will benefit from the action within three years of completing the action. Three years accounts for all three year classes of coho salmon.

Table 6-4. Prioritization system for Dependent and Non-Core 2 populations.

Condition		Priority[1]						
		2b	2c	2d	3b	3c	3d	BR
1	Action needed to prevent significant decline[2] in habitat or population in any population.	x	x	x				
2	Action needed to achieve recovery of the ESU but does not meet Criterion 1.				x	x	x	
3	Action addresses key limiting stress or threat OR benefits[3] coho salmon immediately[4].		x			x		
4	Action addresses key limiting stress or threat AND benefits[3] coho immediately[4].	x			x			
5	Action not needed to achieve ESA recovery but would contribute to broad-sense recovery goals (BR).							x

[1]To qualify for a given priority, an action must meet all the conditions marked for that priority.
[2]Examples of “prevent significant decline”: Prevent loss of one or more year classes; prevent abundance from falling below the depensation threshold; prevent direct take of coho salmon; make habitat available which is necessary for population to build above depensation threshold; prevent loss of a critical life-history requirement (e.g., summer rearing habitat, migratory habitat); and prevent the loss of occupied habitat.
[3] “Benefit” means the action will significantly improve likelihood of survival of coho salmon. Improvement in likelihood in survival may occur at any life-history stage (e.g., increased growth leads to fish being larger when enters ocean, improving likelihood of survival in ocean).
[4] “Immediately” means coho salmon from the subject population will benefit from the action within three years of completing the action. Three years accounts for all three year classes of coho salmon.

6.8 Time to Achieve Phase I of Recovery for Any Population

In order for a population to be at moderate (not high) risk of extinction, it needs to consistently support more adults than the depensation threshold – usually in the tens to hundreds of adults, depending on the size of the population area. Phase I of recovery for independent populations, is to prevent extinction (Section 6.1) by rebuilding to above the depensation threshold and so achieve a moderate risk of extinction. Recovery actions which increase the amount of summer or winter rearing habitat by adding in-channel structure or off-channel ponds, or by ensuring enough water remains in the river in the summer months, can be effective almost immediately in increasing production and survival of the juveniles which will come back as adults. Barrier removal can provide access to dozens of kilometers of habitat in very little time. When these types of actions are implemented, fish response can be very rapid. Phase I of recovery, could therefore be accomplished in less than 10 years in some cases. The priority NMFS has assigned to each recovery action, which is described in Section 6.7, helps conservation partners identify which actions would most benefit coho salmon, either by benefiting them immediately or by addressing the key limiting stresses or key limiting threats which are causing bottlenecks in a population. If conservation partners focus on implementing the highest priority recovery actions, they have the greatest likelihood of helping the population avoid extinction by building to a level above the depensation threshold.

6.9 Time to Achieve Phase II of Recovery for All Populations

The minimum time to recover all populations in the SONCC coho salmon ESU and delist the species is determined by the following: 1) the time to complete all recovery actions, 2) the time for the habitat to respond to the recovery actions, 3) the time for the salmon populations to respond to the habitat improvements by attaining target levels; and 4) continued attainment of recovery criteria objectives described in Chapter 4 (i.e., population recovery targets, habitat condition) for at least 12 years (the time needed for determination of status of population (Williams et al. 2011) (Table 4-1).

Most actions consist of multiple steps and require time for planning and implementation; therefore, under ideal circumstances (e.g., assuming unlimited funding for recovery actions, planning is comprehensive and fast, and implementation is unimpeded) all actions could be completed in ten years. The environmental response to those actions will take in some cases many additional years. Actions such as increasing stream flows will result in an immediate positive benefit for coho salmon. However, other actions such as those associated with tree planting and the maturation of a riparian forest may take up to 80 years to reach the desired condition (Beschta et al. 1987, Keeton et al. 2007, Meleason et al. 2002). Because all recovery actions are necessary for the recovery of the species, and assuming actions will be implemented within ten years, 90 years will be the minimum time required for the improvement of environmental conditions necessary to rebuild coho populations and meet recovery criteria.

Coho salmon populations will likely start to recover immediately as a result of recovery action implementation. However, because that habitat is not expected to be fully recovered until 90 years have passed, and that habitat is expected to be needed to support target population sizes, the population targets cannot be fully realized until after that time. It is expected that another four generations (12 years) must pass before the population can build to a level consistent with final recovery after the habitat is fully restored (Bryant et al. 1999, Kiffney et al. 2007, Pess et al. 2008). At approximately year 102, populations may reach levels of viability. The final monitoring phase will take a minimum of 12 years (Williams et al. 2008; Table 4-1), resulting in delisting as early as year 114 if all recovery criteria are met and maintained during that final phase of monitoring.

The assumption that all recovery actions will be implemented within the first 10 years is likely unrealistic due to available funding, but it is used as a basis for recovery under ideal circumstances. If the actions are not completely implemented until year 30, delisting may not occur until year 134. Other assumptions used for this estimate may also be unrealistic. The time to recovery may be many times greater if any of the following occurs: 1) freshwater habitat conditions degrade further, 2) poor ocean conditions limit adult population size, 3) populations continue to decline, 4) recovery actions are not implemented immediately, or 5) adequate monitoring has not occurred to document improved conditions and populations.

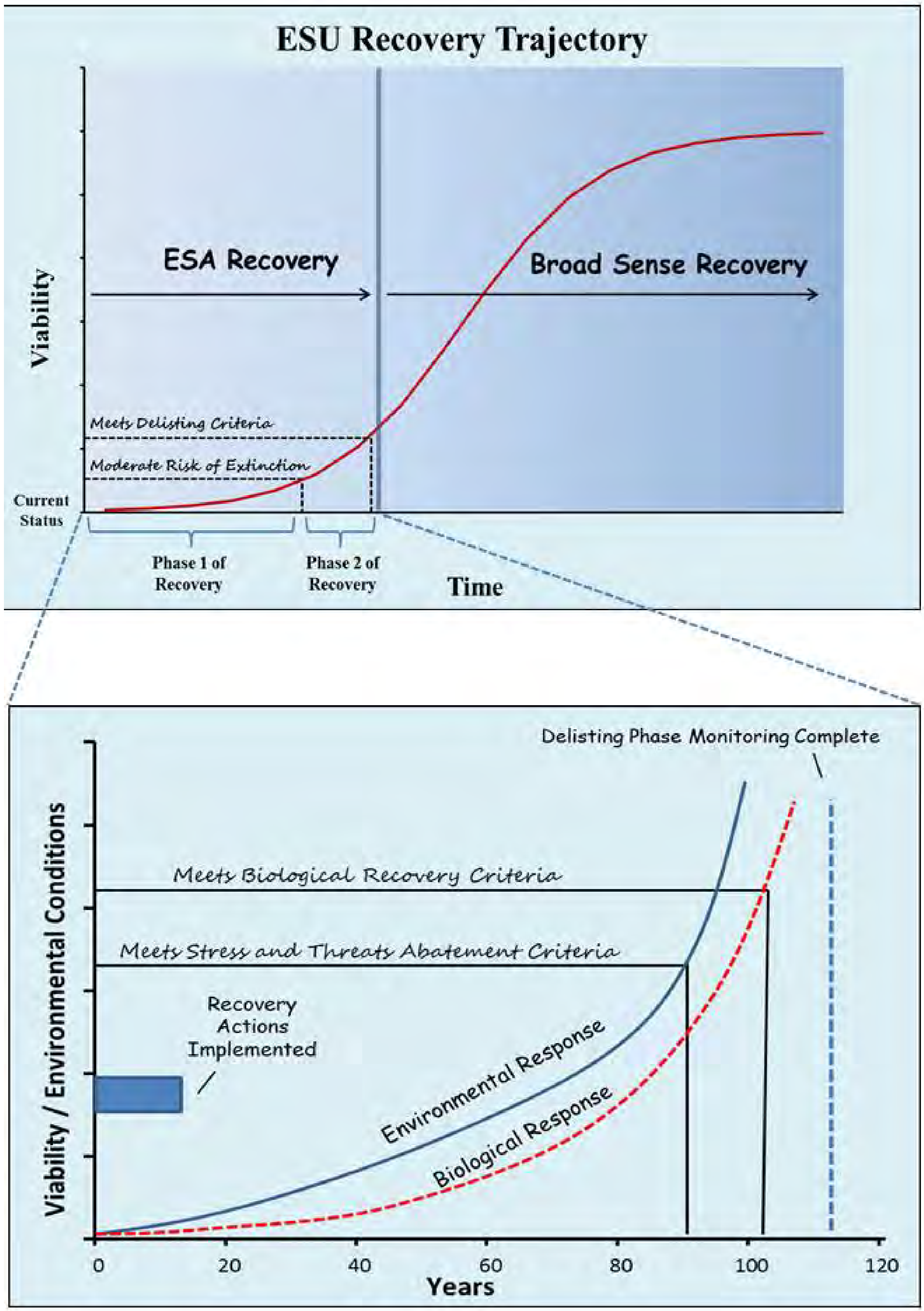

Figure 6-2. Minimum time to recovery displayed in context of long term trajectory and immediate goals.

6.10 Tracking Recovery

NMFS will track implementation of SONCC coho salmon recovery actions using an online database and associated mapping tool. This database and mapping tool, which is currently in final development, will track the implementation of recovery actions for Pacific salmon and steelhead listed under the Endangered Species Act. It is a web application that provides the following functions:

- Maps actions in a Geographic Information System (GIS);
- Tracks recovery action implementation;
- Fulfills NMFS' reporting requirements, specifically related to the Government Performance and Results Act; and
- Enables the public and stakeholders to access real-time data on recovery actions via an interactive web tool.

The Recovery Action Mapping Tool will be available here: www.westcoast.fisheries.noaa.gov/

6.10.1 Review of Recovery Progress

NMFS will regularly review the recovery actions accomplished and actions still in need of implementation, in order to track implementation status and identify any additional recovery needs. NMFS is required to review the status of listed species at least once every five years (ESA Section 4(c)(2)(A)). As part of each status review, NMFS will compare the status of the ESU, stresses, and threats to the delisting criteria. All available monitoring data will be used to determine the status of the ESU, describe progress made toward delisting, and identify any needed changes to the recovery program.

6.11 Changing the Recovery Plan

The recovery plan may be changed at any time. There are three types of plan modifications: update, revision, and addendum.

6.11.1 Update

An update to a recovery plan involves relatively minor changes. An update may identify specific actions that have been initiated since the plan was completed, as well as changes in species status or background information that do not alter the overall direction of the recovery effort. An update cannot suffice if substantive changes are made in the recovery criteria or if any changes in the recovery strategy, criteria, or recovery actions indicate a shift in the overall direction of planned recovery. In this case, a revision would be required.

6.11.2 Addendum

An addendum can be added to a plan after a recovery plan has been finalized. Types of addenda can range from implementation strategies or participation plans, to minor information updates. Addenda that represent significant additions to the recovery plan should undergo public review and comment before being attached to the recovery plan. An example of a significant addendum is one that adds a species to a plan.

6.11.3 Revision

A revision is a substantial rewrite of at least a portion of a recovery plan and is usually required if major changes are required in the recovery strategy, objectives, criteria, or actions. A revision may be required when new threats to the species are identified, when research identifies new life-history traits or threats that have significant recovery ramifications, or when the current plan is not achieving its objectives.

Notification, Review, and Approval of Plan Modifications

Updates to recovery plans and minor addenda represent minor changes and do not require formal public comment. These changes will be made to the latest recovery plan posted on NMFS regional and national internet sites.

Because plan revisions represent a significant change to the recovery plan, they go through the same review and clearance procedures as a draft and final recovery plan. If plan revisions or major addenda are planned, NMFS will publish a Federal Register Notice of Intent at the beginning of the process. This Notice will solicit data, provide information about public review and comment, and state the purpose of the revision.

6.12 How to Recommend Changes to the Recovery Plan

NMFS will accept suggestions for changes to the plan, or new information to be considered in the plan, at any time. Such changes or information can be provided by emailing the following address: SONCC.recovery@noaa.gov.

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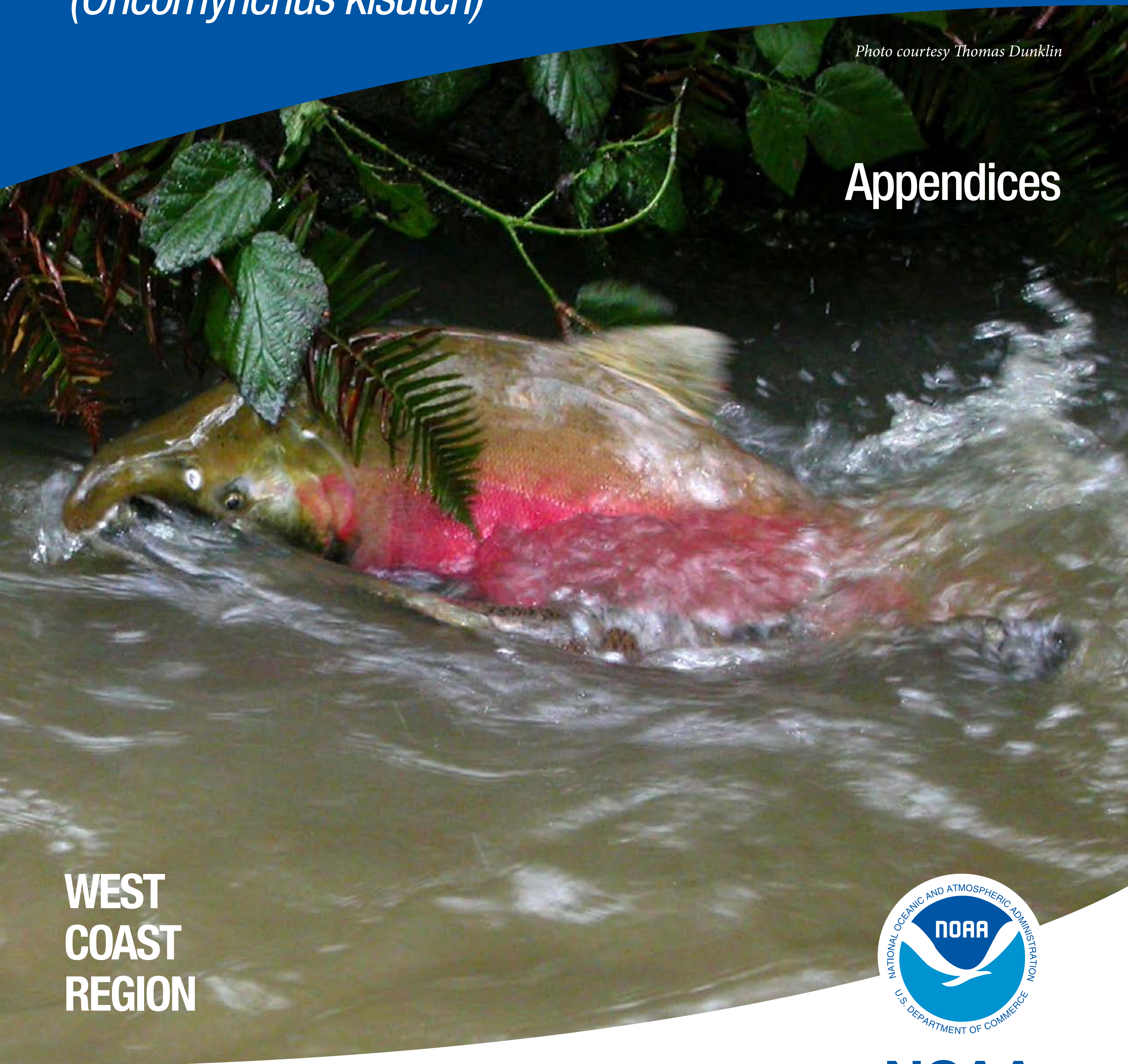
Final Recovery Plan for the Southern Oregon/ Northern California Coast Evolutionarily Significant Unit of Coho Salmon *(Oncorhynchus kisutch)*

2014



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Appendices

WEST COAST REGION

NOAA FISHERIES

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | National Marine Fisheries Service

Disclaimer

Recovery plans delineate such reasonable actions as may be necessary, based upon the best scientific and commercial data available, for the conservation and survival of listed species. Plans are published by the National Marine Fisheries Service (NMFS), sometimes prepared with the assistance of recovery teams, contractors, State agencies and others. Recovery plans do not necessarily represent the views, official positions or approval of any individuals or agencies involved in the plan formulation, other than NMFS. They represent the official position of NMFS only after they have been signed by the Assistant Administrator. Recovery plans are guidance and planning documents only; identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this plan should be construed as a commitment or requirement that any General agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C 1341, or any other law or regulation. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

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Appendix A. Population Designation

The number of kilometers of habitat with Intrinsic Potential (IP-km) identified for some populations was updated from those values provided in Williams et al. (2008), due to previously unaccounted for natural barriers and other habitat-based information. Some of these updates resulted in changes to population classifications (i.e., functionally independent, potentially independent, dependent). Note that the updated IP-km values do not account for manmade barriers such as dams, which in some cases were considered when developing population spawner targets.

The amount of IP-km has been updated in nine of the populations since the public draft. The old and revised IP-km amounts are described in Table A-1, and the rationale for each change is explained in Section A.2.

Table A-1. Population-specific changes to IP-km due to natural barriers and population classification

Diversity Stratum	Population	Williams et al. (2008) IP-km with temperature mask	Updated IP-km	Williams et al. (2008) classification	Current classification
Northern Coastal	Elk River	62.64	-	F. Independent	F. Independent
	Mill Creek	7.25	0	Dependent	None
	Hubbard Creek	17.94	-	Ephemeral	Ephemeral
	Lower Rogue River	80.88	-	P. Independent	P. Independent
	Chetco River	135.19	-	F. Independent	F. Independent
	Winchuck River	56.5	-	P. Independent	P. Independent
	Brush Creek	5.68	-	Dependent	Dependent
	Mussel Creek	6.06	-	Dependent	Dependent
	Hunter Creek	14.63	-	Dependent	Dependent
	Euchre Creek	32.31	-	Ephemeral	Ephemeral
	Pistol River	30.23	-	Dependent	Dependent
Central Coastal	Smith River	385.71	324.84	F. Independent	F. Independent
	Lower Klamath River	204.69	-	F. Independent	F. Independent
	Redwood Creek	151.02	-	F. Independent	F. Independent
	McDonald Creek	5.44	2.77	Dependent	None
	Maple Creek/Big Lagoon	41.3	18.78	P. Independent	Dependent
	Little River	34.2	-	P. Independent	P. Independent
	Mad River	152.87	136.47	F. Independent	F. Independent
	Elk Creek	17.38	-	Dependent	Dependent
	Wilson Creek	18.8	-	Dependent	Dependent
	Strawberry Creek	5.71	6.95	Dependent	Dependent
	Norton/Widow White Cr.	8.54	9.86	Dependent	Dependent
Southern Coastal	Humboldt Bay tributaries	190.91	-	F. Independent	F. Independent
	Low. Eel/Van Duzen rivers	393.52	-	F. Independent	F. Independent
	Bear River	47.84	-	P. Independent	P. Independent
	McNutt Gulch	5.9	< 2.0	Dependent	None
	Mattole River	249.79	-	F. Independent	F. Independent
	Guthrie Creek	14.16	13.82	Dependent	Dependent
Interior – Rogue River	Illinois River	589.69	-	F. Independent	F. Independent
	Mid. Rogue/Applegate R.	758.58	683.16	F. Independent	F. Independent
	Upper Rogue River	915.43	900.9	F. Independent	F. Independent
Interior – Klamath River	Middle Klamath River	113.49	-	P. Independent	P. Independent
	Upper Klamath River	424.71	-	F. Independent	F. Independent
	Salmon River	114.8	113.48	P. Independent	P. Independent
	Scott River	440.87	250.53	F. Independent	F. Independent
	Shasta River	531.01	206.27	F. Independent	F. Independent
Interior – Trinity River	South Fork Trinity River	241.83	-	F. Independent	F. Independent
	Lower Trinity River	112.01	102.10	P. Independent	P. Independent
	Upper Trinity River	64.33	365	F. Independent	F. Independent
Interior – Eel River	South Fork Eel River	481.11	463.65	F. Independent	F. Independent
	Mainstem Eel River	143.9	68.35	P. Independent	P. Independent
	North Fork Eel River	53.87	-	P. Independent	P. Independent
	Mid. Fork Eel River	77.7	-	P. Independent	P. Independent
	Mid. Mainstem Eel River	255.5	231.53	F. Independent	F. Independent
	Upper Mainstem Eel River	54.14	-	P. Independent	P. Independent

A.1 Rationale for population-specific IP-km and classification changes

Northern Coastal Diversity Stratum

Mill Creek

A previously unaccounted for natural barrier at Garrison Lake excludes coho salmon from the watershed. Garrison Lake has a natural historic pattern of connection and disconnection to the ocean by a large sand bar. The watershed has been isolated from the ocean since sand dunes naturally migrated and filled the outlet stream in the mid-1900's (Maguire 2001). Anadromous fish do not currently occur in the Mill Creek watershed (Maguire 2001) and during periods of saltwater intrusion Garrison Lake likely has unsuitable conditions for juvenile rearing. Williams et al. (2006) determined that dependent populations must have at least 5 IP-km. After removing the IP-km in the lake and above it, the Mill Creek population has no IP-km and therefore does not meet the criterion for dependent populations.

Central Coastal Diversity Stratum

Smith River

Lake Earl and its associated stream network were removed from the Smith River IP calculations because the IP model was not intended for open water habitat. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. After removing the IP habitat that occurs in Lake Earl and its associated stream network, the total amount of IP-km for the Smith River population remains high enough for it to qualify as an independent population.

McDonald Creek

Stone Lagoon was removed from the McDonald Creek IP-km calculations because the IP model was not intended for open water habitat. Williams et al. (2006) determined that dependent populations must have at least 5 IP-km. When the lagoon was accounted for, the amount of IP-km in the McDonald Creek population was reduced and did not meet the criteria for a dependent population.

Maple Creek/Big Lagoon

A previously unaccounted for natural barrier occurs 8,000 feet below the M-Line road crossing. A series of boulder rough falls form a 10-15% gradient and extend for 1,000 feet. No coho salmon have been found above the falls (Ryan Bourque, Green Diamond Resource Company, pers. comm. 9/26/13). When the IP-km for Maple Creek/Big Lagoon was decreased, the total amount of IP-km remained high enough for it to qualify as a dependent population.

Strawberry Creek

IP-km which should have been attributed to Strawberry Creek was previously attributed to the Mad River. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. When the IP-km for Strawberry Creek was increased, it did not meet this criterion and so remained a dependent population.

Norton/Widow White Creek

IP-km which should have been attributed to Norton/Widow White Creek was previously attributed to the Mad River. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. When the IP-km for Norton/Widow White Creek was increased, it did not meet this criterion and so remained a dependent population.

Mad River

IP-km which should have been attributed to Strawberry Creek and Norton/Widow White Creek was previously attributed to the Mad River. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. When the IP-km for the Mad River was reduced, the total amount of IP-km for the Mad River population remains high enough for it to qualify as an independent population.

Southern Coastal Diversity Stratum

Guthrie Creek

Due to mapping errors the amount of IP-km originally attributed to Guthrie Creek was too high. Williams et al. (2006) determined that dependent populations must have at least 5 IP-km. When the IP-km for Guthrie Creek was decreased, the total amount of IP-km remained high enough for it to qualify as a dependent population.

McNutt Gulch

A previously unaccounted for 15-foot waterfall with bedrock canyon walls occurs 1.98 km upstream from the mouth of McNutt Gulch. The waterfall is the natural limit to anadromy (CalFish 2009) and is assumed to be the upstream limit of historic coho salmon occurrence in McNutt Gulch. When this natural barrier was accounted for, the amount of IP-km in the Middle McNutt Gulch population was reduced and did not meet the criterion for a dependent population.

Interior Rogue Diversity Stratum

Middle Rogue/Applegate Rivers

A previously unaccounted for waterfall occurs 1.7 miles upstream from the Applegate River at Little Applegate Falls. The falls appear to function as a complete barrier to adult coho salmon (Maiyo 2011). Williams et al. (2006) determined that independent populations must have at least 34 IP-km. When the IP-km for the Middle Rogue/Applegate Rivers population was reduced, the total amount of IP-km remained high enough for it to qualify as an independent population.

Upper Rogue River

IP-km previously attributed to the Upper Rogue River population area was removed because it occurred outside of the population boundary. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. When the IP-km for the Upper Rogue River was reduced, the total amount of IP-km remained high enough for it to qualify as an independent population.

Interior Trinity Diversity Stratum

Lower Trinity River

A previously unaccounted for boulder-roughs barrier occurs upstream of the Boise Creek confluence with Willow Creek. The barrier functions as a complete barrier to adult coho salmon (A. Collins, USFS, pers. comm.). Williams et al. (2006) determined that independent populations must have at least 34 IP-km. When the IP-km for the Lower Trinity River population was reduced, the total amount of IP-km remained high enough for it to qualify as an independent population.

Upper Trinity River

IP-km in the Upper Trinity River population was changed for two reasons: to account for the gradient of the stream under reservoirs, and because the temperature mask was not appropriate.

The IP model used the surface elevations of the reservoirs as the gradient for those areas of the basin, which artificially inflates the low risk spawner threshold. The historic channel gradient of the Upper Trinity was estimated, and revised IP-km was calculated for the area under the reservoirs. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. After reducing the IP-km as a result of this reservoir analysis, the total amount of IP-km for the Upper Trinity River remained high enough for it to qualify as an independent population.

Because the temperature mask is based on air temperature, it does not account for snowmelt and other sources of cold water within the basin, including releases from Lewiston Dam. Numerous streams which are documented to presently support rearing coho salmon rearing occur under the temperature mask. Williams et al. (2006) recognized the potential limitations of the temperature mask approach in the Upper Trinity. The temperature mask was removed from the Upper Trinity River population, which increased the amount of IP-km in the Upper Trinity River population.

Interior Eel Diversity Stratum

South Fork Eel River and Mainstem Eel River

In response to co-manager comments submitted during the public comment period, NMFS considered 20 proposed natural barriers in the South Fork Eel River and 11 proposed natural barriers in the Mainstem Eel River. NMFS analyzed each proposed natural barrier and determined 24 of the 31 proposed natural barriers met NMFS' criteria. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. After reducing the IP-km as a result of this analysis, the total amount of IP-km for the South Fork Eel River and the Mainstem Eel River population areas remained high enough for each to qualify as an independent population.

Upper Mainstem Eel River, Middle Mainstem Eel River, and Mainstem Eel River

In response to public comments regarding the intrinsic unsuitability of mainstem Eel River habitat for coho salmon, NMFS considered multiple factors that may have resulted in the prior inclusion of IP habitat that may be intrinsically unsuitable due to summer temperature. Factors considered included: 1) mean August air temperature data from Alderpoint, California; 2) the range of potential temperature masks considered in Williams et al. (2006); 3) solar heating due to river orientation; 4) natural valley width; 5) natural lack of riparian shade; 6) measured stream temperatures; and 7) lack of coho salmon presence in summer surveys. Based on the information provided, NMFS excluded the reach of the mainstem Eel River (excluding tributaries) extending from Cape Horn Dam to the westernmost extent of the 21.0 °C temperature mask identified in Williams et al. (2006) from spawner target calculations for each population.

Interior Klamath Diversity Stratum

Salmon River

In response to co-manager comments submitted during the public comment period, NMFS considered and accepted one previously unaccounted for natural barrier. Williams et al. (2006) determined that independent populations must have at least 34 IP-km. After reducing the IP-km as a result of this analysis, the total amount of IP-km for the Salmon River remained high enough for it to qualify as an independent population.

Scott River and Shasta River

In response to numerous comments regarding IP in the Scott River and Shasta River basins, NMFS evaluated IP designations for these populations on a reach-scale. NMFS followed three steps to evaluate IP in the Scott River and Shasta River basins: 1) compare reach-scale National Hydrography Dataset (NHD) stream locations to IP model results; 2) examine reference materials and the California Department of Fish and Wildlife's Calfish database to determine the current reach-scale distribution of anadromous salmonids (including coho salmon) and their habitat within the Shasta and Scott rivers; and, 3) visit sites in the field in these basins where IP has been questioned. The evaluation resulted in considerable changes to IP-km in both populations.

Step One: Comparing NHD and IP results

To compare the NHD dataset with IP model outputs, NMFS used the high-resolution version of the NHD dataset, and assumed that if the IP stream network output and NHD stream locations overlapped, or were found to be within 100-feet of each other, that they were in fact the same stream. This exercise identified areas in the IP stream network output that were inconsistent with stream locations described in the National Hydrography Dataset. Comparison between the NHD stream layers and IP stream network outputs found that, with the exception of the Shasta and Scott River, Independent Populations were consistent (overlapped) 94% on average (**Figure A-1**). The IP stream network output overlapped with the NHD stream layer well in confined areas, and tended to deviate more over the flat, low gradient areas that commonly provide high-quality rearing habitat for juvenile coho salmon. However, the overlap in the Shasta and Scott River basins was 53% and 69%, respectively. This low overlap between the NHD and IP occurred, in part, because these two basins have large low gradient valleys, often with multiple braiding channels, and these channels were difficult to capture consistently between the two modeling exercises. The extent to which human alteration of historic stream channels is responsible for this deviation is difficult to discern.

Steps Two and Three: Considering references and field investigations

Once the degree of overlap between NHD and IP in the Scott River and Shasta River basins was identified (Figure A-2 and Figure A-3), NMFS evaluated whether to exclude certain stream reaches from IP based on whether a previously unidentified natural barrier exists. NMFS' analysis considered that natural barriers can exist due to a steep gradient, a physical blockage such as a boulder or gradient change, or the natural lack of sufficient flow in a reach. The latter may be caused not only by a lack of precipitation, but also by porous geology (Crandell 1989), volcanism, or major debris flows. As part of the evaluation of potential natural barriers, NMFS investigated the current distribution of coho salmon and their habitat (as an indicator of potential condition), as well as the degree of watershed disturbance influencing the reach, which is relevant to whether a barrier is of natural origin. Ultimately, NMFS' recommendation to remove some IP-km was based on evaluation of the best available scientific information, which includes NMFS' professional judgment.

NMFS' evaluation of these sources of information produced one of three outcomes at a reach scale:

- Complete or nearly complete alignment between IP and NHD;
- Lack of agreement between IP and NHD, based on small discrepancies that could be resolved with additional resources.
- Lack of agreement between IP and NHD that could not be resolved. In some cases, streams/stream reaches could not be resolved with a defensible determination of how IP should be adjusted. In those cases, NMFS removed IP where additional resources provided compelling justification to do so.

Examples of the first outcome include the eastside drainages in the Scott River, and the southeast and eastside drainages in the Shasta River. In these areas, there is neither the geology nor residual riparian habitat to sustain surface flow. In some instances, human activities have exacerbated such conditions (*e.g.*, eastside drainages of the Scott Basin). Where geologic and associated hydrologic limitations pose a natural barrier to coho salmon, NMFS removed these reaches from the IP stream network.

Examples of the second outcome are Moffett Creek in the Scott River and Parks Creek in the Shasta River. Though Moffett Creek is not currently considered a coho salmon stream, there is no physical evidence suggesting why it did not previously support coho salmon, and why it could not do so in the future. NMFS used available information to remove IP at a reach-scale in the upper Moffet Creek Basin. In Parks Creek, coho salmon have not recently been observed greater than a mile or two upstream from the I-5 crossing. However, as there is no natural barrier precluding coho salmon presence, NMFS elected to retain these areas within IP.

An example of the third outcome is Willow Creek (near Grenada) in the southwest portion of the Shasta River Basin. Irrigation infrastructure has rendered Willow Creek's drainage network almost unrecognizable compared to historic conditions, though it's late fall/winter surface flow is still occasionally considerable. NMFS removed a portion of IP in Willow Creek where agreement between IP and NHD diverged repeatedly.

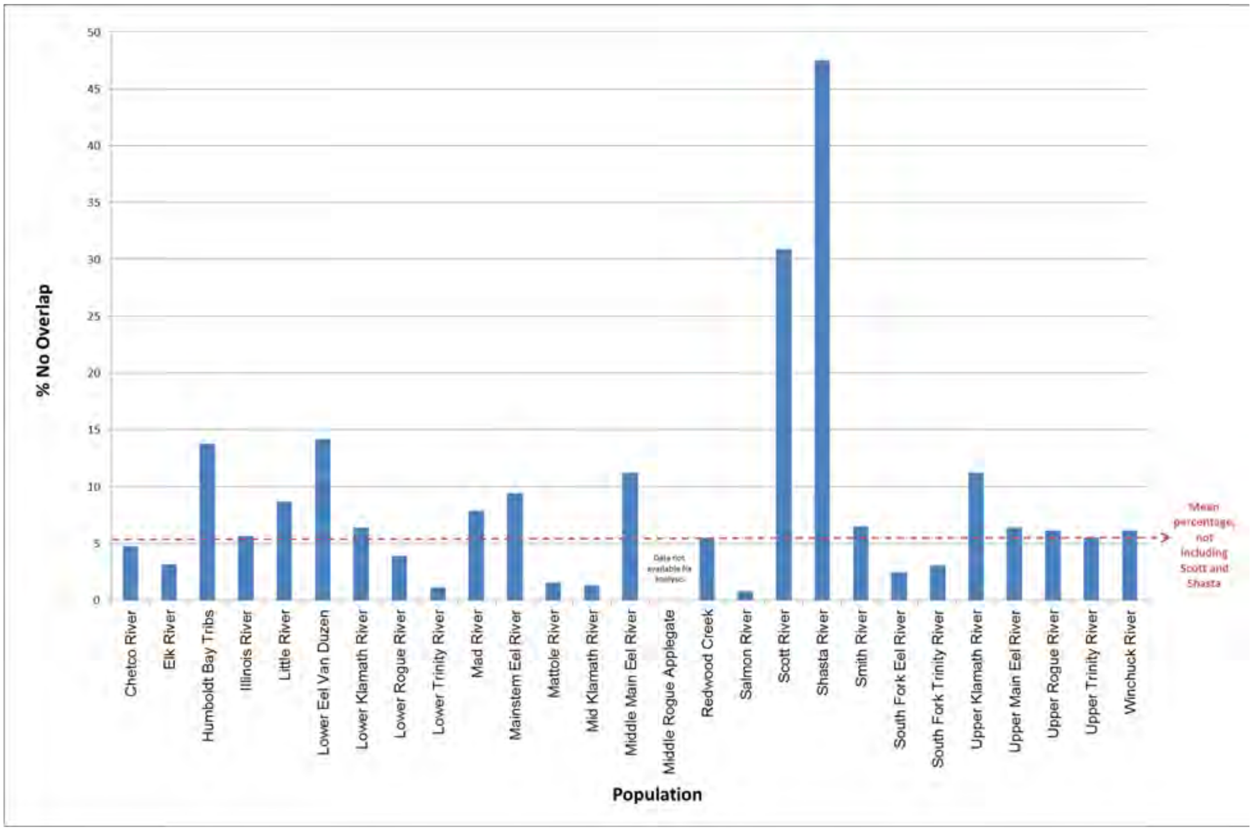

Figure A-1. Percentage of stream lengths for independent populations within the SONCC coho salmon evolutionarily significant unit (ESU) where the National Hydrography Dataset (NHD) of stream layers and Intrinsic Potential (IP) model outputs deviate from each other, indicating potential errors in the IP model output.

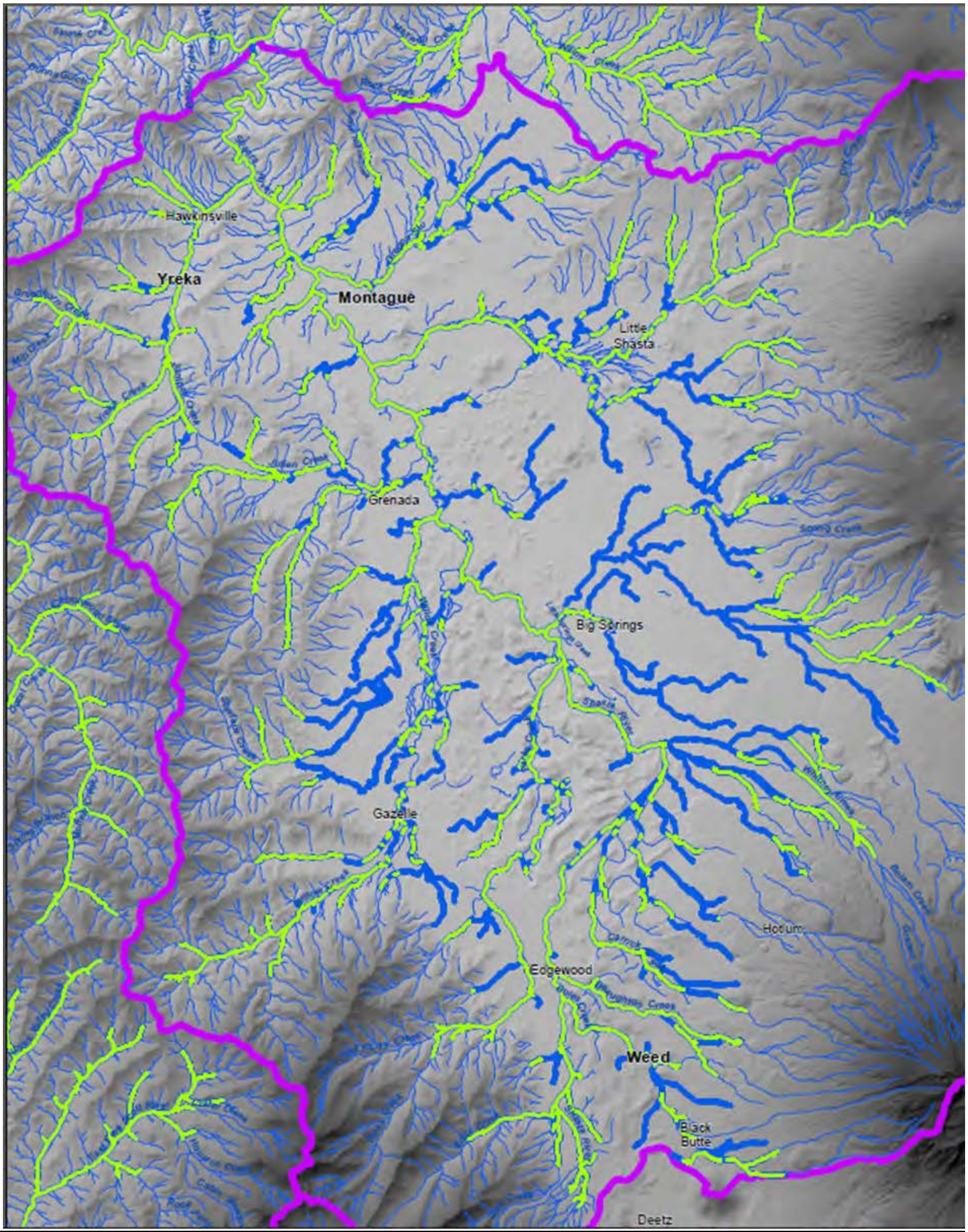

Figure A-2. Map of the Shasta River watershed depicting the results of the comparison between the NHD stream layers and Intrinsic Potential (IP) outputs for coho salmon. Green highlights show areas where IP outputs overlap, or are consistent with the NHD stream layer. Blue highlights depict areas where IP and NHD are inconsistent.

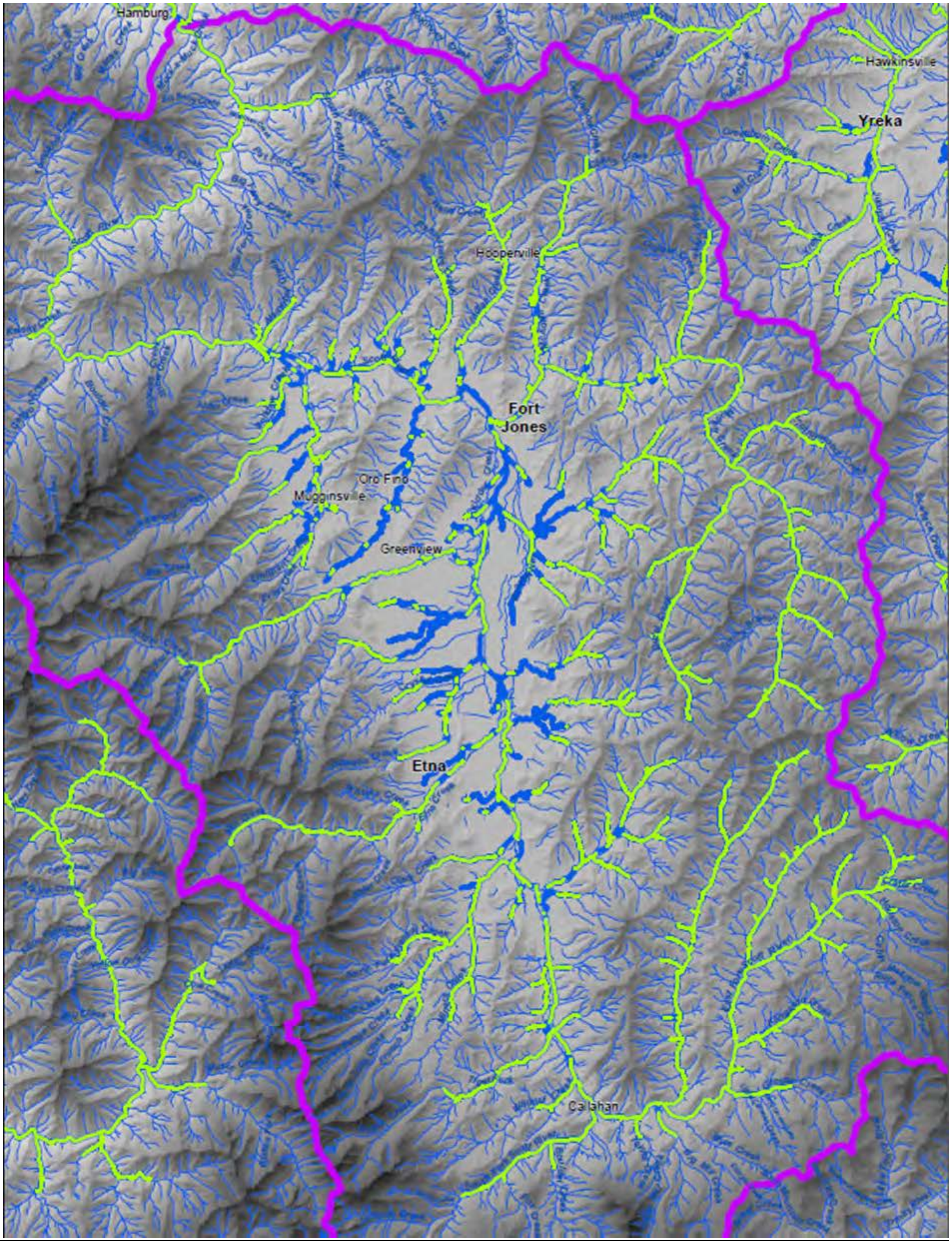

Figure A-3. Map of the Scott River watershed depicting the results of the comparison between the NHD stream layers and Intrinsic Potential (IP) outputs for coho salmon. Green highlights show areas where IP outputs overlap, or are consistent with the NHD stream layer. Blue highlights depict areas where IP and NHD are inconsistent.

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Appendix B. Stress and Threat Analysis Methodology

NMFS used several tools to develop and perform a threat and stress assessment, and to develop methods to score additional threat and stress categories. These tools included The Nature Conservancy's Conservation Action Planning (CAP) process, best professional judgment, climate change models and predictions, and empirical data. NMFS used these tools to ascertain current watershed condition, identify severity and scope of stresses, assess the contribution and irreversibility of identified threats, create additional threat and stress categories, and develop population profiles for each population in the SONCC coho salmon ESU. NMFS used the CAP process as a conceptual framework for the threats assessment. The threats assessment process spanned four years and the methodology evolved over time in response to new information, to incorporate new stresses and threats, and in recognition of the limitations of the initial tools (Table B-1).

The use of best professional judgment, in consideration of available data, underlies the entire threat and stress assessment process. Empirical data were acquired, compiled into a database, summarized, and then entered into an initial set of CAP workbooks. Stress and threat ratings in the CAP workbooks were then revised to include professional judgment for additional stresses and threats. NMFS then utilized best professional judgment to assess the accuracy and reliability of the resulting CAP summary tables, produce a comprehensive stress and threat assessment, and develop individual population profiles that detail the current condition of each population area.

The following sections summarize the components of the stress and threats methodology, including the development of the initial CAP workbooks, revision of the CAP workbooks, creation of GIS maps, refinement of the stress and threat summary tables, additional analyses conducted in response to public comment, and the development of additional stress and threat categories (climate change, estuary/mainstem condition, and fishing/collecting).

Table B-1. Methods used by NMFS to assess stresses.

Stress	Assessment Methods			
	Initial CAP	Revised CAP	Stress Summary Tables	
			2012 Draft Plan	Final Plan
Adverse Fishery-Related Effects	Not included	Not included	Professional judgment	Assessment framework with numeric indicators and professional judgment
Adverse Hatchery-Related Effects	Not included	Professional judgment	Professional judgment	Professional judgment
Altered Hydrologic Function	Qualitative indicators	Professional judgment, qualitative indicators	Professional judgment, qualitative indicators	Assessment framework with numeric indicators and professional judgment
Altered Sediment Supply	Numeric indicators	Numeric indicators, professional judgment	Numeric indicators, professional judgment	Numeric indicators, professional judgment
Barriers	Numeric indicators	Numeric indicators, professional judgment	Numeric indicators, professional judgment	Numeric indicators, professional judgment
Degraded Riparian Forest Conditions	Numeric & qualitative indicators	Numeric & qualitative indicators, professional judgment	Numeric & qualitative indicators, professional judgment	Numeric & qualitative indicators, professional judgment
Impaired Estuary/ Mainstem Function	Not included	Not included	Professional judgment	Professional judgment
Impaired Water Quality	Numeric indicators	Numeric indicators, professional judgment	Numeric indicators, professional judgment	Numeric indicators, professional judgment
Increased Disease/ Predation/ Competition	Not included	Numeric indicators, professional judgment	Numeric indicators, professional judgment	Numeric indicators, professional judgment
Lack of Floodplain and Channel Structure	Numeric & qualitative indicators	Numeric & qualitative indicators, professional judgment	Numeric & qualitative indicators, professional judgment	Numeric & qualitative indicators, professional judgment

Table B-2. Methods used by NMFS to assess threats.

Threat	Assessment Methods			
	Initial CAP	Revised CAP	Threat Summary Tables	
			2012 Draft Plan	Final Plan
Agricultural Practices	GIS analyses	GIS analyses, professional judgment	GIS analyses, professional judgment	GIS analyses, professional judgment
Channelization/ Diking	GIS analyses	GIS analyses, professional judgment	GIS analyses, professional judgment	GIS analyses, professional judgment
Climate Change	Not included	Professional judgment	Computer models, professional judgment	Computer models, professional judgment
Dams/ Diversion	Not included	Professional judgment	Professional judgment	Assessment framework with numeric indicators and professional judgment
Fishing and Collecting	Not included	Professional judgment	Professional judgment	Assessment framework with numeric indicators and professional judgment
Hatcheries	Not included	Professional judgment	Professional judgment	Professional judgment
High Severity Fire	Not included	Professional judgment	Professional judgment	Professional judgment
Invasive Non-Native/ Alien Spices	Not included	Professional judgment	Professional judgment	Professional judgment
Mining/Gravel Extraction	Not included	Professional judgment	Professional judgment	Professional judgment
Roads	GIS analyses	GIS analyses, professional judgment	GIS analyses, professional judgment	GIS analyses, professional judgment
Road-Stream Crossing Barriers	Not included	Professional judgment	Professional judgment	Professional judgment
Timber Harvest	Not included	Professional judgment	Professional judgment	Assessment framework with numeric indicators, and professional judgment
Urban/ Residential/ Industrial	GIS analyses	GIS analyses, professional judgment	GIS analyses, professional judgment	GIS analyses, professional judgment

B.1 Background Information about the CAP Process

As part of the assessment of the viability and condition of SONCC coho salmon populations and their habitat in the SONCC ESU, NMFS performed a series of conservation planning and assessment exercises based upon the Nature Conservancy's Conservation by Design concept (TNC 2006). This concept utilizes Conservation Action Planning (CAP) tools and workbooks to develop a threat and stress assessment. The CAP process is designed to recognize the shifting nature of knowledge and the challenges that causes, by allowing for a regular, iterative process of successive approximations (TNC 2006). The CAP process provided NMFS with a tool to capture the best understanding of the current situation, and develop a set of recovery actions built on that understanding. This understanding included the use of NMFS' best professional judgment and other tools. NMFS utilized this process to identify conservation targets, assess the current status of the selected targets, identify critical threats and stresses occurring in the landscape, and develop a threat and stress assessment that described current population and environmental conditions across the landscape.

NMFS completed the following planning and assessment activities:

1. Identified conservation targets
2. Assessed the current status of conservation targets
3. Determined potential stresses and threats
4. Compiled available literature, empirical data, and best professional knowledge on the condition of the landscape
5. Rated these stresses and threats across the landscape
6. Developed recovery actions to decrease or eliminate the stresses and threats.

The first step in the process was to identify the conservation targets, which were the life stages of coho salmon in the SONCC coho salmon ESU. Next, NMFS assessed the current status of conservation targets by reviewing all available monitoring data on coho salmon population trends.

NMFS then used the best available information to identify the stresses affecting coho salmon populations and the sources of the stresses, also known as threats. Most stresses are caused by incompatible human uses of land, water and natural resources. Stresses destroy, degrade or impair conservation targets by impacting a key ecological attribute relating to their size, condition or landscape context (TNC 2006). Natural factors such as rainfall and marine productivity (ocean conditions, El Niño) were identified as factors for the decline of the SONCC coho salmon ESU (62 FR 24588; May 6, 1997). NMFS elected to not describe these natural factors as threats in this recovery plan for two reasons. First, SONCC ESU coho salmon evolved to live with natural variation in rainfall and marine productivity, and it was likely a combination of these factors with habitat degradation, fishing, and other human-caused threats that led to their decline. Populations that are fragmented or reduced in size and range are more vulnerable to extinction by natural events (62 FR 24588, May 6, 1997), and NMFS chose to focus on the causes of population fragmentation and reduced size rather than natural factors. Second, there is little that recovery actions can do to affect change in natural factors such as rainfall or marine productivity. NMFS developed recovery actions to reduce the detrimental effects of the result of that rainfall (e.g., droughts and floods). For example, water resources can be managed to ensure sufficient water remains in waterways when coho salmon need it even during drought conditions, and land can be managed to promote bank stability and reduce the likelihood that floods will release large amounts of sediment into coho salmon habitat. Similarly, in years when marine productivity is expected to be poor, fishing effort can be moderated to allow sufficient spawner escapement, as described in the current management of ocean salmon fisheries (Sharr et al. 2000). In short, the recovery plan addresses the causes of population fragmentation and decline that can be improved by human actions. Therefore, stresses are the destruction, degradation or impairment of SONCC ESU coho salmon habitats and ecosystem processes caused directly or indirectly by human sources. A threat is the proximate cause of a stress. The stresses and threats considered are either current or have high potential to occur in the next ten years[13] under current circumstances and management (TNC 2006). Ten years was chosen to capture reasonably foreseeable events in the near future. The threats and stresses selected for inclusion in the CAP workbooks are the same as those identified at the time of listing. Eight stresses and 11 threats were identified and analyzed using the CAP toolbox (Table B-1 and Table B-2). After completing the CAP exercises, three additional categories were created and assessed using the other tools available. More information on these additional threats and stresses are explained later.

After threats and stresses were selected, a large amount of data, literature, and other information were acquired to inform the assessment of stresses and threats. The CAP process uses a simple grading scale to assess the current status of threats and stresses –Very High, High, Medium, Low. This four-part ranking scale is based on over 20 years of similar application by natural heritage inventory programs throughout the United States (TNC 2003). It provides a sufficient degree of distinction among the four scores and allows for a reasonable confidence level, while recognizing the lack of the information that would be needed to provide more precise rankings (TNC 2003).The final step was to develop a list of recovery actions designed to decrease or eliminate the stresses and threats. These actions were prioritized to address the most important stresses and threats and to focus effort on the coho salmon populations with the most promising prospects for recovery.

B.2 Development of Initial CAP Workbooks Based on Data

The initial CAP workbooks were produced using only empirical data , with the exception of inclusion of pre-existing USFS and ODFW professional judgments.

For the six stresses included in the initial set of CAP workbooks, one or more indicators of aquatic habitat suitability were used to quantitatively assess each stress. To minimize data gaps, the list of indicators was tailored to match the specific data metrics widely available for populations in the SONCC coho salmon ESU, rather than a comprehensive list which would

[13] 50 years was used for climate change given the longer-term nature of changes in its effects.

include indicators only available for some populations. For each indicator, NMFS developed a set of benchmarks for rating habitat suitability for coho salmon on a four-category scale (poor, fair, good, very good) based on the best available scientific literature (Kier Associates and NMFS 2008)(Table B-3). A few of the indicators reflect previous professional judgments by USFS and ODFW and so are not quantitative. In addition, some threats were quantitatively assessed using GIS analyses (Table B-4).

Table B-3. Indicators of aquatic habitat suitability for coho salmon, with reference values. Table adapted from Kier Associates and NMFS (2008).

Stress	Indicator	Poor	Fair	Good	Very Good
Altered Hydrologic Function	Flow Restoration Needs (ODFW judgment)	3.5-4	2.5-3.5	1.5-2.5	1-1.5
Altered Hydrologic Function	Water Quantity/Flow Regime (USFS judgment)	Altered	Partially Altered		Unaltered
Altered Sediment Supply	Embeddedness (%)	>45%	30.1-45%	25.1-30%	<=25 %
Altered Sediment Supply	Fines (Dry Sample) (% <1 mm)	>12.6%	11.1-12.6%	8.9-11.1%	<8.9%
Altered Sediment Supply	Fines (Wet Sample) (% <1 mm)	>17%	15-17%	12-15%	<12%
Altered Sediment Supply	Sand (Dry Sample) (% <6.4 mm)	>25.8%	21.5-25.8%	12.9-21.5%	<12.9%
Altered Sediment Supply	Sand (Wet Sample) (% <6.4 mm)	>30%	25-30%	15-25%	<15%
Altered Sediment Supply	Silt/Sand Surface (% riffle area)	>17	15-17	12-15	<12
Altered Sediment Supply	Turbidity (hours/year >25 FNU)	>720	361-720	120-360	<120
Altered Sediment Supply	VStar	>0.25	0.21-0.25	0.15 - 0.21	<0.15
Barriers	Fish Passage (% of Dry Habitat Types)	>5%	1-5%	<1%	0%
Degraded Riparian Forest Conditions	Canopy Cover (% Shade)	<60% shade	60-70% shade	70.1-80% shade	>80% shade
Degraded Riparian Forest Conditions	Canopy Type (% Open + Hardwood)	>40%	30-40%	20-30%	<20%
Degraded Riparian Forest Conditions	Riparian Condition (conifers >36" dbh / 1000ft)	<75	75.0-125	125-200	>200
Degraded Riparian Forest Conditions	Stream Corridor Vegetation (USFS judgment)	Impaired	Functioning At-risk		Properly Functioning
Impaired Water Quality	Aquatic Invertebrates (B-IBI NorCal)	<40	40-60	60.1-80	>80
Impaired Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-2523	>23

Stress	Indicator	Poor	Fair	Good	Very Good
Impaired Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40
Impaired Water Quality	D.O. (COLD) (mg/l 7-DAMin)	<6.0 mg/l	6-6.5 mg/l	6.5-7.0 mg/l	>7.0 mg/L
Impaired Water Quality	D.O. (SPAWN) (mg/l 7-DAMin)	<9 mg/l	9-10 mg/l	10-11 mg/l	>11.0 mg/l
Impaired Water Quality	pH	>8.75	8.5-8.75	8.25-8.5	<8.25
Impaired Water Quality	pH (annual maximum)	>8.75	8.5-8.75	8.25-8.5	<8.25
Impaired Water Quality	Temperature (MWAT) (C)	>17ºC	16-17ºC	15-16ºC	<15ºC
Impaired Water Quality	Temperature (MWMT) (C)	>18.3ºC	17-18.3ºC	16-17ºC	<16ºC
Lack of Floodplain and Channel Structure	D50 (median particle size) (mm)	<38 or >128	38-50 or 110-128	50-60 or 95-110	60-95 mm
Lack of Floodplain and Channel Structure	Floodplain Connectivity (USFS judgment)	Impaired	Functioning At-risk		Properly Functioning
Lack of Floodplain and Channel Structure	Pool Depth (Ave. in Feet)	<2 Ft	2-3 ft	3-3.3 ft	> 3.3 ft.
Lack of Floodplain and Channel Structure	Pool Frequency (% by Area)	<10%	10-20%	20-35%	>35%
Lack of Floodplain and Channel Structure	Pool Frequency (% by Length)	<35%	35-40%	40-50%	>50
Lack of Floodplain and Channel Structure	Wood Frequency ODFW (key pieces/100m)	>1	1-2	2-3	>3
Lack of Floodplain and Channel Structure	Wood Frequency USFS: streams <20 ft. wide	>35 pieces/mi	35-53	54-84	<85
Lack of Floodplain and Channel Structure	Wood Frequency USFS: streams >30 ft. wide	>16 pieces/mi	16-33	33-60	<60
Lack of Floodplain and Channel Structure	Wood Frequency USFS: streams 20-30 ft	>25 pieces/mi	26-36	37-64	<65

Table B-4. Quantitative metrics used to assess threats. Table from Kier Associates and NMFS (2008).

Threat	Metric	Low	Medium	High	Very High
Timber Harvest	Harvested area, as percent of watershed	<10%	10-25%	25-35%	>35%
Agricultural Practices	Pasture/hay and cultivated crops, as a percent of watershed	<2%	2-5%	5-10%	>10%
Roads	Road Density (mi/sq. mi)	<1.6	1.6-2.5	2.5-3.0	>3.0
Urban/Residential/ Industrial	Total impervious area, as a percent of watershed	<5%	5-10%	10-25%	>25%

Indicator and threat data were acquired, reformatted, and compiled into a Microsoft Access database. Data were tagged with stream name and either spatial coordinates or GIS-linked stream reach codes (LLID), so that summaries for SONCC CAP populations or other spatial units could be produced as needed.

Data were gathered from all available sources including grey literature, peer reviewed literature, monitoring and research efforts, and county and state planning efforts. Data contributors include the California Department of Fish and Wildlife (CDFW), Oregon Department of Fish and Wildlife (ODFW), U.S. Forest Service (USFS) Region 5 (R5) and Region 6 (R6), California State Water Resources Control Board (SWRCB), Oregon Department of Environmental Quality (ODEQ), California Department of Forestry and Fire Protection (CAL-FIRE), U.S. Environmental Protection Agency (EPA), the Bureau of Reclamation (Reclamation), the Bureau of Land Management (BLM), the U.S. Fish and Wildlife Service (USFWS), the Yurok Tribe, Karuk Tribe, Hoopa Valley Tribe, Resource Conservation Districts (RCDs), Utah State University's (USU) Bug Lab, Klamath Resource Information System (KRIS), the Conservation Biology Institute, South Coast and Lower Rogue Watershed Councils, Mattole Restoration Council, Mattole Salmon Group, and other contributors. A complete list of datasets is included in Appendix C.

A master CAP workbook template was created. Then a set of custom Python computer programs was used to summarize information from the database to the population level and transfer the summaries into a separate CAP workbook for each population.   This methodology ensured that all workbooks used the same criteria and setup, and avoided labor-intensive and error-prone manual data entry. The initial set of CAP workbooks for each population was created in June 2007.

B.3   Revised CAP workbooks Incorporating Professional Judgment

Data were lacking for some indicators and threats that are recognized as affecting coho salmon or their habitats. NMFS staff conducted an extensive review of literature for SONCC coho salmon population watersheds to derive values for those factors. Documents included federal agency watershed analyses, TMDL reports, restoration plans and locally-driven watershed assessments. These supplementary data were then incorporated into the Microsoft Access database and a revised set of CAP workbooks was created in November 2008. This set of workbooks considered NMFS professional judgment in addition to available empirical data. If available empirical data were incomplete, e.g., from only one side of the watershed, NMFS applied its specialized knowledge of the area to determination the appropriate ratings for stresses and threats.

B.4 GIS Maps

NMFS also created GIS (Geographic Information System) maps using the instream monitoring and landscape data compiled for each population. These maps are available upon request from the SONCC recovery coordinator in Adobe Acrobat (PDF) format and are designed to be used as electronic documents, not printed. The many layers in the maps can be toggled on/off and users can zoom in to see more detail. There are two PDF maps included for each population. The main set of maps contains the stress and threat data, in addition to base layers such as coho IP and streams, and was completed in May 2010. The second set of maps was completed in December 2009 and includes canopy change over various time periods and tree size. These maps are described in Appendix I and were used to analyze and interpret habitat condition across the landscape. Additionally, boundary maps for each population unit showing land ownership, coho distribution, and IP habitat are included as the first figure in each population profile.

B.5 Creation of Stress and Threat Summary Tables for the 2012 Public Draft and Final Recovery Plan

The CAP workbooks produced summary tables that display the ranking for identified threats and stresses, the severity of the impact on each life stage (egg, juvenile, smolt, adult), and an overall ranking. One summary table for threats and one summary table for stresses are provided for each independent and dependent population (e.g., Table B-5 and Table B-6).

Table B-5. Example of summary table for identified stresses. Note: table contains ranks for stress Impaired Estuary/Mainstem Function that was not included in the CAP workbooks.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	High	High	Very High[1]	Very High	Very High	Very High
2	Impaired Water Quality[1]		High	Very High[1]	High	Low	High
3	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
4	Impaired Estuary/Mainstem Function	-	Low	Medium	High	Low	Medium
5	Altered Hydrologic Function	Low	Low	High	Medium	Medium	Medium
6	Altered Sediment Supply	Medium	Medium	Medium	Low	Medium	Medium
7	Barriers	-	Medium	Medium	Low	Medium	Medium
8	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low
9	Increased Disease/Predation/Competition	Low	Low	Low	Low	Low	Low
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.

Table B-6. Example of summary table for identified threats. Note: table contains ranks for the threats Fishing and Collecting and Climate Change that were not included in the CAP workbooks.

Threats		Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Agricultural Practices[1]	High	Very High	Very High[1]	Very High	Very High	Very High
3	Channelization/Diking[1]	High	High	High[1]	Medium	Medium	High
2	Dams/Diversions	Low	Medium	High	High	Medium	High
4	Road/Stream Crossing Barriers	-	Low	High	Medium	High	High
5	Roads	Low	Medium	Medium	Medium	Medium	Medium
6	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
7	Invasive/Non-Native Alien Species	-	Medium	Medium	Medium	Medium	Medium
8	Climate Change	-	-	Medium	Medium	Medium	Medium
9	High Severity Fire	Low	Low	Low	Low	Low	Low
10	Hatcheries	Low	Low	Low	Low	Low	Low
11	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
12	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
13	Fishing and Collecting	-	-	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.

After the summary tables were developed, NMFS used best professional judgment to further assess the severity of the identified threats and stresses. Best professional judgment was employed to verify the CAP results, override results known to be erroneous, or include information where no current data are available. While empirical data are the preferred information with which to conduct population area condition assessments, develop indicator criteria, and evaluate threats and stresses in an area, these data are not always available or may be too old for current uses. This was the case in many areas in the SONCC coho salmon ESU. In such cases, NMFS used professional judgment to improve the accuracy of the threat and stress assessment. The summary tables were also revised in response to a subset of public comments.

B.5.1 Analyses of Stresses and Threats Added to Final Plan

To strengthen the technical basis for the recovery plan, and to respond to comments received on the public draft of the recovery plan, NMFS developed and implemented frameworks to re-evaluate several stresses and threats in a more quantitative and comprehensive fashion than had been conducted previously. These new analyses were performed on the stress of altered hydrologic function and the threats of dams/diversions and timber harvest. The following sections provide brief overviews of the analyses, with full details available in separate documents (Asarian 2014 and NMFS 2014).

Altered Hydrologic Function and Dams and Diversions

The stress of altered hydrologic function is strongly affected by the threat of dams and diversions; therefore, NMFS assessed them together in a combined analysis (Asarian 2014). The final products of the analysis were stress ranks for 'altered hydrologic function' and threat ranks for 'dams and diversions' for each coho salmon population and life stage. These ranks (i.e., very high, high, medium, or low) are professional judgments that are informed by a wide variety of information and detailed analyses, as summarized in Figure B-1. The resulting threat ranks were provided to NMFS staff for use in the recovery plan; however, NMFS allowed population profile authors to use professional judgment to over-ride these ranks, because the relatively coarse nature of this analysis does not take all relevant factors into account.

Various data sources were used to calculate indicators of the magnitude of the hydrologic alteration, as well as other effects of dams and diversions such as fish passage barriers. Some indicators were relatively simple to calculate while others required a series of complicated analytical steps. The diagram in Figure B-2 summarizes the data sources and calculation methods for each indicator. After indicators values were calculated, they were then rated on a four-category scale (very good, good, fair, poor), according to rules (i.e., category definitions) that were based on a combination of literature and professional judgment (Table B-7 and Table B-8). As an illustration of one example indicator, Figure B-3 maps the long-term (1953 to 2012) trend in minimum 30-day average streamflow. Besides the indicators listed in Figure B-2, supplemental analyses of streamflow and precipitation were also conducted and are presented in the report; however, these were only tangentially considered in the judgment process.

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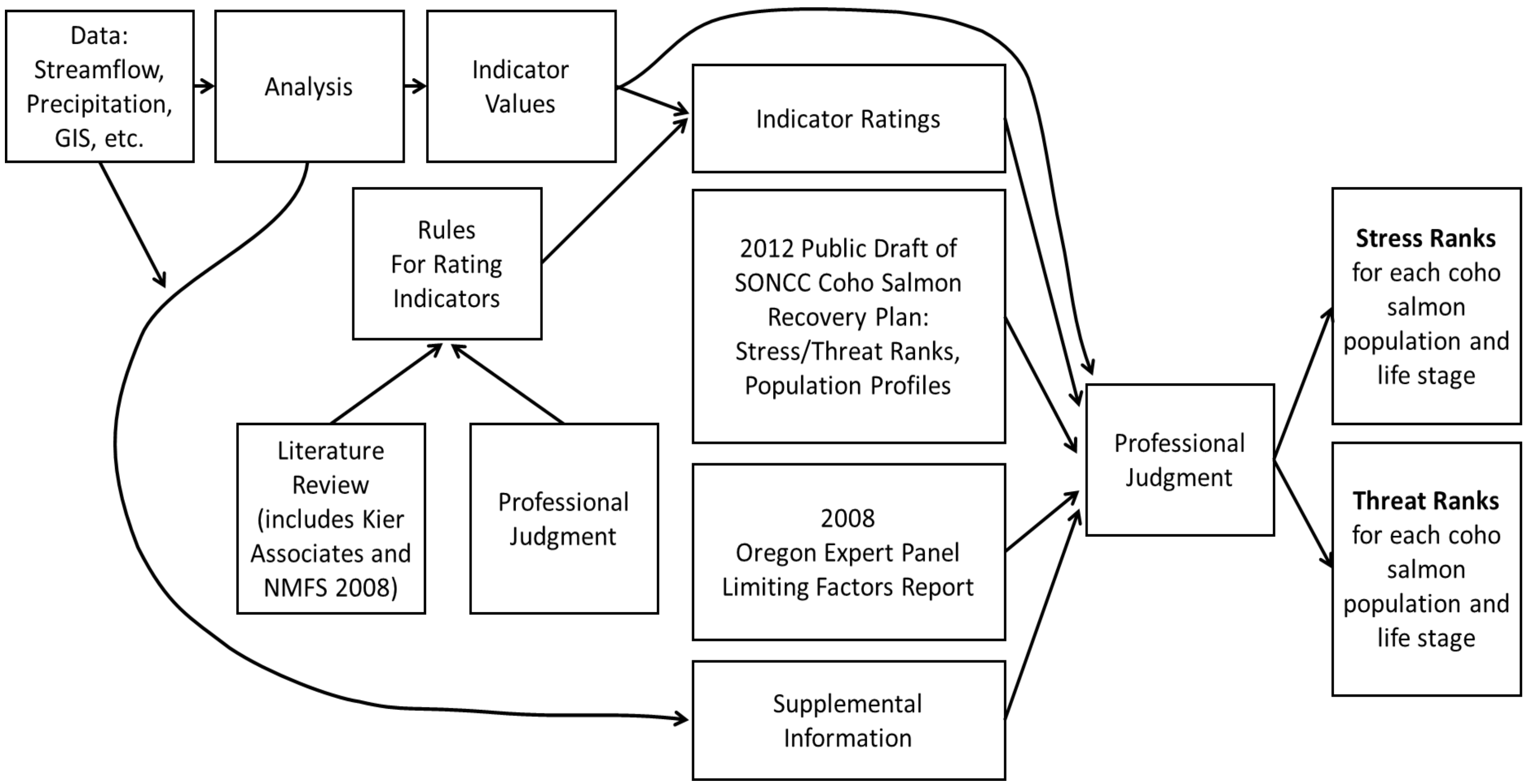

Figure B-1. Summary of process used to inform professional judgments and derive stress ranks for ‘altered hydrologic function’ and threat ranks for ‘dams and diversions’.

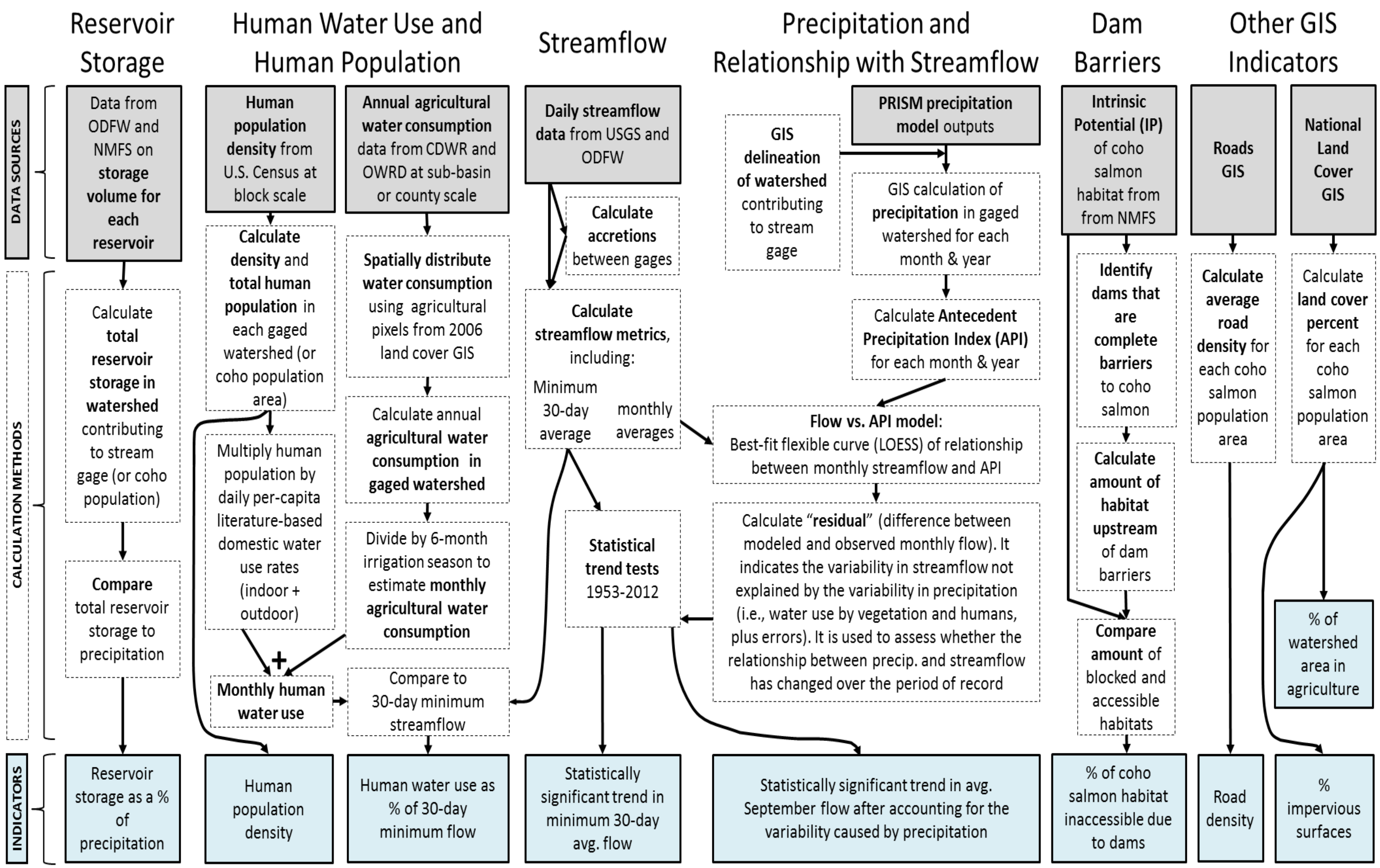

Figure B-2. Diagram summarizing the data sources (gray boxes at top) and calculation methods (hollow boxes in middle) used for each indicator (blue boxes at bottom).

Table B-7. Quantitative indicators for altered hydrologic function stress.

Indicator	Poor	Fair	Good	Very Good
Reservoir storage as a % of precipitation	>15%	>5-15%	0.5-5%	<0.5%
Statistically significant trend[*] in minimum 30-day average flow	>1%/yr decrease	>0.5-1.0%/yr decrease	0-0.5%/yr decrease	Increase or no significant trend
Statistically significant trend[*] in average September flow with the effect of precipitation accounted for	>1%/yr decrease	>0.5-1.0%/yr decrease	0-0.5%/yr decrease	Increase or no significant trend
Human water use (domestic plus agricultural) as a % of 30-day minimum flow	>50%	>20-50%	2-20%	<2%
Human population density	>25 persons/ km.^{2}	>5-25 persons/ km.^{2}	1-5 persons/ km.^{2}	<1 persons/ km.^{2}
% of watershed area in agriculture	>10%	>5-10%	2-5%	<2%
% impervious surfaces	>25%	>10-25%	5-10%	<5%
Road density	>3.0 mi/mi^2	>2.5-3.0 mi/mi^2	1.6-2.5 mi/mi^2	<1.6 mi/mi^2

* Trends evaluated for the period 1953-2012. Percent is relative to the median of the entire period, not the start of period, so total change for the period would be the per-year trend slope multiplied by 30 (half the 60-year period). Threshold of statistical significance is $p < 0.10$.

Table B-8. Quantitative indicators for dams/diversions threat.

Indicator	Poor	Fair	Good	Very Good
% of coho salmon habitat inaccessible due to dams	>40%	>15-40%	1-15%	<1%
Reservoir storage as a % of precipitation	>15%	>5-15%	0.5-5%	<0.5%
Domestic water use as a % of 30-day minimum flow	>50%	>20-50%	2-20%	<2%
Agricultural water use as a % of 30-day minimum flow				
Human population density	>25 persons/km.^{2}	>5-25 persons/km.^{2}	1-5 persons/km.^{2}	<1 persons/km.^{2}
% of watershed area in agriculture	>10%	>5-10%	2-5%	<2%

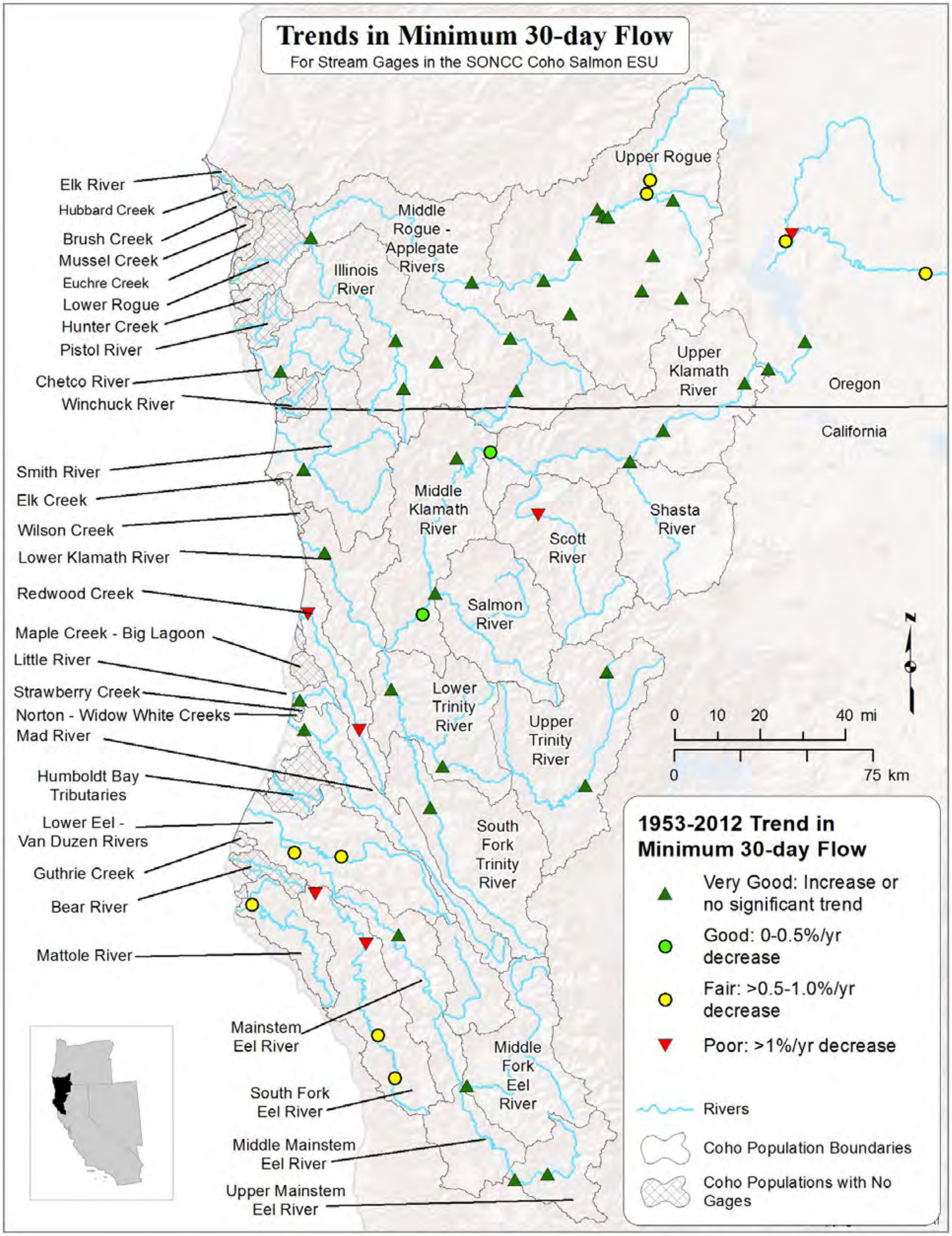

Figure B-3. Map of 1953-2012 trends in minimum 30-day streamflow. Gages are color-coded according to the rules in Table B-7.

Timber Harvest

NMFS evaluated the threat of 'Timber Harvest' within the next ten years (2014-2024) in the SONCC coho salmon ESU. Ten years was chosen to capture reasonably foreseeable events in the near future. The methods and results of the analysis are described in detail by NMFS (2014) and briefly described here. Three metrics are used in the assessment: 1) The Watercourse Management Area Index (WMAI) rates watercourse protection; 2) The Magnitude of Harvest (MH) rates the predicted harvest intensity; and 3) The Conservation Plan (CP) connotes whether timber harvest is guided by a conservation plan.

WMAI consists of four watercourse protection measures, each of which was assessed independently for Class I, Class II, and Class III streams: 1) Width of the Watercourse Management Area, 2) Width of the no-cut zone, 3) inner band canopy retention requirements, and 4) large tree retention requirements (Table B-9).

Rates of harvest were determined from ownership-specific management plans or monitoring reports, or from a literature review of harvest rates for ownership categories, and were then rated according to the rules in Table B-10.

Ownerships with an active conservation or restoration plan that has been approved by NMFS through applicable Endangered Species Act processes received points for the Conservation Plan (CP) metric, while ownerships that do not have a NMFS-approved conservation plan received no points.

The three metrics are summed together to obtain an 'ownership score' for each ownership (Table B-11). The overall threat score for each coho salmon population was determined by calculating an area-weighted average of the ownership scores, with the weight proportional to the percent of the forested area within a coho population area that an ownership covers. In populations with a low percentage (i.e., <75%) of forest area, to account for the reduced threat of timber harvest relative to other threats, an adjustment factor was applied based on the percent of forest area. Using a four-category scale (i.e., low, medium, high, and very high), a threat rank for timber harvest was then assigned according to the overall threat score.

The resulting threat ranks were provided to NMFS analysts for consideration in the recovery plan. However, the NMFS analysts contributing to the development of population profiles had an opportunity to consider other information that was not factored into the main assessment and apply professional judgment to "over-ride" these ranks.

Table B-9. Summary of the values used in the calculation of the Watercourse Management Area Index.

Class I Watercourse	Very Good (4)	Good (3)	Fair (2)	Poor (1)
Width of Watercourse Management Area (one side)	≥ 300’	150-299’	100-149’	< 100’
Width of No-Cut Zone (one side)	≥ 300	≥ 30’	15-29’	0-14’
Inner Band Overstory Canopy Retention (live trees, all species)	100%	70% (30-100’ width)	50-69%	None enforceable
Large Tree Retention	100%	13 largest TPA[1] (30-100 width’)	15 conifers/acre >16” dbh within RMA. Some large trees protected by canopy retention and LWD recruitment requirements	L: 40 live conifer trees per 1000’ >11” or M: 30 live conifer trees per 1000’ >8”
Class II Watercourse	**Very Good (4)**	**Good (3)**	**Fair (2)**	**Poor (1)**
Width of Watercourse Management Area	≥ 150’	100’-150’	76’-100’	< 75’
Width of No-Cut Zone	≥ 150’	≥ 30’	15-29’	0-14’
Inner Band Overstory Canopy Retention (live trees, all species)	100%	70% (25% conifer)	50-69%	None enforceable
Large Tree Retention	100%	13 largest TPA[1] (30-100 width’)	≥ 20’ no-cut buffer, plus L: 40 live conifer trees per 1000’ >11” or M: 30 live conifer trees per 1000’ >8”.	Canopy retention requirements likely protect some large trees
Class III Watercourse	**Very Good (4)**	**Good (3)**	**Fair (2)**	**Poor (1)**
Width of Watercourse Management Area	≥ 100’	≥ 50’ ELZ[2]	30’-49’ ELZ[2]	<30’ ELZ[2]
Width of No-Cut Zone	≥ 100’	≥50’	0-49’ and/or retain channel-stabilizing trees	None
Canopy Retention (live trees, all species)	100%	100% in inner zone, 50% in outer zone	Retain hardwoods, retain conifer to meet stocking, retain all trees in channel zone	Retain trees leaning over channel

[1] TPA = trees per acre.
[2] ELZ = equipment limitation zone with designated skid trail crossings.

Table B-10. Values used for rating Magnitude of Harvest (MH) metric, expressed as the percent of the forested area (as clear-cut equivalent) harvested annually, or as a percent of timber inventory volume harvested annually.

	Very High (1.5 point)	High (3.0 point)	Medium (4.5 points)	Low (6.0 points)	None (7.5 points)
Percent Harvest	>2%	1-2%	0.5-0.99%	0.01-0.49%	0%
Ownership category	Private industrial timberland	Private non-industrial timberland	Hoopa Tribe, BLM OR (unreserved)	USFS (unreserved), BLM CA (unreserved)	USFS (reserved), BLM (reserved), States of CA and OR, NPS, Other

Table B-11. Watercourse Management Area Index (WMAI), Magnitude of Harvest (MH), and Conservation Plan (CP) values used to calculate ownership scores, and resulting category scores.

Ownership	Watercourse Management Area Index (WMAI)	Magnitude of Harvest (MH)	Conservation Plan (CP)	Ownership Score	Notes
National Park Service	12.0	7.5	2	21.5	No harvest
State: California	12.0	7.5	2	21.5	No harvest
State: Oregon	12.0	7.5	2	21.5	No harvest
Other	12.0	7.5	2	21.5	No harvest
USFS (reserved)	12.0	7.5	2	21.5	No harvest
BLM (reserved)	12.0	7.5	2	21.5	No harvest
BLM California (available)	12.0	6.0	2	20.0	Harvest only slightly >0
USFS (available)	12.0	6.0	2	20.0	
BLM Oregon (available)	12.0	4.5	2	18.5	
Hoopa Valley Tribe	9.3	4.5	2	15.8	
Private: Humboldt Redwood Co. - CA HCP	8.6	1.5	2	12.1	
Private: Green Diamond Resource Co. - CA HCP	8.3	1.5	2	11.8	
Private: other land in California	8.3	3.0	0	11.3	
Private: Fruit Growers Supply Co. - CA HCP	6.8	1.5	2	10.3	
Private: CA industrial timberland no HCP	8.3	1.5	0	9.8	
Private: other land in Oregon	3.8	3.0	0	6.8	
Private: OR industrial timberland no HCP	3.8	1.5	0	5.3	

Adverse Hatchery-Related Effects (Stress) and Hatcheries (threat)

The percent of observed adults of hatchery origin is used as an indicator of relative genetic risk to a coho salmon population. Use of less than 5 percent as the threshold for low risk is consistent with the approach described in Williams et al. (2008). Williams et al. (2008) does not provide guidance regarding the degree of risk above 5 percent. The status review for Oregon salmon and steelhead populations in the Willamette and Lower Columbia basins (McElhany et al. 2007) describes categories of genetic risk from hatcheries with break points at 10 percent and 30 percent, and this convention is adopted for all SONCC coho salmon life stages (Table B-12). Ecological effects of hatcheries are accounted for in the Medium stress and threat rank, which is assigned if there is a salmonid hatchery in the basin.

Table B-12. Criteria for ranking hatchery-related stress (Adverse Hatchery Effects) and threat (Hatcheries).

Rank	Definition
Low	Less than 5 percent of observed adults are of hatchery origin AND there is no salmonid hatchery is in the basin.
Medium	Greater than or equal to 5 percent and less than or equal to 10 percent of observed adults are of hatchery origin OR there is a salmonid hatchery in the basin.
High	Greater than 10 percent and less than 30 percent of observed adults are of hatchery origin.
Very High	Greater than or equal to 30 percent of observed adults are of hatchery origin.

B.5.2 Additional Threat and Stress Categories

NMFS developed categories for additional threats and stresses that are currently impacting the SONCC coho salmon ESU. Some were not identified at the time of listing, but are considered to be affecting SONCC coho salmon populations currently. These categories were developed for Climate Change, Impaired Estuary and Mainstem Function, fishing-related stress and threat ("Adverse Hatchery-Related Effects" and "Fishing and Collecting"), and hatchery-related stress and threat ("Adverse Fishery-Related Effects" and "Fishing and Collecting"). Since no empirical data are available for these categories, NMFS utilized additional tools to perform the threat and stress assessment and ranking. NMFS did not utilize the CAP workbooks to predict ratings for these new threat and stress categories. NMFS utilized professional judgment when ranking and assessing the severity for each life stage for the Estuary and Mainstem Condition category. For Climate Change, NMFS utilized climate change models and predictors that assessed future changes in a variety of environmental conditions. See below for environmental variables selected for the Climate Change category.

Climate Change

Climate change has the potential to dramatically alter the recovery landscape and must be considered in assessing current and future conditions. The impacts that are most likely to affect SONCC coho salmon populations include increasing temperatures, changes in quantity and quality of snowpack, changes in precipitation, and rising sea level. NMFS assessed the climate change threat for each individual population using current conditions along with modeled future conditions based on projections for future greenhouse gas emissions. Current climate was derived from PRISM (Parameter-elevation Regressions on Independent Slopes Model), an analytical tool that uses point data, a digital elevation model, and other spatial data sets to generate gridded estimates of monthly, yearly, and event-based climatic parameters, such as precipitation, temperature, and dew point. Future climate data were derived from climate projections produced using a statistical downscaling method (Vertenstein et al. 2004). These projections were derived from the Community Climate System Model (CCSM-3) (Vertenstein et al. 2004). We chose the A2 emission pathways, which uses one of the highest rates of greenhouse gas (GHG) emission predictions and the GFDL model, which has a relatively high sensitivity to emissions compared to other Intergovernmental Panel on Climate Change (IPCC) global climate models (California Environmental Protection Agency (CEPA) 2006). Since recent trends in GHG emission are thought to be well above those used in any of the IPCC (2007) models, it is likely that even the “high emission” scenario may underestimate actual emission in the future (Raupach et al. 2007). We chose the time period of 2030 to 2050 to reflect expected short-term changes in climate. For this recovery plan, ten years is the time period assumed for other stresses and threats in the stress and threats assessment. Ten years was chosen to capture reasonably foreseeable events in the near future. NMFS expects that effects of climate change may take longer to manifest than effects of other stresses, and so chose a longer time period (50 years) in which to detect its effects.

To develop threat rankings for the climate change threat, NMFS analyzed the assigned risks to populations from the various climate change indices and overlaid known life history requirements. Like other threats, the final threat level was based on application of NMFS' professional judgment in consideration of available data.

Current Minimum and Maximum Temperature

An assessment of current summer and winter temperatures provided insight into the vulnerability of populations to climate change. Those populations at or near the current thresholds for coho salmon are likely to have a greater threat from climate change based on the increases in temperature occurring. Current temperature regimes were assessed using PRISM data (PRISM Climate Group 2011) averaged for the time period from 1971 to 2000, which was the time period available through the PRISM Climate Group. The months of January and July were chosen for this analysis to represent winter and summer conditions.

Current Precipitation

Current summer and winter precipitation provided a baseline condition on which to assess future changes in climate. Low precipitation in the summer and high winter precipitation are factors which can increase the threat from climate change based on predicted and ongoing changes in climate (IPCC 2007) and on the environmental requirements of the SONCC coho salmon ESU during those time periods. Current precipitation regimes were assessed using PRISM data (PRISM Climate Group 2011) averaged for the time period from 1971 to 2000. The months of January and July were chosen for this analysis to represent winter and summer conditions. The average precipitation does not indicate the rates or types of precipitation, which is another climate factor that can influence coho salmon growth and survival.

Current snowpack

Changes in temperature and precipitation will ultimately affect the snowpack in Southern Oregon and Northern California. Areas that currently have little snowpack will likely have less in the future given the modeled changes in temperature and precipitation for the area (Gleick and Chalecki 1999, Lettenmeier and Gan 1990). Snowpack-driven systems are highly vulnerable to climate change and identification of these sensitive populations helps inform our assessment of the climate change threat. Information about current snowpack was derived from NRCS SNOTEL and Snow Course snow water equivalents for the month of January (NRCS 2011). These data are represented as a percentage of normal and averaged between 1971 and 2000. High risk was assigned to populations in areas that currently have a low snowpack and are snowpack dependent.

Modeled Future Temperature Change

Regional forecasts of temperature changes related to climate change were derived from the statistical downscaling method and Community Climate System Model (CCSM-3) (Vertenstein et al. 2004). The months of January and July are used to represent changes in the summer and winter in terms of mean daily temperature (Figure B-4 and Figure B-5). A high risk is assigned to populations where temperatures are already high and future increases in summer temperature are expected. High risk is also assigned to snowpack-dependent populations where increases in winter temperature are expected to decrease snowpack levels.

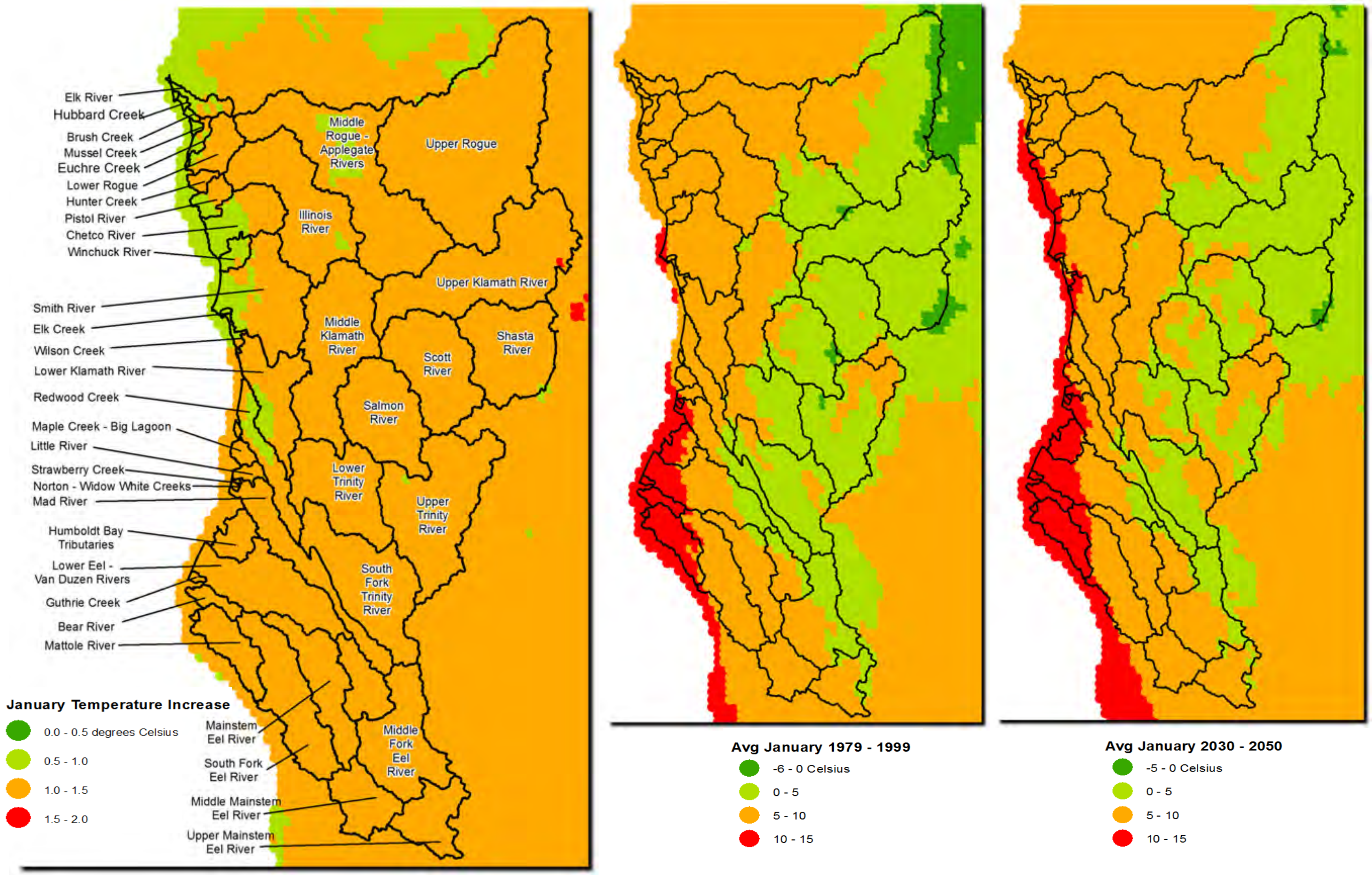

Figure B-4. Modeled average January temperatures for the years 1979 to 1999 (middle panel) and 2030 to 2050 (right panel), and the difference between the two time periods (left panel). Datasets generated by the Community Climate System Model (CCSM) model for the IPCC 4th Assessment Report, and were downloaded from http://www.gisclimatechange.org/. The 1979-1999 data are from the 20th Century Experiment and the 2030-2050 data are from emissions scenario A2. Boundaries of the coho salmon populations in the SONCC coho salmon ESU are also shown.

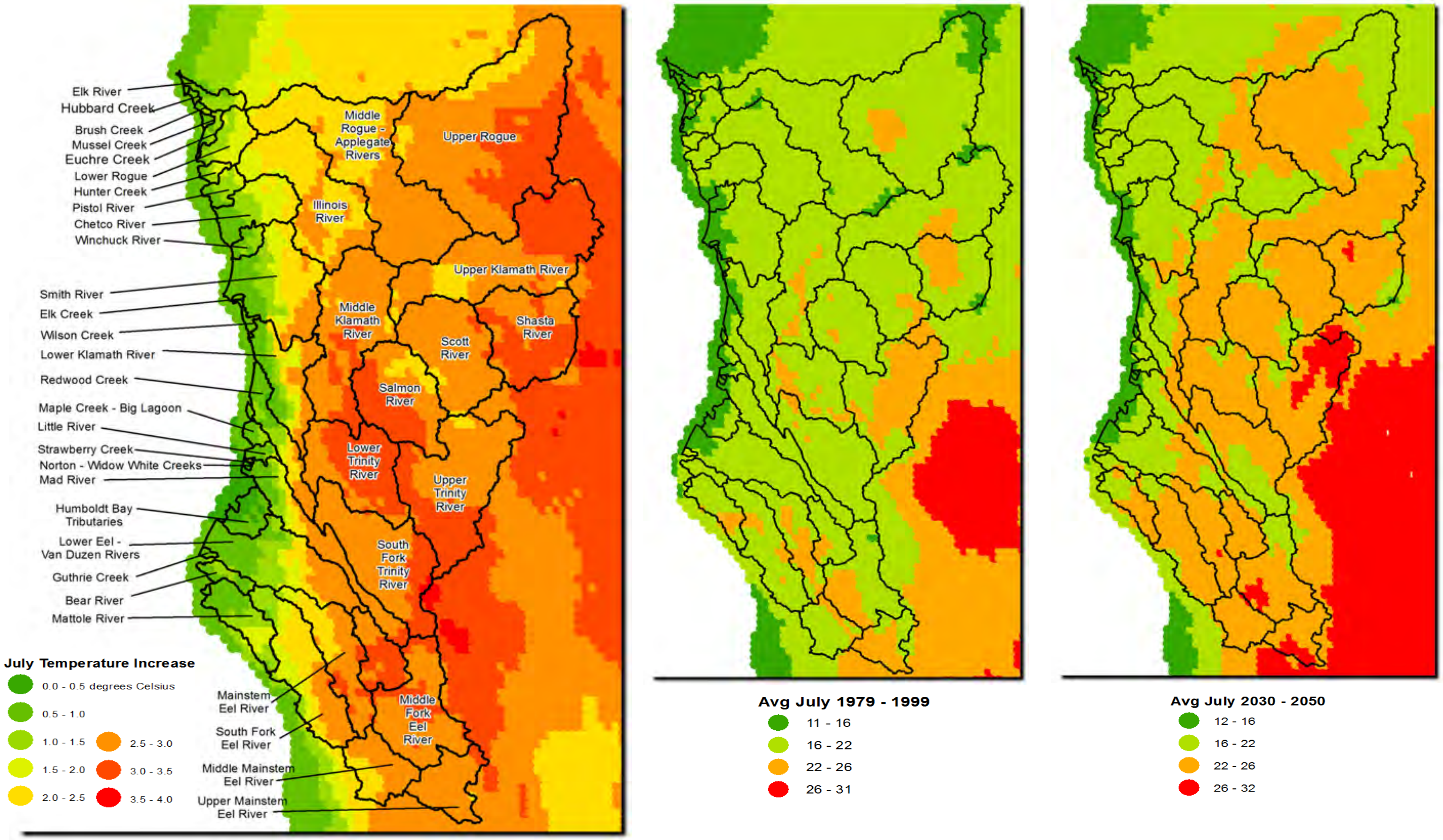

Figure B-5. Modeled average July temperatures for the years 1979 to 1999 (middle panel) and 2030 to 2050 (right panel), and the difference between the two time periods (left panel). Datasets generated by the Community Climate System Model (CCSM) model for the IPCC 4th Assessment Report, and were downloaded from http://www.gisclimatechange.org/. The 1979-1999 data are from the 20th Century Experiment and the 2030-2050 data are from emissions scenario A2. Boundaries of the coho salmon populations in the SONCC coho salmon ESU are also shown.

Modeled Future Precipitation Change

Regional forecasts of precipitation changes related to climate change are derived from projections of precipitation produced using a statistical downscaling method (Vertenstein et al. 2004). These projections are derived from the same A2 emission pathway and the Community Climate System Model (CCSM-3) (Vertenstein et al. 2004). The same time period is used to create model output. We used the general trends of the predicted changes in precipitation (i.e., increasing, decreasing, or stable) instead of the exact predicted values. High risk is assigned to populations where precipitation was already low and the expected trend was for decreasing precipitation over the next 20 years.

Modeled Sea Level Rise

Sea level rise has the potential to have a dramatic impact on salmon habitat in some SONCC coho salmon populations. To assess this aspect of climate change we use a coastal vulnerability index (CVI) provided by the U.S. Geological Survey (Thieler and Hammar-Klose 2000). This classification is based upon the variables geomorphology, regional coastal slope, tide range, wave height, relative sea-level rise, and shoreline erosion and accretion rates. The combination of these variables and the association of these variables to each other furnish a broad overview of regions where physical changes are likely to occur due to sea-level rise (Figure B-6).

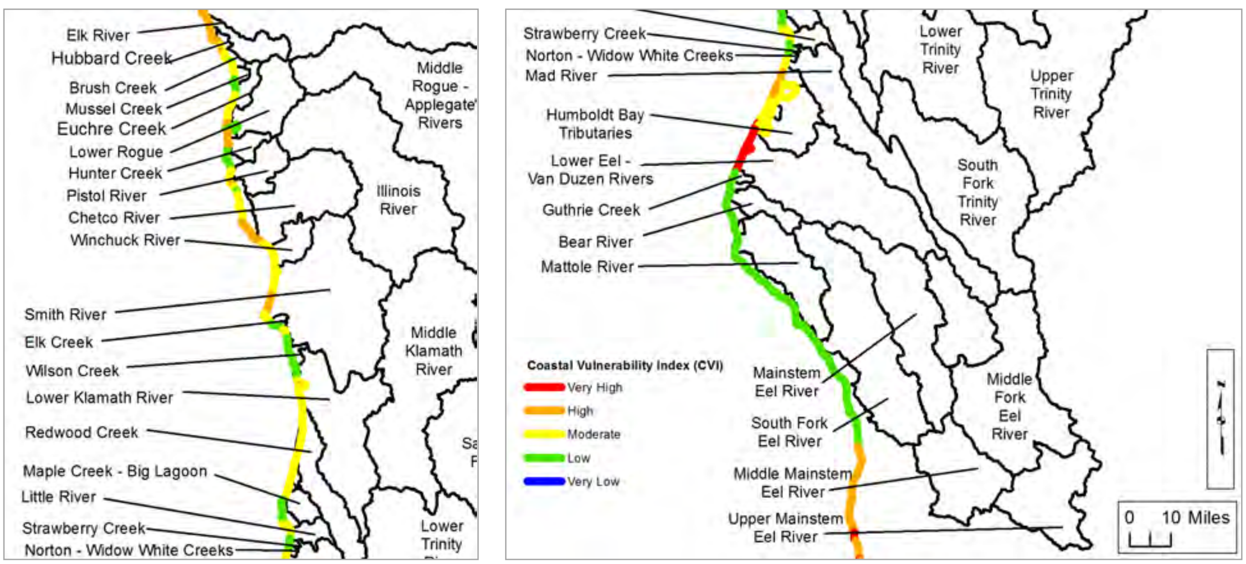

Figure B-6. Coastal Vulnerability Index (CVI) and boundaries of coho salmon populations in the northern (left panel) and southern (right panel) portions of the SONCC coho salmon ESU . CVI data from Thieler and Hammer-Klose (2000).

Impaired Estuary and Mainstem Function

Due to the lack of numeric data that covered the entire ESU, no numeric values or categories were used to develop rankings for this stress. Instead, professional judgment was used based on a series of information about the current state of estuarine or mainstem habitat and environmental conditions. Important considerations included the extent of development in the estuarine floodplain; known or presumed former extent of estuary habitat, availability of diverse and well-connected off-channel, pond, and wetland estuary and mainstem habitat; water quality; presence of dams and other obstacles to migration; and the extent of diking and ditching in the estuary. Life stage specific factors were also considered to contribute to this stress level. For fry, the stress level was elevated if there was a known fry migrant life history or the occurrence of fry migrants in the populations. For juveniles, the occurrence of estuarine life history types, accessibility issues (such as barriers that block access to tributary rearing habitat), the extent and quality of rearing habitat, and water quality issues were all used in developing stress rankings. Smolts were considered to be impacted by this stress if there were predation issues in the mainstem or estuary, poor migratory conditions (such as exposure to stressful water quality conditions, parasites, or diseases) that could reduce survival and growth, a lack of refugia or holding habitat in the mainstem and/or estuary, or ocean accessibility issues (such as a seasonal berm). The adult life stage was ranked based on the accessibility of the watershed, poor migratory conditions in the estuary and/or mainstem which could reduce survival, and the availability of holding habitat in the estuary.

Adverse Fishery and Collection-Related Effects (stress) and Fishing and Collecting (threat)

<u>Fishing Scoring System</u>

NMFS developed a scoring framework that estimates the combined annual ocean and freshwater fishing exploitation for the adult life stage of each population. The framework incorporates an extinction risk status adjustment that increases the score if the population is at moderate or high extinction risk in relation to depensation.

The adult life-stage fishing ratings were determined using the bins in Table B-13. For example, a population with 8% adult exploitation and a status adjustment value of 2 (below depensation and therefore high risk)(Table B-14) would score a 16 or “medium”, and a population with 6% adult exploitation and a status adjustment value of 1.5 (moderate risk) would score a 9 or “low.” After each life-stage was rated, an “overall” rating was determined using the Conservation Action Planning (CAP) methodology.

Table B-13. Bins used to rate the stress and threat for fishing.

Low	0-14.99
Medium	15-29.99
High	30-39.99
Very High	>=40

Table B-14. Extinction-risk status adjustment.

Status Adjustment Value	Population Status
1	Low risk of extinction
1.5	Moderate risk of extinction
2	High risk of extinction

Determination of Ocean Exploitation

The ocean exploitation rate used for all populations was the average ocean exploitation rate as reported by the Pacific Fisheries Management Council, from 1997 to 2013. The PFMC exploitation methodology uses Rogue River and Klamath River hatchery stocks as indicators for the SONCC coho salmon ESU. This rating system assumes SONCC coho salmon populations are exploited at the same rate as the hatchery indicator stocks.

Determination of Estuarine/Freshwater Exploitation

Due to a lack of data documenting population-level estuary/freshwater fishing impacts, NMFS estimated the percent exploitation for each population using the best available information (e.g., "catch-card" data in Oregon; tribal harvest data in the Klamath River) and professional judgment. Exploitation estimates for most California populations relied on rough estimates of coho salmon bycatch due to overlap of run timing with known inland fisheries for other salmonids (e.g., South Fork Eel River steelhead fishery).

Determination of Rating for Collecting Stress and Threat

NMFS authorizes scientific collection activities through ESA section 10(a)(1)(A) research permits and ESA section 4(d) programs. The authorized activities must not operate to the disadvantage of the listed species and must provide a bona fide and necessary or desirable scientific purpose or enhance the propagation or survival of the listed species. In addition, NMFS must determine whether the scientific collection is likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. These provisions, along with the assumption all existing collection activities have been authorized, resulted in the determination that the stress and threat from collection activities is low for all populations.

Adverse Hatchery-Related Effects (stress) and Hatcheries (threat)

The percent of observed adults of hatchery origin is used as an indicator of relative genetic risk to a coho salmon population. Use of less than 5 percent as the threshold for low risk is consistent with the approach described in Williams et al. (2008). Williams et al. (2008) does not provide guidance regarding degree of risk above 5 percent. The status review for Oregon salmon and steelhead populations in the Willamette and Lower Columbia basins (McElhany et al. 2007) describes categories of genetic risk from hatcheries with break points at 10 percent and 30 percent, and this convention was adopted. Ecological effects of hatcheries are accounted for in the Medium stress and threat rank, which is assigned if there is a salmonid hatchery in the basin.

Table B - 1. Criteria for ranking hatchery-related stress (Adverse Hatchery-Related Effects) and threat (Hatcheries).

Rank	Definition
Low	Less than 5 percent of observed adults are of hatchery origin.
Medium	Greater than or equal to 5 percent and less than or equal to 10 percent of observed adults are of hatchery origin OR there is a salmonid hatchery in the basin.
High	Greater than 10 percent and less than 30 percent of observed adults are of hatchery origin.
Very High	Greater than or equal to 30 percent of observed adults are of hatchery origin.

B.6 Stress Analysis

Stresses are the physical, biological, or chemical conditions and associated ecological processes that may impede SONCC ESU coho salmon recovery. When particular conditions are not present, individuals can suffer reduced growth, mortality, or inhibited fertility. Some common examples of stresses are insufficient food, impaired water quality, predation, and insufficient shelter. When habitat required by a species is in short supply, a bottleneck results and this habitat becomes limiting (Reeves et al. 1989).

NMFS utilized the CAP workbooks and summary tables, and professional judgment to determine stress ratings, and developed a narrative to document the results. The results of these exercises were then considered when developing recovery actions. Key limiting stresses and threats were identified as the stresses and threats most affecting current population viability. NMFS identified two key limiting stresses and two key limiting stresses in the stress and threat summary tables, and developed a population-specific narrative to explain them. One factor in the assignment of priorities to recovery actions was whether the recovery action would address a key limiting stress or key limiting threat for the particular population. If it would, the recovery action could be eligible for a higher priority compared to if it would not address a key limiting stress or key limiting threat.

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Appendix C. Datasets Utilized in the Stress and Threat Analysis

Table C-1. Data type, state, year, and reference for data to inform GIS maps, CAP workbooks, and resultant summary tables. Datasets were generally used only if similar information was widely available across the SONCC coho salmon ESU.

Data Type	State/year	Reference
Professional judgment of limiting factors	Oregon	Oregon Department of Fish and Wildlife (ODFW). 2008. Draft Limiting Factors and Threats to the Recovery of Oregon Coho Populations in the Southern Oregon-Northern California Coast (SONCC) Evolutionarily Significant Unit: Results of Expert Panel Deliberations. Draft circulated beginning September 13, 2008. By Jeff Rodgers, ODFW, Corvallis, OR. 38 p
Amount of Impervious Surfaces	California and Oregon	Homer, C. C. Huang, L. Yang, B. Wylie and M. Coan. 2004. Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing, Vol. 70, No. 7, pp 829-840
Agricultural Practices	California and Oregon	Homer, C. C. Huang, L. Yang, B. Wylie and M. Coan. 2004. Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing, Vol. 70, No. 7, pp 829-840
Road Density	California - inland areas	LEGACY-The Landscape Connection Long Range Strategy: Creating a Biodiversity Conservation Network. Released April 29, 1999 by Curtice Jacoby, Noel Soucy, Daniel Boiano, Steven Day, Shayne Green, KayDee Simon, Keith Slauson, and Chris Trudel Produced by LEGACY – The Landscape Connection
	California - coastal areas	CalFire Forest Practices GIS for coastal areas.
Road Density	Oregon	Southwest Oregon Province (SWOP). 1998. Unpublished data released on a CD of GIS Data.
Timber Harvest	California	CalFire Forest Practices GIS - only harvest on non-public lands and harvest not conducted as part of Non-Industrial Timber Management Plans.
	Oregon	Bredensteiner, K., K. Palacios, and J. Strittholt. 2003. Assessment of Aquatic Habitat Monitoring Data in the Rogue River Basin and Southern Oregon Coastal Streams. Performed under grant from David and Lucille Packard Foundation by the Conservation Biology Institute, Corvallis, OR. 42 p. Chapter 1-5. Chapter 6. Chapter 7. Chapter 8 + Appendices.
Timber Harvest	California and Oregon	National Marine Fisheries Service. 2014. Assessment of the Threat of Timber Harvest to Southern Oregon/Northern California Coast Coho Salmon. NOAA/National Marine Fisheries Service, Arcata, CA.

Data Type	State/year	Reference
Land Use and Land Ownership	California and Oregon	U.S. Forest Service and U.S. Fish and Wildlife Service. 2009. Northwest Forest Plan (NWFP) Land Use Allocations (LUA) 2009. U.S. Forest Service Region 6 and U.S. Fish and Wildlife Service Region 1. Available online at: http://www.reo.gov/monitoring/data-maps/general-data-maps.shtml
	California	GreenInfo Network. 2012. California Protected Areas Database v1.8. GreenInfo Network, San Francisco, CA. Available online at: https://projects.atlas.ca.gov/frs/?group_id=115&release_id=5411
Hydrology, Dams, and Diversions	California and Oregon	Asarian, E. 2014. Assessment of altered hydrologic function, dams, and diversions within the Southern Oregon/Northern California Coast evolutionarily significant unit of coho salmon. Prepared for the NOAA Fisheries, Arcata Office. 72 p. plus appendices.
Precipitation	California and Oregon	Daly, C., W. P. Gibson, M. Doggett, J. Smith, and G. Taylor, 2004. Up-to-date monthly climate maps for the conterminous United States. Preprints, 14th Conf. on Applied Climatology, Seattle, WA, Amer. Meteor. Soc., CD-ROM, P5.1. http://prism.oregonstate.edu/pub/prism/docs/appclim04-uptodate_monthly_climate_maps-daly.pdf
Streamflow	California and Oregon	U.S. Geological Survey. 2013. National Water Information System. Digital streamflow data downloaded 2/13/2013. U.S. Department of the Interior, U.S. Geological Survey.
	Oregon	Oregon Water Resources Department (OWRD). Near Real-time Streamflow and Lake Level Data and Historical Streamflow and Lake Level Data. Digital streamflow data downloaded 12/2/2012. Oregon Water Resources Department, Salem, OR.
Agricultural Water Use	California	California Department of Water Resources. 2001. Agricultural Land & Water Use Estimates. California Department of Water Resources, Sacramento, CA.
	Oregon	HDR Inc. 2008. Statewide Water Needs Assessment Oregon Water Supply and Conservation Initiative. Prepared for Oregon Water Resources Department by HDR. Available from: http://www.oregon.gov/owrd/law/docs/owsci/owrd_demand_assessment_report_final_september_2008.pdf

Data Type	State/year	Reference
Domestic Water Use	California and Oregon	State of California. 2010. 20x2020 Water Conservation Plan. Prepared by the California Department of Water Resources, State Water Resources Control Board, California Bay-Delta Authority, California Energy Commission, California Department of Public Health, California Public Utilities Commission, and California Air Resources Board with assistance from the California Urban Water Conservation Council and U. S. Bureau of Reclamation. 60 pp. Available at: http://www.water.ca.gov/wateruseefficiency/sb7/docs/20x2020plan.pdf
Human Population density	California and Oregon	Radeloff VC, R.B. Hammer, S.I. Stewart, J.S. Fried, S.S. Holcomb, and J.F. McKeefry. 2005. The wildland-urban interface in the United States. Ecological applications 15:799–805.
Dams	California	Goslin, M. 2005. Creating a comprehensive dam dataset for assessing anadromous fish passage in California. US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz Laboratory Available from: http://docs.lib.noaa.gov/noaa_documents/NMFS/SWFSC/TM_NMFS_SWFSC/NOAA-TM-NMFS-SWFSC-376.pdf
	Oregon	Oregon Water Resources Department. 2010. Oregon_Dams. Digital dataset. Oregon Water Resources Department, Salem, OR. Downloaded 2/7/2013 from http://spatialdata.oregonexplorer.info/geoportal/catalog/download/download.page
Barriers	California - Mendocino, Humboldt, Del Norte, Trinity, and Siskiyou County	Five Counties Salmonid Conservation Program. 2008. Five Counties Salmonid Conservation Program (5C) Final Report. Contract P0510327. California Department of Fish and Game, Fisheries Restoration Grant Program March 2007 – July 2008.
	California	Pacific States Marine Fisheries Commission. 2013. California Fish Passage Assessment Database, September 2013 version. Pacific States Marine Fisheries Commission, Sacramento, CA. Available online at: http://www.calfish.org.
	Oregon	Oregon Department of Fish and Wildlife. 2012. Oregon Fish Passage Barriers, 6/22/2012 version. Oregon Dept. of Fish and Wildlife, Salem, Oregon. Available online at https://nrimp.dfw.state.or.us/nrimp/default.aspx?pn=fishbarrierdata

Data Type	State/year	Reference
		Oregon Department of Fish and Wildlife. 2013. ODFW 2013 Statewide Fish Passage Priority List. Oregon Dept. of Fish and Wildlife, Salem, Oregon. Available online at http://www.dfw.state.or.us/fish/passage/docs/2013_Statewide_Fish_Passage_Priority_List.xls
Coho Distribution	California	California Department of Fish and Game. 2012. Coho Distribution, July 2012 Version. Available online at: http://www.calfish.org
	Oregon	Oregon Department of Fish and Wildlife. Oregon Fish Habitat Distribution - Current and Historical Coho. Oregon Dept. of Fish and Wildlife, Salem, Oregon. Available online at: https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=202&XMLname=8.xml
SONCC coho salmon intrinsic potential	California and Oregon	Williams, T. H. and others. 2008. Framework for Assessing Viability of Threatened Coho Salmon in the Southern Oregon/Northern California Evolutionary Significant Unit. Southwest Fisheries Science Center. Santa Cruz, CA.
Coho brood year information	California	California_Coho_Status_Review_Brood_Year_Investigation.shp, version 11/3/2009, received 11/2/2009 from CDFG. Supplemental information: Atlas_Hydro_SONCC.shp, version 10/22/2009, received 11/3/2009 from CDFG.
	California	California Department of Fish and Game (CDFG). 2002a. North Coast California Coho Salmon Investigation.
Change Scene and tree size data	California only	Tree size data downloaded from: http://www.reo.gov/monitoring/reports/10yr-report/map-data/index.shtml
	California and Oregon	Methods for tree size and change scene data: Moeur, M., T.A. Spies, M. Hemstrom, J.R. Martin, J. Alegria, J. Browning, J. Cissel, W.B. Cohen, T.E. Demeo, S. Healey, and R. Warbington. 2005. Northwest Forest Plan- the first 10 years (1994 to 2003): status and trend of late-successional and old-growth forest. Gen. Tech. Rep. PNW-GTR-646. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 142 p.
Aquatic Invertebrates (B-IBI NorCal)	2000	Rehn, A.C. and P.R. Ode. 2005. Draft Development of a Benthic Index of Biotic Integrity (B-IBI) for Wadeable Streams in Northern Coastal California and its Application to Regional 305(b) Assessment. CDFG Aquatic Bioassessment Laboratory, Rancho Cordova, CA. 24 p.
Aquatic Invertebrates (EPT)	1980 -1998	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft.

Data Type	State/year	Reference
Aquatic Invertebrates (EPT)	California	Salmon River Restoration Council (SRRC). 1994. Unpublished data of macroinvertebrate samples for the year 1994 in tributaries of the Salmon River: Salmon River Macroinvertebrate Reconnaissance Study. Data included in the "Aquatic Inverts: EPT Richness Index Three Salmon River Tribs Fall 1994" topic of the Klamath Resource Information System. Salmon River Restoration Council, Somes Bar, CA.
Aquatic Invertebrates (Rich)	1980-1996	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft.
Canopy Cover (% Shade)	1991	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.
Canopy Cover (% Shade)	1994	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Canopy Cover (% Shade)	2002-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002-2003. Petrolia, CA.
Canopy Cover (% Shade)	2005	Mattole Restoration Council (MRC). 2008. Unpublished spreadsheet of stream habitat information for the Mattole River for the years 2005-2007, acquired from Nathan Queener on 5/15/2008. Mattole Restoration Council, Petrolia, CA.
Canopy Type (% Open + Hardwood)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.
Canopy Type (% Open + Hardwood)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
D.O. (COLD) (mg/l 7-DAMin)	1995	U.S. Fish and Wildlife Service. 1995. Unpublished Klamath River water quality data for the year 1995. Data are included in the "Temperature: Salmonid Stress Klamath River at Blue Creek 1995" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity. U.S. Fish and Wildlife Service, Arcata, CA.

Data Type	State/year	Reference
D.O. (COLD) (mg/l 7-DAMin)	1994-2003	Asarian, E. and J. Kann. 2006. Klamath River Nitrogen Loading and Retention Dynamics, 1996-2004 (Appendix C: updated version of Klamath TMDL water quality database). Kier Associates Final Technical Report to the Yurok Tribe Environmental Program, Klamath, California. 56pp + appendices.
D50 (mm)	1998 -2000	Dresser, A. T., C. Cook, and M. Smith. 2001. Long Term Trend Monitoring Program for the South Fork Trinity River watershed. Data are included in the "Sediment: Median Particle Size (3) - Hyampom (1998, 2000)" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity
D50 (mm)	1992	Knopp, C. 1993. Testing indices of cold water fish habitat. Final report for development of techniques for measuring beneficial use protection and inclusion into the North Coast Region's Basin Plan by Amendment of the.....Activities, September 18, 1990. Data are included in the " Sediment: V* by NCRWQCB, 1992" topic of the Klamath Resource Information System (KRIS) Mattole. North Coast Regional Water Quality Control Board in cooperation with California Department of Forestry. 57 pp.
D50 (mm)	2001-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002-2003. Petrolia, CA.
D50 (mm)	1979-1995	Redwood National and State Parks. 2002. Unpublished particle size distribution data for Redwood Creek at locations of gaging stations from 1979 to 1995. Data included in the "Sediment: D50 from Cross-Sections at Redwood Creek at Gauging Stations" topic of the Klamath Resource Information System (KRIS) Redwood. Redwood National and State Parks, Orick, CA.
D50 (mm)	2000-2008	Aquatic and Riparian Effectiveness Monitoring Program (AREMP). 2009. Unpublished database of aquatic habitat monitoring and temperature data for Northern California and Southern Oregon for the years 2000-2008, collected as part of the Northwest Forest PlanInteragency Regional Monitoring Program, acquired from Mark Isley on 12/4/2009. United States Forest Service, Corvallis, OR.
Embeddedness (%)	2002-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002-2003. Petrolia, CA.
Embeddedness (%)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.

Data Type	State/year	Reference
Embeddedness (%)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Embeddedness (%)	2005-2007	Mattole Restoration Council (MRC). 2008. Unpublished spreadsheet of stream habitat information for the Mattole River for the years 2005-2007, acquired from Nathan Queener on 5/15/2008. Mattole Restoration Council, Petrolia, CA.
Fines (Dry Sample) (% <1 mm)	2002	Trinity County Resource Conservation District (TCRCD). 2003. South Fork Trinity River Water Quality Monitoring Project - Agreement No. P0010340 Final Report. Data included in the "Sediment: SF Trinity - Cumulative Percent Fines <0.85 mm, GMA 2002" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity .Prepared for California Department of Fish and Game by TCRCD, with assistance from Graham Matthews. Weaverville, CA. 77 pp.
Fines (Dry Sample) (% <1 mm)	1983-1995	North Coast Regional Water Quality Control Board. 2002. Unpublished fine sediment data for the Redwood Creek Basin for the years 1983-1995. Data included in the "Sediment: Percent Fines <1mm at Redwood Creek Mainstem Sites" topic of the Klamath Resource Information System (KRIS) Redwood. North Coast Regional Water Quality Control Board, Santa Rosa, CA.
Fines (Wet Sample) (% <1 mm)	1967-1996	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft. Salmon Creek, 1994" topic of the Klamath Resource Information System (KRIS) Humboldt Bay. Arcata CA. 81 pp. without appendices.
Fines (Wet Sample) (% <1 mm)	1967-1996	Barnard, K. 1992. Physical and Chemical Conditions in Coho Salmon (Oncorhynchus kisutch) Spawning Habitat in Freshwater Creek, Northern California. Master's Thesis. Humboldt State University. Some data included in the " Sediment: Fines <0.85mm".
Fines (Wet Sample) (% <1 mm)	1992	Hoopa Valley Tribe Fisheries Department. 1997. Pine Creek Sediment Monitoring Project. Grey literature report submitted to USFWS Yreka, in fulfillment of a Klamath Task Force funded evaluation report of restoration in Pine Creek. Some data included in the "Sediment: Pine Creek Coho Expected Emergence, 1992-1993" topic of the Klamath Resource Information System (KRIS) Klamath Trinity Hoopa Valley Tribe Fisheries Department, Hoopa, CA.

Data Type	State/year	Reference
Fines (Wet Sample) (% <1 mm)	1990	Preston, L. 2002. Unpublished data of wet sieve McNeil samples from Lost Man Creek and seven mainstem Mattole sites in 1990 by Larry Preston. Data included in the "Sediment: Fines <4.7 mm Mattole South Subbasin, 1990" topic of the Klamath Resource Information System (KRIS) Mattole. California Department of Fish and Game, Eureka, CA.
Fines (Wet Sample) (% <1 mm)	1974	North Coast Regional Water Quality Control Board. 2002. Unpublished fine sediment data for the Redwood Creek Basin for the years 1983-1995. Data included in the "Sediment: Percent Fines <1mm at Redwood Creek Mainstem Sites" topic of the Klamath Resource Information System (KRIS) Redwood North Coast Regional Water Quality Control Board, Santa Rosa, CA.
Fish Passage (% of Dry Habitat Types)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.
Fish Passage (% of Dry Habitat Types)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Floodplain Connectivity (USFS judgment)	2000	U.S. Forest Service. 2000. Rating Watershed Condition: Reconnaissance Level Assessment for the National Forest of the Pacific Southwest Region in California. U.S.D.A. Forest Service, Region 5, San Francisco, CA. 31 p.
Flow Restoration Needs (ODFW judgment)	1998	Oregon Department of Fish and Wildlife (ODFW). 1998. Stream Flow Restoration Priority GIS Data for the Rogue and South Coast Basins. Oregon Department of Fish and Wildlife, Salem, OR.
pH (Annual Maximum)	1995	U.S. Fish and Wildlife Service. 1995. Unpublished Klamath River water quality data for the year 1995. Data are included in the "Temperature: Salmonid Stress Klamath River at Blue Creek 1995" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity U.S. Fish and Wildlife Service, Arcata, CA.
pH (Annual Maximum)	1990-2003	Asarian, E. and J. Kann. 2006. Klamath River Nitrogen Loading and Retention Dynamics, 1996-2004 (Appendix C: updated version of Klamath TMDL water quality database). Kier Associates Final Technical Report to the Yurok Tribe Environmental Program, Klamath, California. 56pp + appendices.

Data Type	State/year	Reference
pH (Annual Maximum)	1995-2004	Oregon Department of Environmental Quality (ODEQ). 1997. Unpublished water quality data from the ODEQ Laboratory Analytical Storage and Retrieval (LASAR) database, exported and acquired from Robb Keller, 4/17/2007. Oregon Department of Environmental Quality, Salem, OR.
Pool Depth (Ave. in Feet)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.
Pool Depth (Ave. in Feet)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Pool Depth (Ave. in Feet)	2005-2007	Mattole Restoration Council (MRC). 2008. Unpublished spreadsheet of stream habitat information for the Mattole River for the years 2005-2007, acquired from Nathan Queener on 5/15/2008. Mattole Restoration Council, Petrolia, CA.
Pool Depth (Ave. in Feet)	1990-2003	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR.
Pool Depth (Ave. in Feet)	1990-1995	United States Forest Service. 1995. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1989-1995, acquired from the Conservation Biology Institute (who compiled the data from multiple files). Rogue River-Siskiyou National Forest, Medford, OR.
Pool Depth (Ave. in Feet)	1995-2006	United States Forest Service. 2006. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1995-2006, acquired from the Rogue River-Siskiyou National Forest. Rogue River-Siskiyou National Forest, Medford, OR.
Pool Depth (Ave. in Feet)	2000-2008	Aquatic and Riparian Effectiveness Monitoring Program (AREMP). 2009. Unpublished database of aquatic habitat monitoring and temperature data for Northern California and Southern Oregon for the years 2000-2008, collected as part of the Northwest Forest Plan Interagency Regional Monitoring Program, acquired from Mark Isley on 12/4/2009. United States Forest Service, Corvallis, OR.

Data Type	State/year	Reference
Pool Frequency (% by Area)	1990	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR.
Pool Frequency (% by Area)	1990-1995	United States Forest Service. 1995. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1989-1995, acquired from the Conservation Biology Institute (who compiled the data from multiple files). Rogue River-Siskiyou National Forest, Medford, OR.
Pool Frequency (% by Area)	1995-2006	United States Forest Service. 2006. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1995-2006, acquired from the Rogue River-Siskiyou National Forest. Rogue River-Siskiyou National Forest, Medford, OR.
Pool Frequency (% by Length)	1991-2003	California Department of Fish and Game (CDFG). 2007. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1991-2003, acquired from Ron Rogers in 2007. California Department of Fish and Game, Sacramento, CA.
Pool Frequency (% by Length)	1994-2008	California Department of Fish and Game (CDFG). 2009. Unpublished data from a database of stream habitat surveys in Northwestern California for the years 1994-2008, acquired from Karen Wilson in 2009. California Department of Fish and Game, Sacramento, CA.
Pool Frequency (% by Length)	2005-2007	Mattole Restoration Council (MRC). 2008. Unpublished spreadsheet of stream habitat information for the Mattole River for the years 2005-2007, acquired from Nathan Queener on 5/15/2008. Mattole Restoration Council, Petrolia, CA.
Riparian Condition (conifers >36" dbh / 1000ft)	1990-2003	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR.

Data Type	State/year	Reference
Sand (Dry Sample) (% <6.4 mm)	2002	Trinity County Resource Conservation District (TCRCD). 2003. South Fork Trinity River Water Quality Monitoring Project - Agreement No. P0010340 Final Report. Data included in the "Sediment: SF Trinity - Cumulative Percent Fines <0.85 mm, GMA 2002" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity (available online at http://krisweb.com/krisklamathtrinity/krisdb/webbuilder/st_c49.htm). Prepared for California Department of Fish and Game by TCRCD, with assistance from Graham Matthews. Weaverville, CA. 77 pp.
Sand (Dry Sample) (% <6.4 mm)	1983-1995	North Coast Regional Water Quality Control Board. 2002. Unpublished fine sediment data for the Redwood Creek Basin for the years 1983-1995. Data included in the "Sediment: Percent Fines <1mm at Redwood Creek Mainstem Sites" topic of the Klamath Resource Information System (KRIS) Redwood. North Coast Regional Water Quality Control Board, Santa Rosa, CA.
Sand (Wet Sample) (% <6.4 mm)	1967-1996	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft.
Sand (Wet Sample) (% <6.4 mm)	1967-1996	Barnard, K. 1992. Physical and Chemical Conditions in Coho Salmon (Oncorhynchus kisutch) Spawning Habitat in Freshwater Creek, Northern California. Master's Thesis. Humboldt State University. Some data included in the " Sediment: Fines <0.85mm Salmon Creek, 1994" topic of the Klamath Resource Information System (KRIS) Humboldt Bay. Arcata CA. 81 pp. without appendices.
Sand (Wet Sample) (% <6.4 mm)	1992	Hoopa Valley Tribe Fisheries Department. 1997. Pine Creek Sediment Monitoring Project. Grey literature report submitted to USFWS Yreka, in fulfillment of a Klamath Task Force funded evaluation report of restoration in Pine Creek. Some data included in the "Sediment: Pine Creek Coho Expected Emergence, 1992-1993" topic of the Klamath Resource Information System (KRIS) Klamath Trinity Hoopa Valley Tribe Fisheries Department, Hoopa, CA.
Sand (Wet Sample) (% <6.4 mm)	1990	Sommarstrom, S., E. Kellogg and J. Kellogg. 1990. Scott River watershed granitic sediment study: Report for Siskiyou Resource Conservation District, 152 p. plus appendices.

Data Type	State/year	Reference
Sand (Wet Sample) (% <6.4 mm)	1990	Preston, L. 2002. Unpublished data of wet sieve McNeil samples from Lost Man Creek and seven mainstem Mattole sites in 1990 by Larry Preston. Data included in the "Sediment: Fines <4.7 mm Mattole South Subbasin, 1990" topic of the Klamath Resource Information System (KRIS) Mattole. California Department of Fish and Game, Eureka, CA.
Silt/Sand Surface (% riffle area)	Oregon 1990-2003	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR.
Stream Corridor Vegetation (USFS judgment)	2000	U.S. Forest Service. 2000. Rating Watershed Condition: Reconnaissance Level Assessment for the National Forest of the Pacific Southwest Region in California. U.S.D.A. Forest Service, Region 5, San Francisco, CA. 31 p.
Temperature (MWAT) (C)	1995-1996	PL [Pacific Lumber Company]. 1998. Sustained yield/Habitat Conservation Plan for the properties of The Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Public Review Draft.
Temperature (MWAT) (C)	1997-2002	Klamath National Forest. 2003. Unpublished water temperature data for the Middle Klamath River watershed in 1997-2002, compiled by Klamath National Forest's Mark Reichert. Data included in the " Temperature: MWAT at Many Mainstem Klamath Sites by Year 1997-2002 ", "Temperature: MWAT at Many Mainstem Klamath Sites by Year 1997-2002", and "Temperature: MWAT at Many Scott R Sub-basin, by Year 1997-2002" topics of the Klamath Resource Information System (KRIS) Klamath-Trinity
Temperature (MWAT) (C)	2002-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002 - 2003. Petrolia, CA.
Temperature (MWAT) (C)	1995-2001	North Coast Regional Water Quality Control Board (NCRWQCB). 2002. Unpublished water temperature data for the Mattole River watershed in 1995-2001. Data included in the "Temperature: MWATs of Mainstem Mattole River (Celsius)" topic of the Klamath Resource Information System (KRIS) Mattole North Coast Regional Water Quality Control Board, Santa Rosa, CA.

Data Type	State/year	Reference
Temperature (MWAT) (C)	1974-2001	North Coast Regional Water Quality Control Board (NCRWQCB). 2002. Unpublished water temperature data for the Redwood Creek watershed in 1974-2001. Data included in the "Temperature: MWATs at All Mainstem Redwood Creek Sites (1994-2001)" topic of the Klamath Resource Information System (KRIS) Redwood. North Coast Regional Water Quality Control Board, Santa Rosa, CA.
Temperature (MWAT) (C)	1999-2003	Friedrichsen, G. 2003. Eel River Baseline Temperature Final Report. Performed for the California Department of Fish and Game under Agreement No. P0110546. Humboldt County Resources Conservation District. Eureka, CA. 32 pp.
Temperature (MWAT) (C)	1990-1998	Lewis, T. E., D. W. Lamphear, D. R. McCanne, A. S. Webb, J. P. Krieter, and W. D. Conroy. 2000. Executive Summary: Regional Assessment of Stream Temperatures Across Northern California and Their Relationship to Various Landscape-Level and Site-Specific Attributes. Forest Science Project. Humboldt State University Foundation. Arcata, CA. 14 pp.
Temperature (MWMT) (C)	1994-2008	Green Diamond Resource Company. 2009. Unpublished water temperature data from Green Diamond's northern California land holdings for the years 1994-2008, acquired from David Lamphear. Green Diamond Resource Company, Korbel, CA.
Temperature (MWMT) (C)	1998-2006	Oregon Department of Environmental Quality (ODEQ). 1997. Unpublished water quality data from the ODEQ Laboratory Analytical Storage and Retrieval (LASAR) database, exported and acquired from Robb Keller, 4/17/2007. Oregon Department of Environmental Quality, Salem, OR.
Temperature (MWMT) (C)	1990-1997	Southwest Oregon Province (SWOP). 1998. Unpublished water temperature data released on a CD of GIS Data.
Turbidity (hours >25 FNU)	2001-2007	Kier Associates. 2007. Unpublished turbidity data from multiple data sources within the SONCC coho salmon ESU, derived from various tables in the Klamath Resource Information System (KRIS). Kier Associates, Arcata, CA.
Turbidity (hours >25 FNU)	2003-2005	Klein, R., W. Trush, M. Buffleben. 2008. Watershed condition, turbidity, and implications for anadromous salmonids in northern coastal California streams. A Report to the California North Coast Regional Water Quality Control Board. Redwood National and State Parks, McBain and Trush, and California Regional Water Quality Control Board North Coast Region: Arcata and Santa Rosa, CA. 89 pp + appendices.

Data Type	State/year	Reference
Vstar	1992-1999	Halligan, D. and J. P. Fisher. 2001. Appendix F: Freshwater Creek Watershed Analysis - Fisheries Assessment. Review DRAFT. Prepared for Pacific Lumber Company (PALCO). Scotia, CA. 95 pp.
Vstar	1992-2001	Redwood Sciences Lab (RSL). 2001. Unpublished data regarding the proportions of pools filled by fine sediment (Vstar) in several creeks in the Klamath-Trinity watershed measured by Redwood Sciences lab crews in 1992-2001. Data included in the "Sediment: V* Horse Linto Creek 1992-2000" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity. Redwood Sciences Lab, Arcata, CA.
Vstar	1994	Redwood Sciences Lab (RSL). 1994. Unpublished data regarding the proportions of pools filled by fine sediment (Vstar) in several creeks in the Scott watershed measured by Redwood Sciences lab crews in 1994. Data included in the "Sediment: Proportion in Pools (V*) French Creek by Reach 1994" topic of the Klamath Resource Information System (KRIS) Klamath-Trinity. Redwood Sciences Lab, Arcata, CA.
Vstar	1991-1993	Knopp, C. 1993. Testing indices of cold water fish habitat. Final report for development of techniques for measuring beneficial use protection and inclusion into the North Coast Region's Basin Plan by Amendment of the.....Activities, September 18, 1990. Data are included in the " Sediment: V* by NCRWQCB, 1992" topic of the Klamath Resource Information System (KRIS) Mattole North Coast Regional Water Quality Control Board in cooperation with California Department of Forestry. 57 pp.
Vstar	2000	Mattole Salmon Group (MSG). 2001. Unpublished data regarding the proportions of pools filled by fine sediment (Vstar) in the 2000 in the tributaries of the Mattole River. Data included in the "Sediment: V* Averages by Mattole Salmon Group for All Reaches, 2000" topic of the Klamath Resource Information System (KRIS) Mattole. Mattole Salmon Group, Petrolia, CA.
Vstar	2000-2003	Mattole Salmon Group (MSG). 2003. Final Report: Mattole Basin Channel Monitoring 2002 - 2003. Petrolia, CA.
Vstar	1992-2001	Redwood Sciences Lab (RSL). 2001. Unpublished data regarding the proportions of pools filled by fine sediment (Vstar) in the 1991-2001 for Little Lost Man Cr, Bridge Creek and the Mainstem of Redwood Creek at Emerald Cr. Data included in the " Sediment: V* From Little Lost Man Creek, 1992-2001" topic of the Klamath Resource Information System (KRIS) Redwood. Redwood Sciences Lab, Arcata, CA.

Data Type	State/year	Reference
Water Quantity/ Flow Regime (USFS judgment)	2000	U.S. Forest Service. 2000. Rating Watershed Condition: Reconnaissance Level Assessment for the National Forest of the Pacific Southwest Region in California. U.S.D.A. Forest Service, Region 5, San Francisco, CA. 31 p.
Wood Frequency ODFW (key pieces/mile)	1990-2003	Oregon Department of Fish and Wildlife (ODFW). 2007. Unpublished geo-referenced stream survey data "Aquatic Inventories Project Habitat and Reach Data", downloaded from ODFW's statewide database. Oregon Department of Fish and Wildlife, Salem, OR.
Wood Frequency USFS (score by stream width)	1990-1995	United States Forest Service. 1995. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1989-1995, acquired from the Conservation Biology Institute (who compiled the data from multiple files). Rogue River-Siskiyou National Forest, Medford, OR.
Wood Frequency USFS (score by stream width)	1995-2006	United States Forest Service. 2006. Unpublished geo-referenced stream survey data for the Rogue River-Siskiyou National Forest for the years 1995-2006, acquired from the Rogue River-Siskiyou National Forest. Rogue River-Siskiyou National Forest, Medford, OR.

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Appendix D. Methods Used to Select Core Populations

NOAA's National Marine Fisheries Service (NMFS) considers the role each population is expected to play in a recovered Evolutionarily Significant Unit (ESU) to determine population abundance and juvenile occupancy targets for all the populations in the SONCC coho salmon ESU. Independent populations are evaluated using a modified Bradbury et al. (1995) framework. This evaluation produces a set of biological and habitat scores for each independent population which informs development of demographic targets for each independent population. NMFS' objective is to develop scientifically sound demographic targets that reflect each population's capacity for coho salmon production and potential for meeting demographic and threat abatement recovery criteria. Professional judgment is relied upon to rate biological integrity parameters.

D.1 Demographic Population Targets

NMFS identified five population categories and the method to establish demographic targets for each category (Table D-1). The rationale for NMFS' choice of each population's recovery role, and associated demographic targets, is described in Exhibits 1 to 7.

Table D-1. Population type (as determined by Williams et al. 2006), category, demographic target, and life stage used to measure progress toward target.

Type	Recovery Role	Demographic Target	Life Stage
Dependent	Dependent	Juvenile occupancy (80 percent of habitat occupied in years following spawning of brood years with high marine survival)	Juvenile
Independent	Non-Core 2		
	Non-Core 1	Moderate risk threshold (depensation threshold multiplied by four)	Spawner
	Core	≥ Low risk threshold	

Extirpated Populations

Some populations in the SONCC coho salmon ESU may be extirpated. To determine whether each extirpated population should have a recovery target, NMFS considers several questions related to coho salmon absence and potential for recovery.

Evidence of coho salmon absence

Have there been surveys that document the absence of coho salmon? How extensive have they been? How recently were they completed? Is there documented past presence or absence of coho salmon? How much uncertainty surrounds the information?

Prospects of coho salmon use

Are there characteristics of the watershed which suggest it will likely not support coho salmon in the future? What is the current condition of accessible habitat? What are the prospects for improvement of accessible habitat? What are the prospects for threat abatement?

Connectivity

Would designation as an extirpated population create a gap of more than 30 km (Williams et al. 2008) between population river mouths along the coastline? If so, a target of juvenile occupancy is required.

Dependent populations

All populations identified as dependent by Williams et al. (2006) are assigned the juvenile occupancy demographic target. If NMFS determines a dependent population is extirpated, it has no juvenile occupancy requirement.

Independent populations

To determine the appropriate target for each independent population, NMFS considers the current condition of the population and its habitat, as well as the role that population is expected to play in a recovered ESU (i.e., core, non-core).

Method used to score characteristics of independent populations

NMFS developed a framework to describe characteristics of each independent population, starting with a model provided by Bradbury et al. (1995). This model uses three groupings of criteria for ranking watersheds for Pacific salmon restoration prioritization: 1) biological and ecological resources (Biological Importance); 2) watershed integrity and salmonid extinction risk (Integrity and Risk); and 3) potential for restoration (Optimism and Potential). Some of the ranking criteria proposed under these categories are also used in the NMFS method, and NMFS developed additional criteria. Scores given to each criterion are based on information in the population profiles and professional judgment. Other factors that pertain to the potential success of restoration (e.g., economic, social, or political) are considered, and although they are not scored, they may influence the final choice of population category and demographic targets for independent populations. These other factors are described in Exhibits 1 through 7.

Biological Importance

Scores for Biological Importance are based on the concept of viable salmonid populations (VSP) (McElhany et al. 2000), and are used to describe the current status of the population – population size, productivity, spatial structure, and diversity. Almost all populations are information limited, so perceived differences between populations in population size, productivity, spatial structure, and diversity could be due to a lack of data rather than true differences. These limitations are described in Exhibits 1 to 7.

Population Size and Productivity

Coho salmon typically follow a three year life cycle, producing three cohorts. NMFS' rating of the current population size and productivity of populations is based on the number of cohorts present, the consistency of runs, and trends over time. The number of individuals (population size) and growth rate (productivity) of a population are interrelated risk factors that affect population viability over time. Small populations are subject to numerous risks due to low abundance, whereas large populations are more resilient to the same risks. Productivity refers to production over the entire life cycle. The trends in abundance reflect the long-term population growth rate (McElhany et al. 2000).

The following metrics, described in Table D-2 through Table D-7, are especially important because a coho salmon population that drops to extremely low levels of abundance and productivity represent greater challenges for restoration and recovery. Scores are determined based on the following guidance.

Population Size

Table D-2. Metric used to assess population size parameter.

Score	Description
0	No coho salmon are produced by any cohort, AND any adults are likely strays.
1	Number of spawners is consistently (multiple generations) < 50 percent of the depensation threshold.
2	Number of spawners is consistently (multiple generations) ≥ 50 percent of the depensation threshold.
3	Number of spawners is consistently (multiple generations) > the depensation threshold.

Population Productivity

Table D-3. Metric used to assess population productivity parameter.

Score	Description
0	No coho salmon are produced in any cohort, AND any adults are likely strays.
1	At least one naturally-spawned cohort is absent, or close to absent, AND the other cohorts are not consistently present (at least six consecutive years) or show decreasing trends in abundance.
2	Three cohorts are consistently present (at least six consecutive years) AND all cohorts show decreasing trends in abundance.
3	Three cohorts are consistently present (at least six consecutive years) AND at least one cohort shows no change in trend in abundance or an increasing trend in abundance.

Spatial Structure and Diversity

NMFS expects that populations that are well distributed have a diverse array of life history traits and maintain greater genetic diversity. NMFS expects such populations will be more resilient and have higher potential for recovery than populations with diminished spatial structure and diversity.

Spatial Structure

The spatial structure of a population depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population (McElhany et al. 2000).

The spatial structure rating is based on the current spatial extent of the population compared with the potential juvenile habitat, as described by a model of intrinsic habitat potential (IP).

Table D-4. Metric used to assess spatial structure parameter.

Score	Description
0	No coho salmon are present from any cohort, and any adults are likely strays.
1	Coho salmon occur in 0-25 percent of the IP habitat outside the temperature mask*.
2	Coho salmon occur in ≥25 but ≤50 percent of the IP habitat outside the temperature mask*.
3	Coho salmon occur in >50 percent of IP habitat outside the temperature mask*.
*The temperature mask (Williams et al. 2006) was applied to the IP model results to exclude areas with high air temperatures from calculation of spawner targets.	

Diversity

This parameter was made up of 50 percent Life History Diversity and 50 percent Genetic Diversity. Genetic Diversity included two equally-weighted elements: Hatchery Influence and Small Population Dynamics (depensation).

Life History Diversity

Within and among populations, coho salmon exhibit diverse life history traits which have the potential to enhance growth and survival of individuals in a spatially and temporally variable environment. Because populations are made up of individuals, maintaining diverse life history traits (1) allows for individuals to utilize a wide range of habitats; (2) protects species against short term spatial and temporal changes in habitat; and (3) increases the likelihood that some individuals will survive and reproduce. The diversity of life history traits expressed by individuals, and the availability of a diversity of habitats, spreads any risk to population viability over space and time (Weitkamp et al. 1995, Spence et al. 1996, McElhany et al. 2000).

Life history traits are phenotypic and genotypic characteristics which provide the potential for individuals to utilize multiple habitats in order to enhance growth and survival. These traits include: adult age, size, fecundity, run and spawning timing, and spawning behavior; egg size and developmental rate; juvenile physiology and behavior; smolt size, age, and outmigration timing; disease resistance; and ocean distribution patterns (Weitkamp et al. 1995, Spence et al. 1996, McElhany et al. 2000).

Table D-5. Metrics used to assess life history diversity parameter.

Score	Description
0.5	Diverse habitat types are not present, so potential for expression of atypical life history traits is not apparent, AND there is no evidence of expression of atypical life history traits.
1	Diverse habitat types are present, suggesting potential for expression of atypical life history traits, AND there is no evidence of expression of atypical life history traits.
1.5	Diverse habitat types are present, suggesting potential for expression of atypical life history traits, AND there is evidence of expression of atypical life history traits.

Hatchery Influence

Table D-6. Metrics used to assess hatchery influence parameter.

Score	Description
0.25	The proportion of hatchery strays in the spawning population is high (Proportion of Natural Influence [PNI] <0.3) in >50 percent of years, and these strays support the population.
0.5	The proportion of hatchery strays in the spawning population is moderate (PNI >0.5) in >50 percent of years, and these strays do not support the population.
0.75	The proportion of hatchery strays in the spawning population is low or zero (PNI >0.7) in >50 percent of years, and these strays do not support the population.

Small Population Dynamics (Depensation)

Small populations tend to have less genetic diversity than large ones. The depensation threshold is used to define a small population. The score for small population dynamics as it relates to genetic diversity can be calculated by multiplying the population's score for population size (Table D-2) by 0.25.

Table D-7. Metrics used to assess small population dynamics parameter.

Score	Description
0	No coho salmon are produced by any cohort AND any adults are likely strays.
0.25	Number of spawners is consistently (multiple generations) < 50 percent of depensation threshold.
0.5	Number of spawners is consistently (multiple generations) 51 percent to 100 percent of depensation threshold.
0.75	Number of spawners is consistently (multiple generations) greater than depensation threshold.

Habitat Integrity and Risks

The Habitat Integrity and Risks parameter describes the relative habitat integrity (lack of human-caused disturbance; Bradbury et al. 1995) and relative risk to current biological and ecological resources (Bradbury et al. 1995) in each population. The following metrics were chosen to assess Habitat Integrity and Risks because they were related to the parameter, and because numeric data describing them were readily available.

Road Density

This metric is the average density (miles per square mile) of roads in the population area. It is based on the rationale that areas with high road densities are more prone to unnatural levels of disturbance and relatively high rates of chronic sedimentation, while areas with lower road densities have a higher integrity and less risk. Scores were based on a frequency distribution of road density data from the populations in the ESU divided into roughly equal thirds and scored as 3 for the lowest third (road density 1.6-2.5), 2 for the middle third (2.6-3.0), and 1 for the highest third (3.24-12.59).

Number of Stresses Ranked High or Very High

This metric is the total number of high or very high stresses indicated in the stress summary tables from population profiles. It is based on the rationale that numerous high-level stresses are an indication of a lower ecological integrity and higher degree of risks. Scores were based on a frequency distribution of the number stresses for each population in the ESU divided into roughly equal thirds and scored as 3 for the lowest third (0-3), 2 for the middle third (4-6), and 1 for the highest third (7-9).

Slope

This metric is the proportion of the watershed with a percentage of slope ≥ 55 percent based on GIS analysis of 30-meter digital elevation model. It is based on the rationale that populations within a stratum with more high-gradient area are more likely to experience large-scale disturbance (e.g., mass-wasting), whereas areas with a less high-gradient habitat are likely to experience these disturbances on a smaller scale within the landscape. Scores were based on a frequency distribution of proportion watershed with slope ≥ 55 percent for each population divided into roughly equal thirds and scored as 3 for the lowest third (proportion 0.04-0.09), 2 for the middle third (0.11-0.24), and 1 for the highest third (0.26-0.51).

Forest Integrity

This metric is based on the percentage of large trees (>30" or >20" depending on location) and change scene detection (percent harvested, percent change due to other impacts). Both are GIS-based and determined from LandSat imagery. This metric was chosen based on the rationale that areas that have a higher degree of mature forest and/or have been less impacted by timber harvest have a higher resiliency and more ecological integrity. Large tree scores were based on a frequency distribution of data from the ESU divided into roughly equal thirds and scored as 0.5 for the lowest third, 1 for the middle third, and 1.5 for the highest third. Harvest scores were based on a frequency distribution of data from the ESU divided into roughly equal thirds and scored as 1.5 for the lowest third, 1 for the middle third, and 0.5 for the highest third. These two scores were then combined for the overall score.

Optimism and Potential

The Optimism and Potential parameter describes the relative degree of optimism that freshwater or estuarine ecosystems can be protected or restored and the potential benefits to populations if protection and restoration are effective (Bradbury et al. 1995). The following metrics were chosen to assess Optimism and Potential because they are related to the parameter, and numeric data is readily available.

Public Land

This metric is the percent of land within the population that is in public ownership. Populations within a stratum with more public land are assumed to benefit from higher standards of management and greater ease of implementation of recovery measures. Individual scores were based on a frequency distribution of data from the ESU divided into roughly equal thirds and scored as 1 for the lowest third, 2 for the middle third, and 3 for the highest third.

California State Recovery Priority

The California Department of Fish and Game (CDFG) Coho Recovery Strategy (CDFG 2004) used a prioritization model to predict restoration and management potential based on the existing population status, risks, and watershed condition. This metric, which is based on the CDFG scores of restoration and management potential, indicates which areas the state of California believes have the greatest likelihood for successful coho recovery. A similar metric is not available for Oregon populations. Scores were based on a frequency distribution of scores for each population in the ESU divided into roughly equal thirds and scored as 1 for the lowest third (score 1.0-1.5), 2 for the middle third (2.0-3.2), and 3 for the highest third (3.3-5.0).

Number of Threats Ranked High or Very High

This metric is the total number of high or very high threats as shown in the threat summary tables from population profiles. It is based on the rationale that numerous high-level threats means there likely is a lower ecological integrity, higher degree of risk, and a reduced potential for success. Scores were based on a frequency distribution of the number of high/very high threats for each population in the ESU and were divided into roughly equal thirds and scored as 3 for the lowest third (0-3), 2 for the middle third (4-6), and 1 for the highest third (7-9).

Number of Other Listed Anadromous Salmonid Species

This metric is the number of other NMFS-listed anadromous species (e.g., Chinook salmon, steelhead) that occur within the population area. It is based on the rationale that a population with more listed species is more likely to be high priority for restoration and will likely attract more restoration effort. Scores were based on a frequency distribution of number species for each population in the ESU divided into roughly equal thirds and scored as 1 for the lowest third, 2 for the middle third, and 3 for the highest third.

Number of Other Non-Listed Anadromous Salmonid Species

This metric is the number of non-listed anadromous salmonid species that occupy the population area. It is based on the rationale that populations with other anadromous salmonid species maintain some of the habitat features that are critical for supporting coho salmon populations. Scores were based on a frequency distribution of number salmonid species for each population in the ESU divided into roughly equal thirds and scored as 1 for the lowest third (0-2 species), 2 for the middle third (3-4), and 3 for the highest third (5-6).

Using Ratings to Choose Core Populations

NMFS considers the population ratings to inform the choice of core populations. Consistent with Bradbury et al. (1995), NMFS places most importance on the Biological Importance (BI) score. The BI scores, and other BI-related considerations, play a strong role in the decision because they are relevant to how quickly a population can improve from its current state. Populations with the highest BI scores are likely in the best condition and are expected to recover more quickly than populations with lower BI scores. The scores for the other two categories are considered if the BI scores do not support a clear choice.

Using Ratings to Determine Targets for Non-Core Populations

There are a range of possible targets for non-core populations, and reasons why a particular target may be chosen. NMFS considers two factors when setting these targets: 1) What are the prospects for recovery in a particular population? NMFS uses the scores described in the appropriate sections (i.e., D.1 through D.7) to answer this question; and 2) Given what was learned for factor 1, what role does each population need to play in a recovered ESU? Is the population more or less important as a source to recolonize areas? The rationale for selection of particular targets for each population is explained in the appropriate section below (i.e., D.1 through D.7).

Non-Core 2

The target for populations in this category is 80 percent of habitat occupied in years following spawning of brood years with high marine survival (Table 4-1). NMFS chooses this target if the chance of recovery of a coho salmon population in a basin is very low, but it is feasible that some habitat could be restored to support all life stages of coho salmon. If strays were to arrive, the basin would be able to support all life stages, and juveniles may be observed in some years. A population with this target would not be relied upon to provide a source of colonists for other populations.

Non-Core 1

The target for populations in this category is the four spawners per IP-km (see Section 2.3.2). NMFS chooses this target if the population is likely to ultimately produce considerably more than the depensation threshold, but less than the low risk threshold.

Core

The target for populations in this category is the low risk threshold. NMFS chooses this target for a population after considering its current condition, its geographic location in the ESU, its low risk threshold compared to the number of spawners needed for the entire stratum, and other factors. The rationale for selection of particular core populations is explained in the appropriate section below (i.e., D.1 through D.7).

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D.2 Northern Coastal Stratum Population Targets

Application of the method used to select each population's recovery role (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Northern Coastal Stratum population profiles.

Table D-8. Biological Importance (BI) Score for Northern Coastal Populations.

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Chetco River	2	2	2	1	0.75	0.25	8
Elk River	2	2	2	1	0.75	0.25	8
Lower Rogue River	2	2	1	1	0.5	0.5	7
Winchuck River	1	1	1	1	0.75	0.25	5

Available data indicate the Winchuck River population abundance is currently well below the depensation threshold, while the Elk River, Chetco River, and Lower Rogue River populations have at least one year class that is likely above the depensation threshold. Coho salmon in the Chetco River and Elk River populations are believed to occupy a higher percentage of the IP habitat in their basins, while the Lower Rogue River population is believed to be constrained to a few tributaries.

The extent of life history diversity is rated the same for all populations due to similar coastal and estuary condition. Hatchery influence is of low concern in the Chetco River, Elk River, and Winchuck populations. However, stray coho salmon from the Cole Rivers hatchery are known to occasionally spawn in the Lower Rogue River. The Lower Rogue River population supports more coho salmon than the others, so it is less affected by depensatory effects.

Table D-9. Integrity and Risks (IR) Scores for Northern Coastal Populations.

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Chetco River	3	2	1	3	9
Elk River	3	3	1	3	10
Lower Rogue River	1	2	2	2	7
Winchuck River	3	2	1	2	8

Road density is higher in the Lower Rogue River than in the other populations. There were no scored differences in the number of high or very high stresses across populations. The Lower Rogue River has a lower incidence of steep slopes compared to the other populations.

Populations with more high-gradient areas may be more vulnerable to large-scale disturbance than areas with less high-gradient areas. The forest integrity of the Chetco and Elk rivers was rated higher than that of the other population area, suggesting more mature forest and more resiliency and ecological integrity in the Chetco River and Elk River populations.

Table D-10. Optimism and Potential (OP) Scores for Northern Coastal Populations.

Optimism and Potential						
Population	Federal Land	CDFG	Listed Species	Species	Threat	Total
Chetco River	3	NA	0	2	2	7
Elk River	3	NA	0	2	2	7
Lower Rogue River	2	NA	0	3	2	7
Winchuck River	3	NA	0	2	2	7

The proportion of publicly–owned land is greater in the Chetco River, Elk River, and Winchuck River populations than in the Lower Rogue River population. Populations with more public land are assumed to benefit from higher standards of management and greater ease of implementation of recovery measures. There are more salmonid species in the Lower Rogue River than in the other populations. A population with more salmonid species may maintain more of the habitat features critical for supporting coho salmon populations than a population with less salmonid species. There are less highly-ranked threats in the Elk River and Winchuck River than the other populations, possibly indicating greater ecological integrity and a greater potential for success in restoring coho salmon.

The Elk River has great potential for recovery due to an ongoing public effort to protect and restore salmon habitat, as well as the management of a large portion of the watershed as Wilderness or a Late Successional Reserve. All population areas possess suitable private land which could contribute toward restoration if state, federal, or private funding was available.

Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each potential core population is as follows:

Elk River – $20 million
Lower Rogue River - $30 million
Chetco River - $27 million
Winchuck River - $14 million

The cost estimates reflect the recovery role for each population. Therefore, the cost estimates for recovery actions identified for non-core populations do not include recovery actions that may be necessary were they made core populations. Cost estimates are often based on the size of a watershed, or length of IP, making costs to produce nearly equal number of spawners disproportionately large for small population areas, and vice versa.

Preliminary cost estimates reveal the cost of recovery actions identified for the Lower Rogue River population is higher than the cost for the other populations. This result is due to extensive road treatment and decommissioning actions, as well as estuarine restoration, in the Lower Rogue River. Although the Lower Rogue River is not proposed as a core population, the estuarine restoration actions there are needed by other populations in the Rogue basin. If the Chetco River was not selected as a core population, then the remaining three populations would have to be selected in order to meet the stratum 50% abundance threshold. This scenario would result in a more costly scenario.

Table D-11. Score Summary for Northern Coastal Populations.

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Chetco River	8	9	7	24	4,500
Elk River	8	10	7	25	2,400
Lower Rogue River	7	7	7	21	3,000
Winchuck River	5	8	7	20	2,200
Number spawners needed to meet stratum requirement (50% of total)					6,050

Table D-12. Spawner Targets for Northern Coastal Populations.

Population	Recovery Role	Target
Chetco River	Core	4,500
Elk River	Core	2,400
Lower Rogue River	Non-Core 1	320
Winchuck River	Non-Core 1	230
		Total Core : 6,900 Spawners

The Chetco River and Elk River populations are the best choices for core populations in this stratum primarily because the coho salmon populations found there are in the best condition. In addition, their IR scores are the highest, indicating greater watershed integrity. The core population targets would result in a low risk of extinction. The Lower Rogue River and Winchuck River targets would result in a moderate risk of extinction.

D.3 Interior Rogue Stratum Population Targets

Application of the method used to select each population's recovery role (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Rogue River Stratum population profiles.

Table D-13. Biological Importance (BI) Score for Interior Rogue Populations.

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Upper Rogue River	3	2	2	1	0.5	0.75	9.25
Middle Rogue/Applegate	3	2	1	1	0.75	0.75	8.5
Illinois River	3	2	2	1	0.75	0.75	9.5

The number of adults in each population is consistently greater than the depensation threshold, and all populations have three cohorts consistently present. The Illinois and Upper Rogue have more adult coho salmon than the Middle Rogue/Applegate River.

Juvenile coho salmon are better distributed in the Upper Rogue River and Illinois River population areas than in the Middle Rogue/Applegate population areas (between 25 and 50 percent of IP occupied, compared to 0 to 25 percent occupied). Juvenile density is higher in the Upper Rogue River and Illinois River populations than in the Middle Rogue/Applegate River.

Diversity measures are the same across all populations, except hatchery influence is greater in the Upper Rogue River than in the other two populations.

Table D-14. Integrity and Risks (IR) Scores for Interior Rogue Populations.

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Upper Rogue River	1	1	3	3	8
Middle Rogue/Applegate	1	1	1	2	5
Illinois River	2	1	1	2	6

The road density is lower in the Illinois River than in the other two populations. There were no scored differences in the number of high or very high stresses in the three populations. The Upper Rogue River has a lower incidence of steep slopes than seen in the other two populations. Populations with more high-gradient areas may be more vulnerable to large-scale disturbance than areas with less high-gradient areas. The forest integrity of the Upper Rogue River was rated higher than that of the Middle Rogue/Applegate and Illinois Rivers, indicating there is more mature forest and so more resiliency and ecological integrity in the Upper Rogue River.

The natural hydrograph of the Illinois River is still in place and not affected by dams as are the Upper Rogue (William L. Jess Dam) and Middle Rogue/Applegate Rivers (William L. Jess and Applegate dams).

Table D-15. Optimism and Potential (OP) Scores for Interior Rogue Populations.

Optimism and Potential Score						
Population	Public Land	CDFG	Listed Species	Species	Threat	Total
Upper Rogue River	2	NA	0	3	1	6
Middle Rogue/Applegate	3	NA	0	3	1	7
Illinois River	3	NA	0	3	1	7

The proportion of publicly–owned land is greater in the Middle Rogue/Applegate River and Illinois Rivers than in the Upper Rogue River. Populations with more public land may benefit from higher standards of management and greater ease of implementation of recovery measures. More public land is owned by the U.S. Forest Service than BLM in the Illinois River basin. The U.S. Forest Service and BLM currently manage land under the Northwest Forest Plan. All three populations host at least five salmonid species A population with more salmonid species may maintain more of the habitat features critical for supporting coho salmon populations than a population with less salmonid species. The threat rating for the Upper Rogue River was less than for the other two populations, possibly indicating greater ecological integrity and a greater potential for success in restoring coho salmon.

Recent removal of mainstem dams on the Upper Rogue River has restored passage to much of the basin. Much of the Middle Rogue River is too steep for coho salmon, and many of the lower gradient areas are highly impacted and do not present a great opportunity for restoration. The Applegate is less impacted, but has less recovery potential than the Illinois River. All population areas possess suitable private land which could contribute toward restoration if state, federal, or private funding was available.

Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each potential core population is as follows:

Illinois River – $251 million
Upper Rogue River - $509 million
Middle Rogue/Applegate River - $455 million

The cost estimates reflect the recovery role for each population. Therefore, the cost estimates for recovery actions identified for non-core populations do not include recovery actions that may be necessary were they made core populations. Cost estimates are often based on the size of a watershed, or length of IP, making costs to produce nearly equal number of spawners disproportionately large for small population areas, and vice versa.

Table D-16. Score Summary for Interior Rogue Populations.

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Upper Rogue River	9.25	8	6	23.25	18,000
Middle Rogue/Applegate	8.5	5	7	20.5	14,700
Illinois River	9.5	6	7	22.5	11,800
Number spawners needed to meet stratum requirement (50% of total)					22,250

Table D-17. Spawner Targets for Interior Rogue Populations.

Population	Recovery Role	Target
Upper Rogue River	Core	13,800
Middle Rogue/Applegate	Non-Core 1	2,400
Illinois River	Core	11,800
		Total Core : 25,600 Spawners

The Upper Rogue River and Illinois River populations are the best choices for core populations in this stratum, primarily because the coho salmon populations found there are in the best condition. In addition, the Upper Rogue has more mature forest and the lowest number of threats compared to the other population areas, and the Illinois has greater recovery potential than the Middle Rogue because it is less urbanized. The core population targets would result in a low risk of extinction. The Middle Rogue/Applegate River target would result in a moderate risk of extinction.

D.4 Central Coastal Stratum Population Targets

NMFS applied the modified Bradbury et al. (1995) framework to the Central Coastal Stratum to select each population's recovery role (i.e., core, non-core 1 or 2, extirpated) and to identify the population spawner abundance or juvenile occupancy targets. Application of the framework resulted in the following Biological Importance (BI), Integrity and Risk (IR), and Optimism and Potential (OP) scores for each independent population in the stratum. The BI score for this stratum represents the mean of four staff scores, which are largely based upon best professional judgment given the paucity of data within the stratum. Otherwise, results are based on information presented in the Central Coastal Stratum population profiles.

Table D-18. Biological Importance (BI) Scores for Central Coastal Populations.

	Biological Importance						
Population	Abundance Score	Productivity Score	Spatial Score	Life History	Hatchery	Depensation	BI Score
Little River	3	3	3	1	0.75	0.75	11.5
Lower Klamath R.	2	2	3	1.5	0.5	0.5	9.5
Mad River	2	2	2	1.5	0.75	0.5	8.75
Redwood Creek	3	2	2	1.5	0.75	0.75	10
Smith River	2	2	2	1.5	0.75	0.5	8.75

Population abundance is uncertain as surveys are few and results are variable. Data from Redwood Creek are some of the most robust within the stratum, with data sets spanning 12 years. However, the most robust data on spawner abundance is from Prairie Creek, a tributary to Redwood Creek. Data indicate that spawner escapement in Prairie Creek is highly variable between years, ranging from 680 spawners in 2002 to a low of 28 adults in 2010. Within the five-year period from 2007 to 2011, three of five years the spawner estimates for Prairie Creek exceeded the depensation threshold of 151 spawners calculated for Redwood Creek watershed, although during one of those years the estimate was very close to depensation. Prairie Creek is a stronghold for coho salmon in Redwood Creek, whereas very little production is documented elsewhere in the watershed. In contrast, data are limited for the Little River, Mad River, and Smith River. Based upon NMFS' professional judgment, Little River likely produces equal to or greater than the depensation threshold (34), whereas population abundance in the Mad and Smith rivers are likely below depensation (153 and 325, respectively). Finally, NMFS debated whether the data from the Lower Klamath was reliable. While the data suggest that the Lower Klamath is likely above the depensation threshold, staff members were concerned that the use of juvenile data may poorly reflect abundance and distribution of the population due to the presences of juveniles from upper basin populations (non-natal rearing).

Table D-19. Integrity and Risks (IR) Scores for Central Coastal Populations.

	Integrity and Risks				
Population	Roads Score	Stress Score	Slope Score	Forest Score	IR Score
Little River	1	3	3	2	9
Lower Klamath River	1	2	2	2	7
Mad River	1	2	2	2	7
Redwood Creek	1	2	3	3	9
Smith River	1	2	1	2	6

Road density is of concern throughout the stratum, and as such, each basin scored a one for road density. Populations differ, however, according to the remainder of the metrics that make up the Integrity and Risk score. The larger of the basins in this stratum, the Lower Klamath, Smith, and Mad rivers, and Redwood Creek scored as a two for high-level stresses. The Smith River scored low in the slope metric due to the proportion of the basin contained in high gradient reaches; however, the metric oversimplifies the relationship between slope and the risk of mass wasting. While the Smith River may have a higher proportion of steep slopes than other watersheds within the stratum, the underlying geology is inherently different between the Smith River and the other basins within the stratum. The Smith River basin contains more competent rocks (primarily Josephine Ophiolite sequence) and produces coarser grain landslides that tend to be less detrimental to fish and their habitat, and can contribute to the formation and maintenance of spawning habitat. In contrast, other basins within the stratum consist primarily of sedimentary rocks, which produce finer grain landslides that can severely damage salmonid habitat. Consequently, NMFS considered the final IR scores for each population in concert with relative strength of each metric in arriving at the final recommendation for the core populations for the stratum.

Table D-20. Optimism and Potential (OP) Scores for Central Coastal Populations.

	Optimism and Potential					
Population	Land Score	CDFG Score	Listed Species Score	Species Score	Threat Score	OP Score
Little River	1	3	2	2	3	11
Lower Klamath River	2	3	1	3	2	11
Mad River	2	3	3	3	2	13
Redwood Creek	2	3	3	3	3	14
Smith River	3	3	1	3	2	12

The three highest scoring populations for Optimism and Potential (OP) are the Mad River, Smith River, and Redwood Creek. The number of listed anadromous fish species influences this score with the Mad River and Redwood Creek occurring within the range of all listed anadromous fish within the stratum. That is, although Pacific eulachon are listed within the Central Coastal stratum, they are generally relegated to larger watersheds such as the Lower Klamath, Smith, and Mad rivers. In contrast, the Northern California steelhead DPS and the California Coastal

Chinook salmon ESU are limited to watersheds south of the Klamath River. Thus, the Mad River and Redwood Creek contain the highest number of listed anadromous fish species. The final OP score for the Smith River also reflects the fact that this basin has the highest proportion of lands within public ownership.

Other Considerations

Climate change

The anticipated effect of future climate change influenced the final core populations selected for this stratum. NMFS expects that projected temperature increases and changes in precipitation patterns from climate change models would have a relatively smaller effect on coho salmon and their habitat in the Smith River basin than other watersheds within the stratum. Because the headwaters of the Smith River originate on US Forest Service land, which is managed to protect water quality and quantity, and water quantity and water temperatures are not currently limiting coho salmon in the Smith River, the Smith River population may be more buffered from the effects of climate change. NMFS expects that climate change would not decrease the availability of suitable habitat for coho salmon in the Smith River, or if suitable habitat were to decline due to climate changes, then we would expect such declines to be less severe than the declines that would occur in neighboring basins.

Cost

Preliminary results indicate the total cost of recovery actions needed in each potential core population of this stratum is as follows:

Smith River - $136 million
Lower Klamath River - $158 million
Redwood Creek - $139 million
Mad River - $116 million
Little River – $23 million

The cost estimates reflect the recovery role for each population. Therefore, the cost estimates for recovery actions identified for non-core populations do not include recovery actions that may be necessary were they made core populations. Cost estimates are often based on the size of a watershed, or length of IP, making costs to produce nearly equal number of spawners disproportionately large for small population areas, and vice versa.

Table D-21. Score summary for Central Coastal Populations.

Population	BI Score	IR Score	OP Score	Total Score	Low Risk Spawner Threshold
Little River	11.5	9	11	31.5	1,400
Lower Klamath River	9.5	7	11	27.5	5,900
Mad River	8.75	7	13	28.75	4,500
Redwood Creek	10	9	14	33	4,900
Smith River	8.75	6	12	26.75	6,800
Number spawners needed to meet stratum requirement (50% of total)					12,550

Given the paucity of data to inform the scoring methodology, NMFS spent considerable time deliberating the merits of choosing the populations with the highest overall scores. According to above BI scores the Smith River and Mad River tied for the third highest scoring population. After much deliberation, NMFS decided the Lower Klamath River, Redwood Creek, and Smith River should be designated as core populations. Rationale for recommendation:

Lower Klamath River – CORE

- Abundance likely above depensation threshold
- Estuarine habitat is considered some of the highest quality in the stratum
- Supports upstream populations in the Interior Klamath Stratum and the Interior Trinity Stratum, five of which are core populations
- Currently coho salmon are widely distributed

Smith River – CORE

- Northern expression within stratum, key basin for seeding dependent populations nearby and maintaining metapopulation structure with populations in most northern extent of SONCC ESU coho salmon range (northern coastal stratum)
- Unique geology (Siskiyou bioregion)
- Cold water tributaries originate in Siskiyou Mountains; within stratum considered basin most resilient to climate change; water temperatures likely least impacted within stratum
- Hydrology considered less impacted than other basins within stratum; no large hydroelectric dams, headwaters contained within wilderness or other public land
- Steep geology, possibly more springs than other basin
- Currently coho salmon are widely distributed

Redwood Creek – CORE

- Abundance likely below depensation threshold
- Only basin in stratum with documented 2 year freshwater rearing of juveniles
- Lower watershed managed by Redwood National and State Parks, which has goals that include recovering listed species
- Currently coho salmon are suspected to have a limited distribution

Mad River – Non-Core 1

- Neighboring basin to south coastal stratum; would assist in seeding and maintaining metapopulation dynamics
- Optimism increasing; increasing interest in disperse parties for restoring/making improvements; most urban development within stratum
- Currently coho salmon are moderately distributed

Little River – Non-Core 1

- Abundance likely above depensation threshold; however, population considered too small to contribute substantially to the 50% target for stratum viability
- Presently considered "potentially independent" population; genetic studies needed to determine if supports a unique population or clusters with neighboring basin
- Majority of watershed in Green Diamond ownership and covered by AHCP; fate of population highly dependent upon Green Diamond management practices.
- Estuarine habitat degraded by grazing practices
- High spawner requirement likely difficult to meet

Table D-22. Spawner Targets for Central Coastal Populations.

Population	Category	Target
Little River	Non-Core 1	140
Lower Klamath River	**Core**	**5,900**
Mad River	Non-Core 1	550
Redwood Creek	**Core**	**4,900**
Smith River	**Core**	**6,800**
		Total Core : **17,600 spawners**

The Lower Klamath River, Redwood Creek, and Smith River are considered the best candidates to serve as the core populations in this stratum because these populations represent the populations that NMFS believes have the highest likelihood of persisting as strongholds in the face of climate change. With the exception of Redwood Creek, these basins also currently contain the widest in-basin distribution of coho salmon, which suggests that these basins are more resilient to stochastic events and within basin re-seeding can occur. Although the distribution of coho salmon within Redwood Creek is limited, Redwood Creek, in particular Prairie Creek, is an important stronghold within the stratum at present and is expected to persist due to the protections afforded the watershed by Redwood National and State Parks. Similarly, the Smith River contains a considerable amount of protected habitat because much of the watershed is contained within US Forest Service lands and the Redwood National and State Parks.

Literature Cited

Bradbury, B., W. Nehlsen, T.E. Nickelson, K.M.S. Moore, R.M. Huges, D. Heller, J. Nicholas, D.L. Bottom, W.E. Weaver, R.L. Beschta. 1995. Handbook for prioritizing watershed protection and restoration to aid recovery of native salmon. 56 p.

D.5 Interior Klamath Population Targets

Application of the method used to select each population's recovery role (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; summary of findings; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Klamath Stratum population profiles.

Table D-23. Biological Importance (BI) Score for Interior Klamath populations.

Population	Abundance Score	Productivity Score	Spatial Score	Life History Score	Hatchery Score	Depensation Score	BI Score
Mid-Klamath	3	2	3	1	0.75	0.75	10.5
Salmon	1	2	1	0.5	0.75	0.25	5.5
Scott	3	2	3	1	0.5	0.75	10.25
Shasta	1	1	1	1.5	0.25	0.25	5
Upper Klamath	2	2	1	1	0.25	0.5	6.75

Table D-24. Integrity and Risks (IR) Scores for Interior Klamath populations.

Population	Roads Score	Stress Score	Slope Score	Forest Score	IR Score
Mid-Klamath	3	1	1	3	8
Salmon	3	3	1	3	10
Scott	2	2	2	3	9
Shasta	3	1	3	3	10
Upper Klamath	2	1	2	3	8

Table D-25. Optimism and Potential (OP) Scores for Interior Klamath populations.

Population	Land Score	CDFG Score	Listed Species Score	Species Score	Threat Score	OP Score
Mid-Klamath	3	2	0	3	3	11
Salmon	3	2	0	3	3	11
Scott	2	3	0	2	1	8
Shasta	2	3	0	2	2	9
Upper Klamath	2	3	0	2	1	8

Summary of Population Profile Findings

Scott River Population

- High natural production in recent history.
- Current distribution of coho salmon in the Scott River is widespread.
- Exhibits a wide variety of habitats and life histories.
- Limiting factors that currently limit production are well understood.
- Potential for high production given the high IP, and large runs of Chinook.
- One strong brood year.
- Strong monitoring program exists.

Shasta River Population

- Low numbers of abundance contrast with high value of Integrity and Optimism.
- High production of Chinook salmon currently exists, indicating production value for coho could exist if limiting factors are addressed.
- Diversify of habitat features (e.g., spring flow dominated hydrology) and life history traits contribute to the overall adaptability and resiliency of the stratum to combat future climate effects and catastrophic events.
- Stressors are well understood, as are the identification of effective restoration priorities.
- Location allows for strays to support other populations.
- Recent success in acquiring more than 6,000 acres within the Big Springs Complex increases optimism for long term recovery.
- Large quantity of high IP habitat.
- Strong monitoring program exists.

Upper Klamath Population

- Optimism high given the KHSA/KBRA.
- Population comprised of a series of small streams, some intermittent.

- High quality habitat above Iron Gate Dam will be made available upon fish passage. Cold water tributaries will provide refugia from climate effects.
- Selection as core allows for full extent and range of occupied habitat to be restored, enhancing the spatial structure of the ESU.
- Location allows for strays to support other populations.
- Moderate monitoring program exists (Bogus Creek, Iron Gate Hatchery).

Middle Klamath Population

- Population may be above depensation threshold.
- Provides non-natal rearing habitat and migratory habitat.
- Comprised of a series of low production tributaries with generally monotypic habitat features.
- Formation of low gradient coho habitat systems is constrained by the geology of the Klamath Mountain geomorphic province (particularly the northern range). Deep soils, steep slopes, high precipitation and sediment yields are natural factors controlling the geomorphology within the Middle Klamath population unit. This geomorphology naturally confines coho distribution and abundance.
- Habitat condition is currently good relative to Shasta and Scott.
- High amount of public land ownership
- Concern that recovery actions will not result in population response to the degree necessary to meet the low risk threshold.
- Poor monitoring program exists.

Salmon River Population

- Geology is rocky and does not provide a lot of high IP habitat
- Carrying capacity of the sub-basin is likely lower than other populations in stratum

Other Considerations

Co-manager comments

Co-manager comments included recommendations to (1) re-consider the Shasta population as a core population and replace the selection with the Middle Klamath population; and (2) re-evaluate depensation threshold targets for non-core populations.

We did not find compelling evidence to re-configure the original recommendation to select Upper Klamath, Shasta River, and Scott River as core populations for the Klamath Interior stratum. The decision to select the Shasta River population is based on the factors described above including: a clear understanding of limiting factors and restoration priorities, a high potential for production value, a diversity of life history strategies and habitat features, and a long term data and strong monitoring program. No new information was discovered that warranted changing the selections of the Scott and Upper Klamath populations as core.

Revised IP

The amount of IP above Dwinnell Dam in the Shasta River was calculated and removed from the IP value used to calculate the population's spawner target, but was included in the calculation for the population's low-risk spawner threshold which contributes to the 50% stratum viability target.

IP was revised due to previously unaccounted for natural barriers in the Salmon, Scott, and Shasta river population areas. These revisions are described in Appendix A.

Cost

Preliminary results indicate the total cost of recovery actions needed in each potential core population is as follows:

Upper Klamath - $668 million
Shasta River - $203 million
Scott River - $296 million
Mid-Klamath - $50 million
Salmon River - $25 million

The cost estimates reflect the recovery role for each population. Therefore, the cost estimates for recovery actions identified for non-core populations do not include recovery actions that may be necessary were they made core populations. Cost estimates are often based on the size of a watershed, or length of IP, making costs to produce nearly equal number of spawners disproportionately large for small population areas, and vice versa.

Table D-26. Score Summary for Interior Klamath populations.

Population	BI Score	IR Score	OP Score	Total Score	Low Risk Spawner Threshold
Mid-Klamath	10.5	8	11	29.5	3,900
Salmon	5.5	10	11	26.5	3,900
Scott	10.25	9	8	27.25	6,500
Shasta	5	10	9	24	5,900
Upper Klamath	6.75	8	8	22.75	8,500
Number spawners needed to meet stratum requirement (50% of total)					14,350

Table D-27. Spawner Targets for Interior Klamath populations.

Population	Recovery Role	Target
Scott	**Core**	**6,500**
Shasta	**Core**	**4,700** [1]
Upper Klamath	**Core**	**8,500**
Middle Klamath	Non-Core 1	450
Salmon	Non-Core 1	450
		Total Core: **19,700 Spawners**

[1]IP-km above Dwinnell Dam not included in calculation of population spawner target. See Chapter 4 for explanation of spawner target methodology.

Three core populations, the Upper Klamath, Shasta River, and Scott River populations were chosen for this diversity stratum. This combination allows for the largest amount of IP habitat, spatial diversity, greatest production potential, most appropriate habitat, and unique life history traits to be restored and will achieve the goal of 50% stratum abundance. Non-core population targets represent a four-fold increase in abundance over depensation thresholds.

D.6 Interior Trinity River Population Targets

Application of the method used to select each population's recovery role (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in the Interior Trinity River Stratum population profiles.

Table D-28. Biological Importance (BI) Scores for Interior Trinity Populations.

Biological Importance							
Population	Abundance Score	Productivity Score	Spatial Score	Life History Score	Hatchery Score	Depensation Score	BI Score
Lower Trinity River	2	3	3	1	0.25	0.5	9.75
South Fork Trinity River	2	2	1	0.5	0.25	0.5	6.25
Upper Trinity River	3	3	3	1.5	0.25	0.75	9.5

The two highest scoring populations for Biological Importance (BI) are the Lower Trinity and the Upper Trinity. Of great concern across the stratum is the high proportion of hatchery fish within the Trinity watershed. This concern is greatest for the Upper Trinity population where hatchery fish dominate the run (typically, greater than 85% with some years as high as 97% hatchery fish comprising the run [see the year 2000, in Table 2 of the Upper Trinity River population profile]). Population abundance is uncertain for all three populations because surveys are few throughout the basin, although estimates are most robust for Upper Trinity population due to the survey efforts at the Willow Creek weir. Based on this effort, it appears that in some years naturally spawning coho salmon to the Upper Trinity River may exceed the low risk spawner threshold. In contrast, best available information suggests that the South Fork Trinity River and the Lower Trinity River are not likely meeting the population's depensation thresholds.

Table D-29. Integrity and Risks (IR) Scores for Interior Trinity Populations.

Integrity and Risks					
Population	Roads Score	Stress Score	Slope Score	Forest Score	IR Score
Lower Trinity River	3	2	1	2	8
South Fork Trinity River	1	2	2	2	7
Upper Trinity River	3	2	1	3	9

Table D-30. Optimism and Potential (OP) Scores for Interior Trinity Populations.

Optimism and Potential						
Population	Land Score	CDFG Score	Listed Species Score	Species Score	Threat Score	OP Score
Lower Trinity River	3	2	0	3	2	10
South Fork Trinity River	3	2	0	3	2	10
Upper Trinity River	3	2	0	2	2	9

Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each potential core population of this stratum is as follows:

Lower Trinity River—$68 million
South Fork Trinity River—$123 million
Upper Trinity River—$33 million

The cost estimates reflect the recovery role for each population. Therefore, the cost estimates for recovery actions identified for non-core populations do not include recovery actions that may be necessary were they made core populations. Cost estimates are often based on the size of a watershed, or length of IP, making costs to produce nearly equal number of spawners disproportionately large for small population areas, and vice versa.

Table D-31. Score Summary for Interior Trinity Populations.

Population	BI Score	IR Score	OP Score	Total Score	Low Risk Spawner Threshold
Lower Trinity River	9.75	8	10	27.75	3,600
South Fork Trinity River	6.25	7	10	23.25	6,400
Upper Trinity River	9.5	9	9	27.5	7,300
Number spawners needed to meet stratum requirement (50% of total)					8,800

Table D-32. Spawner Targets for Interior Trinity Populations.

Population	Category	Target
Lower Trinity River	**Core**	**3,600**
South Fork Trinity River	Non-core 1	970
Upper Trinity River	**Core**	**5,800**
		Total Core : **9,700 Spawners**

The Lower Trinity and Upper Trinity River populations are considered the best candidates to serve as the core populations in this stratum for several reasons. Chief among these is a concern that the IP model likely overestimates the current production potential of the South Fork, given the severe degradation that has occurred within the basin as a result of historic flooding. In addition, only a small portion of the tributaries in the South Fork is likely to support coho salmon or their reintroduction in the near future. In comparison, the Lower Trinity and Upper Trinity have nearly three times the number of tributaries that could support coho salmon (See also CDFG 2004). Moreover, according to the Trinity River Flow Evaluation document (USFWS and HVT 1999) about 80 percent of the best coho salmon habitat within the basin historically occurred upstream of the dams.

Literature Cited

California Department of Fish and Game (CDFG). 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. 594 p. Available from: http:www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

U.S. Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT). 1999. Trinity River Flow Evaluation Final Report. Report to the Secretary, U.S. Department of the Interior. Washington, D.C. Available from: http://www.fws.gov/arcata/fisheries/reportsDisplay.html. Accessed October 2008.

D.7 Southern Coastal Stratum Population Targets

Application of the method used to select each population's recovery role (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Southern Coastal Stratum population profiles.

Table D-33. Biological Importance (BI) Score for Southern Coastal Populations.

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Bear River	0	0	0	0.5	0.75	0	1.25
Humboldt Bay Tribs	3	2	3	1.5	0.75	0.75	11
Lower Eel / Van Duzen	2	2	1	1.5	0.75	0.50	7.75
Mattole River	1	2	1	1	0.75	0.25	6

Population abundance is uncertain as surveys are few and the results are variable. The Bear River population has a conspicuous absence of coho salmon. Surveyed streams in the Humboldt Bay Tributaries population indicate regular adult abundance greater than depensation (191), while the adult abundance is likely below depensation in the Lower Eel/Van Duzen and Mattole Rivers populations. All populations show evidence of decline in all three cohorts, except for Bear River which has no evidence of coho salmon being present.

Coho salmon are found well-distributed throughout the Humboldt Bay tributaries and estuary. However, they are found in less than a quarter of IP habitat in the Mattole River and Lower Eel / Van Duzen River populations – likely as a result of degraded or inaccessible habitat or lack of survey effort. In 2008, coho salmon adult spawners were found in just one Mattole River tributary.

Diversity across the stratum can be influenced by many factors, including life history strategies, hatcheries, and abundance proximity to depensation. The amount of environmental diversity in an area can indicate the degree of potential diversity that same area can support. Life history strategies are greater in Humboldt Bay Tributaries and Lower Eel/Van Duzen Rivers populations where greater environmental and habitat variability exists. The Humboldt Bay Tributaries population includes life history strategies that take advantage of relatively stable temperature and estuarine and bay habitat. The Lower Eel/Van Duzen Rivers population likely possesses many of the same life history strategies as found in the Humboldt Bay Tributaries population, plus strategies that succeed in warmer and dryer conditions farther inland.

Table D-34. Integrity and Risks (IR) Scores for Southern Coastal Populations.

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Bear River	1	2	2	2	7
Humboldt Bay Tributaries	1	2	3	1	7
Lower Eel / Van Duzen	1	2	2	2	7
Mattole River	2	2	1	2	7

Water in the mainstem Eel River is closely regulated in accordance with provisions identified in NMFS' biological opinion addressing the Potter Valley Project diversion, including opportunity to annually augment flow by 2,500 acre-feet. Water diversion in all other streams is largely unregulated or uncontrolled.

Humboldt Bay Tributaries and Lower Eel/Van Duzen Rivers populations are comprised of much low-grade slope areas, often associated with a delta or valley. Road densities on low-grade slopes likely produce less erosion and sedimentation than those on steep slopes or inherently unstable geologic material.

Principle stresses in the Lower Eel/Van Duzen Rivers population are altered sediment supply and impaired estuary function, compared to the Mattole River population where they are impaired water quality and altered hydrologic function. Cooling and increasing the volume of water in the Mattole River population is challenging, and severely influences survival. Decreasing sediment and improving estuary function in the Lower Eel/Van Duzen Rivers population appears feasible.

Much of the forest in the Humboldt Bay Tributaries population area has been harvested. However, several decades have passed since most harvest activity, resulting in mid-mature forests which provide more suitable habitat elements than less mature forest. A large portion of the Humboldt Bay Tributaries population area is managed under a federal aquatic habitat conservation plan or by federal agencies with salmonid conservation goals. Other forested areas in the Humboldt Bay Tributaries population area, and other population areas, are primarily regulated by the California Forest Practice Rules.

Table D-35. Optimism and Potential (OP) Scores for Southern Coastal Populations.

Optimism and Potential Score						
Population	Federal Land	CDFG	Listed Species	Species	Threat	Total
Bear River	1	2	1	1	3	8
Humboldt Bay Tributaries	1	3	3	2	2	11
Lower Eel / Van Duzen	2	3	3	2	1	11
Mattole River	2	3	3	2	2	12

There is high non-government organization (NGO) interest in salmon recovery in all populations, except Bear River. The Humboldt Bay Tributaries population is located in the heart of Humboldt County's hub, near Arcata and Eureka, California. Generating interest and support for restoring habitats in highly visible watersheds such as the Humboldt Bay Tributaries and Lower Eel/Van Duzen Rivers population areas is generally much easier than rural sites. However, some rural locations, such as in the Mattole River population, have created a culture centered on salmon restoration and conservation.

Moderate amounts of federal land managed with salmon conservation goals in the Lower Eel/Van Duzen Rivers and Mattole River populations provide enhanced opportunity for restoration opportunities. All population areas possess suitable private land which can contribute toward restoration through development, or implementation, of a federal habitat conservation plan, or are eligible for receipt of federal or state grant funding.

The number of threat categories that rank high or very high is a function of threat opportunity. The Lower Eel/Van Duzen Rivers scores low due to a larger array of different environs and thus human activity. For instance, the Lower Eel/Van Duzen Rivers population area may have more opportunity for agricultural threat because a large portion of the area is conducive to farming, in contrast to the Mattole River population area where little traditional farming opportunities exist. Threat opportunity may be linked to the size of the population area – potentially explaining why the large Lower Eel/Van Duzen Rivers population area received a low threat score.

In addition, the larger population areas with the greatest amount of IP habitat may equate to more opportunity for active and passive restoration.

Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each potential core population is as follows:

Bear River - $21 million
Humboldt Bay Tributaries - $99 million
Lower Eel / Van Duzen - $567 million
Mattole River - $81 million

The cost estimates reflect the recovery role for each population. Therefore, the cost estimates for recovery actions identified for non-core populations do not include recovery actions that may be necessary were they made core populations. Refer to chapter 6 for additional information about cost.

Cost estimates are often based on the size of a watershed, or length of IP, making costs to produce nearly equal number of spawners disproportionately large for small population areas, and vice versa.

Table D-36. Score Summary for Southern Coastal Populations.

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Bear River	1.25	7	8	16.25	1,900
Humboldt Bay Tributaries	11	7	11	29	5,700
Lower Eel / Van Duzen	7.75	7	11	25.75	7,900
Mattole River	6	7	12	25	6,500
Number spawners needed to meet stratum requirement (50% of total)					11,000

Table D-37. Spawner Targets for Southern Coastal Populations.

Population	Recovery Role	Target
Bear River	Non-Core 2	Juvenile occupancy
Humboldt Bay Tributaries	**Core**	**5,700**
Lower Eel / Van Duzen	**Core**	**7,900**
Mattole River	Non-Core 1	1,000
		Total Core : **13,600 Spawners**

The Humboldt Bay Tributaries and Lower Eel/Van Duzen Rivers populations are the best candidates to efficiently serve as core populations in this stratum because they have the total highest BI scores, and their collective adult spawner abundance target exceeds the minimum stratum requirement. IR scores are nearly equal for all populations.

Targets for the Humboldt Bay Tributaries and Lower Eel/Van Duzen Rivers populations reflect the adult spawner abundance required for a low risk of extinction. The Mattole River population spawner abundance target is a product of the depensation threshold multiplied by four, because it is serving a non-core 1 role. The Bear River population target is juvenile occupancy, because it is serving as a non-core 2 population.

D.8 Interior Eel River Stratum Population Targets

Application of the method used to select each population's recovery role (i.e., core, non-core 1, non-core 2, extirpated) and identification of appropriate population adult spawner abundance or juvenile occupancy targets resulted in the following Biological Importance (BI), Integrity and Risks (IR), and Optimism and Potential (OP) Scores; discussion of other related considerations such as cost; and conclusion. Unless otherwise noted, results are based on information presented in Interior Eel River Stratum population profiles.

Table D-38. Biological Importance (BI) Score for Interior Eel River Populations.

Biological Importance Score							
				Diversity			
Population	Abundance	Productivity	Spatial	Life History	Hatchery	Depensation	Total
Mainstem Eel River	1	1	1	1	0.75	0.25	5
Middle Mainstem Eel River	1	1	1	1	0.75	0.25	5
Upper Mainstem Eel River	0	0	0	0.5	0.75	0	1.25
North Fork Eel River	0	0	0	0.5	0.75	0	1.25
Middle Fork Eel River	0	0	0	0.5	0.75	0	1.25
South Fork Eel River	3	3	2	1	0.75	0.75	10.5

Population abundance is uncertain as surveys are few and the results are variable. Limited surveys of the Upper Mainstem Eel River, Middle Fork Eel River, and North Fork Eel River sub-basins suggest that they do not support coho salmon consistently. The South Fork Eel River population abundance is likely above depensation (i.e., 460) in some years. All populations show evidence of decline in all three cohorts, particularly for the Upper Mainstem Eel, Middle Fork Eel, and North Fork Eel populations, which may have lost all three year classes.

Coho salmon distribution is largely un-documented in the populations within this stratum and is rated as very limited in all areas except the South Fork Eel River population. In the South Fork Eel River, coho salmon occur in 25 to 50 percent of Intrinsic Potential (IP) habitat, primarily in the western tributaries such as Hollow Tree Creek. In the western tributaries of the South Fork Eel River population, coho salmon are well distributed and occupy the majority (>90%) of IP habitat.

Diversity across the stratum is influenced by many factors, including life history strategies and abundance which is often below the depensation threshold. The rating for life history diversity assigned to all populations indicates they contain diverse habitat types which could support atypical life history strategies. Most populations in this stratum could be considered "long run" given the distance adult fish must migrate to their natal spawning grounds from the ocean, which constitutes a unique life history strategy. All populations rated the same for hatchery influence, with a presumed low proportion of hatchery strays in the spawning populations. All populations except the South Fork Eel River received a low score for depensation, because the number of spawners is likely significantly less than the depensation threshold.

Table D-39. Integrity and Risks (IR) Scores for Interior Eel River Populations.

Integrity and Risks Score					
Population	Road	Stress	Slope	Forest	Total
Mainstem Eel River	1	1	2	2	6
Middle Mainstem Eel River	1	1	2	3	7
Upper Mainstem Eel River	2	2	2	3	9
Middle Fork Eel River	2	2	2	2	8
North Fork Eel River	2	1	2	2	7
South Fork Eel River	1	1	2	2	6

Water in the mainstem Eel River is closely regulated in accordance with provisions identified in NMFS' biological opinion addressing the Potter Valley Project diversion, including opportunity to augment flow which may assist in reducing issues with water quality during periods of extremely low flows or muted spring flow. Water diversion in all other streams is largely unregulated or uncontrolled.

In the Upper Mainstem Eel River, Middle Fork Eel River, and North Fork Eel River, much of the high IP habitat is located under the temperature mask, indicating water temperature within these populations is likely intrinsically inhospitably warm.

The highest road densities occur in the Mainstem, Middle Mainstem, and Middle Fork Eel River populations. Principle stresses in most populations are sediment, degraded riparian condition, and floodplain and channel structure. The Upper Mainstem Eel River principal stresses, in contrast, are barriers obstructing passage and impaired water quality. These stresses in these populations may be more difficult to resolve than those in the other populations. All populations are comprised of primarily mid to low gradient stream reaches, often associated with a delta or valley. Forest integrity in the Middle Mainstem Eel River and Upper Mainstem Eel River populations was rated higher than other populations primarily due to lower harvest rates.

Table D-40. Optimism and Potential (OP) Scores for Interior Eel River Populations.

Optimism and Potential Score						
Population	Federal Land	CDFG	Listed Species	Species	Threat	Total
Mainstem Eel River	1	2	2	2	2	9
Middle Mainstem Eel River	2	3	1	2	1	9
Upper Mainstem Eel River	3	1	2	1	2	9
Middle Fork Eel River	2	1	3	2	2	10
North Fork Eel River	2	1	3	2	2	10
South Fork Eel River	1	3	3	2	1	10

There is a high level of interest in the South Fork Eel River population area, and it hosts the most abundant and stable spawning cohorts in the stratum. One of the most significant tributaries, Hollow Tree Creek, has consistent presence of all three cohorts of coho salmon. Out-migrant trapping efforts indicate that Hollow Tree Creek can produce more than 35,000 smolts per season. There is a draft federal aquatic Habitat Conservation Plan (HCP) throughout most of the Hollow Tree Creek watershed. The HCP, when finalized, would reduce sediment and improve habitat complexity in the near future. Several long-standing and well-supported non-government organizations, as well as state, federal and tribal entities regularly express interest in conserving salmon and aquatic habitat within the Eel River basin.

The Eel River estuary is located within the Lower Eel/Van Duzen Rivers population area (downstream of the Interior Eel River stratum) and has great potential for restoration because the estuary remains functional and there is high opportunity for increasing the size and availability of the floodplain and off channel habitats. The Eel River estuary likely serves as essential non-natal juvenile rearing habitat,. Impaired estuarine function is a stress to all populations in this stratum. All population areas possess suitable private land which can contribute toward restoration through development, or implementation, of a federal HCP. Much of the private land is eligible for receipt of federal or state grant funding.

Other Considerations

Cost

Preliminary results indicate the total cost of recovery actions needed in each potential core population is as follows:

Mainstem Eel River - $130 million
Middle Mainstem Eel River - $126 million
Upper Mainstem Eel River - $36 million
Middle Fork Eel River - $163 million
South Fork Eel River - $251 million

The cost estimates reflect the recovery role for each population. Therefore, the cost estimates for recovery actions identified for non-core populations do not include recovery actions that may be necessary were they made core populations. Cost estimates are often based on the size of a watershed, or length of IP, making costs to produce nearly equal number of spawners disproportionately large for small population areas, and vice versa.

Table D-41. Score Summary for Interior Eel River Populations.

Population	BI	IR	OP	Total	Low Risk Spawner Threshold
Mainstem Eel River	5	6	9	20	2,600
Middle Mainstem Eel River	5	7	9	21	6,300
Upper Mainstem Eel River	1.25	9	9	19.25	2,100
Middle Fork Eel River	1.25	8	10	19.25	2,900
North Fork Eel River	1.25	7	10	18.25	2,100
South Fork Eel River	10.5	6	10	26.5	9,300
Number spawners needed to meet stratum requirement (50% of total)					12,650

Table D-42. Spawner Targets for Interior Eel River Populations.

Population	Recovery Role	Target
Mainstem Eel River	**Core**	**2,600 spawners**
Middle Mainstem Eel River	**Core**	**6,300 spawners**
Upper Mainstem Eel River	Non-Core 2	Juvenile occupancy
Middle Fork Eel River	Non-Core 2	Juvenile occupancy
North Fork Eel River	Non-Core 2	Juvenile occupancy
South Fork Eel River	**Core**	**9,300 spawners**
		Total Core : **18,200 Spawners**

The Mainstem Eel River, Middle Mainstem Eel River, and South Fork Eel River populations are the best candidates to efficiently serve as core populations in this stratum because they have the total highest BI scores, and their collective adult spawner abundance target exceeds the minimum stratum requirement. Equally important, the other three populations – Upper Mainstem Eel River, Middle Fork Eel River, and North Fork Eel River – have inherently extremely low potential to produce coho salmon and several anthropogenic-derived challenges.

Targets for the Mainstem Eel River, Middle Mainstem Eel River, and South Fork Eel River populations reflect the adult spawner abundance required for core populations. Targets for core populations were set to achieve a low risk of extinction.

The target for the Middle Fork Eel River and North Fork Eel River populations is juvenile occupancy, which is the target for non-core 2 populations. This is based on the lack of coho salmon in these populations over the last several decades.

Over a period of several decades, the Upper Mainstem Eel River population has had very few observations of coho salmon at the fish counting station at Van Arsdale. Although recent observations in the last decade appear promising, the Upper Mainstem Eel River population remains unoccupied during almost all years on record. Furthermore, all of the IP habitat which is not covered by the temperature mask is located upstream of the Scott Dam. When IP habitats upstream of the dam or under the temperature mask are removed, it leaves this population with only 0.5 km of IP habitat (which is not enough lineal habitat to be considered as a population). Given the extremely episodic nature of coho salmon observations in the Upper Mainstem Eel River population, the non-core 2 population target for juvenile occupancy is the most reasonable target.

Appendix E. Recovery Action Cost Methodology

To determine recovery action costs for the SONCC coho salmon ESU, a systematic and consistent methodology is applied. In general, cost estimates are derived from previous, similar projects or tasks (Tables E-2 to E-51). Each recovery action cost estimate is limited to the monetary expenditure required to physically perform the task, and therefore does not include secondary costs (e.g., administrative, overhead) or economic costs or benefits (e.g., fishing, tourism, lost opportunity) that may result from action implementation. In order to facilitate the short-term and mid-term costs of the recovery actions, costs are presented in five year intervals out to 25 years (i.e., 0-5, 5-10, 15-20, 20-25), with one value estimated for costs beyond 25 years (i.e., 26+ years). Cost estimates are not calculated for those actions determined not essential for recovery ("NA" priority).

Factors such as project scale and location are accounted for when possible, and costs are calculated accordingly. For example, county and population-specific data is used to inform the cost of actions that occur in those particular areas. Additionally, the costs of past projects used to inform recovery action cost estimates are adjusted for inflation. The scale of a recovery action is often unknown. In these cases an assumption is made regarding the amount or extent of work needed to achieve the recovery objective. For example, if the amount of roads in need of decommissioning in a given population is unknown, the assumption is to reduce the amount of roads to a level equal to a "medium" threat. Table E-18 indicates the cost to decommission one mile of road in the Humboldt Bay watershed is $39,878. If 85 miles of road need to be decommissioned, the estimated cost is $3,389,630 ($39,878 multiplied by 85 miles).

Some recovery actions involve policy changes, coordination, or other activities that rely primarily on staff time. The cost of these actions may either be "0" or the cost of staff salary. When the cost is calculated as "0," the action was assumed to be cost of doing business. This would include an administrative action such as regulation change or a task that is part of an existing work load. When an action requires a staff person to go above and beyond their existing duties, the cost is calculated by multiplying the annual salary (Table E-2) of the occupation most likely to complete the task by the amount of time anticipated to complete the task. For example, an action to educate stakeholders regarding water conservation practices may require six months of a professional biologist's time. (Table E-2) indicates a professional biologist's time costs $68,030 a year. In this case, the estimated cost is $34,015 ($68,030 multiplied by 0.5 years).

Recovery action costs are calculated for each action-step level and calculated in spreadsheets containing population specific data (e.g., watershed acreage, amount of IP habitat, road density) and recovery action cost information. A sample spreadsheet outlining the process for calculating recovery action costs can be found in Table E-1.

Table E-1. Sample of the cost estimation spreadsheet.

Number of miles is unknown; use blanket assumption

Number of miles is unknown; use blanket assumption

Data from "Road Inventory" worksheet ($635/mi)

Data from "Population Statistics" worksheet (878 total road miles in the Mattole watershed)

Action Step	Explanation	Factor 1	Factor 2	Cost (years 1-5)
Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective	Road inventory in Mattole * 878 miles total roads in watershed	635	878	$557,530
Decommission roads, guided by assessment	Road decom. in California * 286 miles (to obtain 2mi/mi² density)	39,878	286	$11,405,108
Upgrade roads, guided by assessment	Road upgrade in Mattole * 59.4 miles (10% of remaining roads after decom)	32,857	59.4	$1,951,706
Maintain roads, guided by assessment	Gravel road maintenance * 594 (# of road miles remaining after decom)	2,389	594	$1,419,066

Table E-2. Information used to estimate cost of staff time.

Staff Time			
Occupation	**Hourly Wage (seasonals)**	**Annual Wage (FTE)**	**Source**
Biologist	33	68,030	Bureau of Labor Statistics 2009
Biologist Technician	20	40,900	
Fish and Game Warden	27	56,030	
Police/Sheriff Patrol Officers	25	52,810	
Forest Fire Inspectors/ Prevention	18	36,400	
Forest and Conservation Workers	13	26,110	
Urban and Regional Planners	30	62,400	
Physical Scientists (all others)	44	91,850	
Engineers (all others)	43	89,080	
Hydrologist	36	73,540	

Table E-3. Information used to estimate cost of lining a ditch.

Ditch Lining		
Type of Liner	**$/ft**	**Source**
Plain Concrete	21	NMFS 2008, pg. 46
Flexible Membrane	15	
Galvanized Steel	21	

Table E-4. Information used to estimate cost of irrigation pipe.

Piping		
Type	**$/ft***	**Source**
Aluminum Pipeline	16	NMFS 2008, pg. 47

*When number of feet of pipe is unknown, assume 1% of privately owned land is in agriculture (population stats worksheet). Assume 50% of those acres are irrigated and 1 ft per acre of land will be piped.

Table E-5. Information used to estimate cost of headgates.

Install Headgates		
Size of Headgate	**$/Diversion**	**Source**
<3 cfs	5,156	NMFS 2008, pg. 47
>3 cfs	10,309	

Table E-6. Information used to estimate cost of storm drain retrofits.

Storm Drain Retrofit		
Action	**$/filter or program**	**Source**
Catch Basin/Filter Installation	98	Kosciusko County 2002
Annual Maintenance Program	6,452	

Table E-7. Information used to estimate cost of stream flow gate installation and maintenance.

Stream Flow Gage Installation & Maintenance		
Action	**$/gage or year**	**Source**
Installation of State/Private Gage	26,136	Rhode Island DEM-WRB 2004
Installation of USGS Gage	29,545	
Annual Maintenance of State/Private Gage	7,955	
Annual Maintenance of USGS Gage	3,409	

Table E-8. Information used to estimate cost of tidegate restoration.

Tidegate Restoration		
Activity	**$/Tidegate**	**Source**
Replace Tidegate	120,114	NMFS 2008, pg. 20
Retrofit Tidegate	28,571	

Table E-9. Information used to estimate cost of tailwater management.

Tailwater Management		
Area Covered by System (acres)	**Cost ($)**	**Source**
1-50	10,309	NMFS 2008, pg. 45
51-100	20,618	
101-200	30,928	
201-300	41,237	
301-400	61,856	
401-500	82,474	

Table E-10. Information used to estimate cost of a forbearance program.

Forbearance Program		
Part of Program	**$/landowner, $/year**	**Source**
Avg. cost for installation & agreements	70,000	Tasha McKee Sanctuary Forest, pers. comm. 2010
Avg. cost for compliance & flow monitoring	500	

Table E-11. Information used to estimate cost of installing or maintaining engineered beaver ponds.

Engineered Beaver Ponds		
Activity Type	**$/pond, $/year**	**Source***
Installation of Pond	15,000	Tasha McKee Sanctuary Forest, pers. comm. 2010
Maintenance of Ponds	25,000	

*Recommends 10 years of maintenance following installation.

Table E-12. Information used to estimate cost of fish passage improvement.

Fish Passage Improvement ($/Project)					
Stream Crossing	**Land Use**				**Source**
Tributary	**Forest**	**Agriculture**	**Suburban**	**Urban**	CDFG 2004, pg I-16
Total Barrier	63,636	159,090	318,181	556,818	
Partial/Temporal Barrier	31,818	79,545	159,090	278,409	
Stream					
Total Barrier	159,090	381,818	556,818	795,454	
Partial/Temporal Barrier	79,545	190,909	278,409	397,727	

Table E-13. Information used to estimate cost of dam removal.

Dam Removal		
Size of Dam	**$; $/ft**	**Source**
one cost estimate for <15ft dam	568,181	CDFG 2004, pg I.11
>15 ft high -cost/ft	17,045	
one estimate - unknown height; complete barrier	1,022,727	
one estimate - unknown height; partial/temporal or unknown barrier	511,363	

Table E-14. Information used to estimate cost of bridge construction.

Bridge Construction		
Bridge Type	**$/sq. ft. of decking**	**Source**
RC Slab	191	California DOT 2008
RC Box Girder	170	
CIP/PS Slab	168	
CIP/PS Box Girder	298	
PC/PS "I" Girder	231	
PC/PS Bulb "T" Girder	239	
Average	216	

Table E-15. Information used to estimate cost of arch/box culvert replacement.

Replacing a Culvert w/ a New Type of Structure		
New Type of Crossing	**Avg. Cost ($)**	**Source**
Bridge <40ft	51,546	NMFS 2008, pg 11-15
Bridge >40ft	103,093	
Bottomless/Open Bottom Arch	193,961	
Natural Bottom Pipe Arch	215,776	
Box Culvert	248,352	

Table E-16. Information used to estimate cost of road construction.

Road Construction (for relocation purposes)		
Type of Road	**$/mile**	**Source**
Non paved: two directional 12' shared path	175,000	DOT 2010
Undivided 2 lane rural road w/ 5' paved shoulders	1,713,000	

Table E-17. Information used to estimate cost of road upgrade.

Road Upgrade		
Location	**$/mi***	**Source**
California	18,104	NMFS 2008, pg. 43-44
Mendocino County	34,278	
Siskiyou County	50,119	
Klamath River	29,186	
Salmon River	41,453	
Smith River	53,068	
Eel River	32,658	
Mattole River	32,857	
SONCC	14,535	
Russian River	95,275	
Garcia River	32,528	

*If number of miles unknown, assume 10% of road miles remaining in watershed after decommissioning to the level of 2 mi/mi^2.

Table E-18. Information used to estimate cost of road decommissioning.

Road Decommissioning		
Location	**$/mi***	**Source**
Average Cost of Local Decom. Projects (Humboldt Bay, Klamath, Mendocino, Trinity, Salmon River)	39,878	NMFS 2008, pg. 42

*when number of miles unknown, reduce watershed road density to 2 mi/mi^2

Table E-19. Information used to estimate cost of road maintenance.

Average Road Maintenance Cost		
Type*	$/mi*	Source
Gravel Roads	2,389	Jahren et al. 2005
Bituminous Roads	2,639	

*If type and number of miles is unknown, assume 'gravel roads' and total number of miles of road in the watershed after decommissioning to a level of 2mi/mi².

Table E-20. Information used to estimate cost of installing a fish ladder.

New Fish Ladder		
Size of Waterway	$/Ladder	Source
Large Waterway	1,022,727	NMFS 2008, pg 9
Small Waterway	568,181	

Table E-21. Information used to estimate cost of gate installation.

Average Cost of Gate and Installation		
Gate	$/gate	Source
Aluminum Gate (5ft tall, 10ft wide) + installation	880	www.profenceworks.com (site accessed March 4, 2011)

Table E-22. Information used to estimate cost of culvert replacement.

Culvert Replacement ($/Culvert)					
Size of Waterway	Road Type				Source
	Forest Road	Minor 2 Lane	Major 2 Lane	Hwy 4+ Lane	
Small (0-10')	31,976	87,209	174,419	319,767	NMFS 2008, pg. 10
Medium (10-20')	87,209	220,930	319,767	436,047	
Large (20-30')	133,721	267,442	406,977	813,953	

*if number and type of barriers is unknown, assume 1 barrier per 5 miles of high IP miles and type is 'small' and 'forest road'.

Table E-23. Information used to estimate cost of tributary and floodplain reconnection.

Floodplain and Tributary Reconnection ($/acre)				
Materials	Extent of Earth Moving			Source
	Minimal	Moderate	Substantial	
Minimal	8,721	17,442	40,698	NMFS 2008, pg 26
Moderate	17,442	29,070	58,140	
Substantial	40,698	58,140	81,395	

Table E-24. Information used to estimate cost of side channel reconnection projects.

Side Channel Reconnection ($/acre)				
Extent of Earthmoving	Energy of Waterway			Source
	Low	Medium	High	
Minimal/Near	34,884	63,953	87,209	NMFS 2008, pg 26
Moderate/Avg. Distance	58,140	98,837	174,419	
Substantial/Far	93,023	191,860	290,698	

Table E-25. Information used to estimate cost of supplementing spawning gravel.

Spawning Gravel Supplementation	
$/cubic yard	Source
28	NMFS 2008, pg. 25

Table E-26. Information used to estimate cost of placing large woody debris structures.

LWD Structure Placement	
Avg. $/mi*	Source
547,850	NMFS 2008, pg 23-24

*If length unknown, assume 25% of high IP miles, unless this results in less than 1, then use total IP miles.

Table E-27. Information used to estimate cost of channel restoration.

Channel Restoration		
Type	$/mi	Source
Large scale reach restoration	4,217,623	NMFS 2008, pg 27

Table E-28. Information used to estimate cost of creating off channel ponds.

Creation of Off Channel Pond	
$/project*	**Source**
102,258	Bob Pagliuco: NOAA RC pers. comm. 2010; averaged from proposed projects: Lower Terwer Creek and Salt Creek

*If number of projects is unknown, assume 1 project/mi. in 25% of total high IP miles, unless this results in less than 1, then use 25% of total IP miles.

Table E-29. Information used to estimate cost of reintroducing beavers.

Beaver Reintroduction	
$/beaver family translocation*	**Source**
10,000	Michael Pollock NMFS, personal communication Feb. 2011

*If numbers are unknown, assume 1 per mi in 5% of high IP miles.

Table E-30. Information used to estimate cost of riparian planting.

Riparian Planting ($/acre)				
Materials/Site Accessibility	**Level of Site Preparation***			**Source**
	Flat/Light Clearing	**Avg. Slope/Avg. Clearing**	**Steep/Heavy Clearing**	
Low Cost	17,442	40,698	93,023	NMFS 2008, pg 32
Medium Cost	26,163	63,954	110,465	
High Cost	46,512	78,488	1,366,279	

*If type of riparian thinning is unknown, assume 'flat/light clearing' and 'low cost'.
*If number of acres is unknown, assume 80 acres per mile will need to be treated in 15% of high IP miles.

Table E-31. Information used to estimate cost of thinning upslope riparian areas.

Upslope Riparian Thinning		
Type	**$/acre***	**Source**
Mechanical	876	NMFS 2008, pg. 64
Hand 15-30% slope 40-60% cover	928	
Hand 30-50% slope 60-90% cover	1,237	
Chemical	155	
Average	799	

*If number of acres is unknown, assume 80 acres/mi will be thinned within 15% of high IP habitat miles.

Table E-32. Information used to estimate cost of bank stabilization.

Bank Stabilization*		
Distance From Road (mi)	**$/ft***	**Source**
0.25-0.5	284	NMFS 2008, pg. 38
0.5-1	313	
1-2	341	
2-3	369	
>3	398	

*If number of feet is unknown, assume 1% of IP miles will be treated.

Table E-33. Information used to estimate cost of wetland restoration.

Wetland Restoration		
Type	**$/acre**	**Source**
Seasonal Wetland (large scale)	11,111	NMFS 2008, pg. 28
Wetland Enhancement (reveg, exotic spp. removal, modest management)	1,235	
Restore Tidal Action to Salt Pond	1,266	
Levee Construction/Repair, Extensive Dredging	34,177	
Highly Engineered, Large Soil Volume, Channel Excavation, Low Berms	70,886	

Table E-34. Information used to estimate cost of livestock management.

Livestock Management		
Fencing Activity	**$/ft**	**Source**
Riparian Fencing - Conventional*	3.09	NMFS 2008, pg. 29
Riparian Fencing and Planting	18.69	
Riparian Fencing w/ Water Relocation	9	

*If number of feet is unknown, assume 5% of high IP miles.

Table E-35. Information used to estimate cost of landslide/gully stabilization.

Landslide/Gully Stabilization	
$/Acre	**Source**
2,609	NMFS, 2008 pg. 44

Table E-36. Information used to estimate cost of estuary restoration.

Estuary Restoration		
Type of Project	**$/acre**	**Source**
Small- Tidegate removal, culvert upgrade; restore tidal salt marsh	6,000	Coastal Resources Management Council 2010
Medium- Automated tidegates, culverts, 500 ft new dikes	67,000	
Large- Automated tidegates, excavation of fill, re-vegetation	20,000	

Table E-37. Information used to estimate cost of setting back or breaching levees.

Levee Setback and Breach		
Type of Project	**$/linear foot*, $/breach****	**Source**
Setback, includes construction of new levee and restoration of wetlands inside levee	31.7	Bob Pagliuco: NOAA RC pers. comm. 2010; from proposed project, McDaniel Slough
Breach	30,000	

*If number of feet is unknown, assume 1% of high IP miles.
**If number of breaches is unknown, assume 1/mile of 1% of high IP miles.

Table E-38. Information used to estimate cost of water development away from streams.

Water Development Away from Streams		
Materials	**$/ft, $**	**Source**
Piping*	0.4	USEPA 1990
Tank**	407	

*If length of piping is unknown, assume 500 ft/project.
**If number of projects (tanks) is unknown, assume 1 per mile in 5% of high IP miles.

Table E-39. Information used to estimate cost of day-lighting a stream section.

Stream Day-lighting	
$/lineal foot*	**Source**
886	Leah Mahan: NOAA RC pers. comm. Dec. 2010; average from projects, Madrona Park Creek and Ravenna Creek

*If number of feet is unknown assume 5,280 (1 mi).

Table E-40. Information used to estimate cost of creating a conservation easement.

Conservation Easement		
Region	**$/acre**	**Source**
Wolverton Gulch, Van Duzen River, Humboldt County, Monterey County, Arroyo Seco River	1,992	NMFS 2008, pg. 55
South Coast, Santa Barbara	65,000	
San Joaquin River	6,867	
Battle Creek	395	
North Fork Cosumnes River	1,101	
Mill Creek/Deer Creek	223	
Tuolumne River	6,282	
San Joaquin Delta	3,205	
Mill Creek/Deer Creek - Sac River	5,385	
Sacramento River	1,646	
Lower Tuolumne/San Joaquin	1,646	
CA	534	

Table E-41. Information used to estimate cost of performing a road inventory.

Road Inventories		
Location	**$/mi**	**Source**
Humboldt County	829	NMFS 2008, pg. 61
Eel River	538	
Mattole River	635	
Russian River	936	
Salmon Creek	1068	
Gualala River	837	
Avg. all Inventories	807	

Table E-42. Information used to estimate cost of performing an erosion assessment.

Erosion Assessments		
Location	**$/acre***	**Source**
Humboldt County	9.5	NMFS 2008, pg 61
Del Norte County	11.9	
Average all assessments in CA**	10.7	

*When number of acres unknown, assume 25% of total watershed acres.

**Average does not include figure of $3,157/acre.

Table E-43. Information used to estimate cost of conducting a fuels management program.

Fuel Management Program		
Type of Program*	**$/acre***	**Source**
Prescribed burn: brush/grass	35	USDA Forest Service 2004
Prescribed burn: ponderosa pine	98	
Prescribed burn: mixed conifer	198	
Prescribed burn: Douglas fir	14	
Mechanical Treatment: Low intensity	426	FRFTP 2006
Mechanical Treatment: High Intensity	851	

*If type of program and number of acres is unknown, assume 25% of high IP habitat will treated w/ mechanical thinning and 25% will be treated with burning. Treat IP miles as square miles and convert to acres.

Table E-44. Information used to estimate cost of running a lifecycle monitoring station.

Life Cycle Monitoring Station	
$/Monitoring Station	**Source**
204,000	NMFS 2008

Table E-45. Information used to estimate cost of removing invasive plants.

Removal of Invasive Plant Species		
Species	**$/acre***	**Source**
Arundo	29,762	Neil 2002
Himalayan Blackberry	990	Bennet 2007 (avg)
Purple Loosestrife and Water Chestnut	361	USFWS 2001
Pepperweed and Giant Reed	1,000	Northern California Conservation Center 2010
Average (excluding outlier of Arundo)	784	

*If number of acres is unknown, assume 80 acres per mile will be treated in 5% of high IP miles.

Table E-46. Information used to estimate cost of eradicating pikeminnow.

Pikeminnow Eradication	
$/Fish	Source
6.65	NMFS 2008, pg. 67

*Cost averaged from rewards in a bounty program.

Table E-47. Information used to estimate cost of installing fish screens.

Fish Screens		
Size of Tributary	$/Screen*	Source
Large Trib	45,454	NMFS 2008, pg 16
Small Trib	11,364	

*If number and type of screens is unknown, assume 'small trib' and 1 screen per mile in 5% of the high IP miles.

Table E-48. Information used to estimate cost of maintaining fish screens.

Fish Screen Maintenance	
$/Screen/yr	Source
1,566	NMFS 2008, pg. 68

Table E-49. Information used to estimate cost of education and outreach programs.

Education and Outreach Programs		
Type	$/program	Source
General Education and Outreach	76,136	CDFG, 2004 pg I.42
Coho Specific Education	55,682	

Table E-50. Information used to estimate cost of all aspects of running a conservation hatchery.

Conservation Hatchery		
Type of Operation	$/year	Source
General Operation	120,000	pers. comm. Jeff Jahn 2010; estimate from Monterey County Conservation Hatchery
Robust Monitoring and Evaluation Program to Support Program	250,000	pers. comm. Jeff Jahn 2010; estimate from Russian River monitoring program
Genetic Component (samples, assessments)	50,000	pers. comm. Jeff Jahn 2010; estimate from Russian River genetic program

Table E-51. Information used to estimate cost of converting a production hatchery to a conservation hatchery.

Conversion to Conservation Hatchery		
Extent of Retrofit	**$/type**	**Source**
No retrofit needed, facilities in place	0	pers. comm. Jeff Jahn 2010; estimated based on heavy retrofitting in the Russian River Conservation Hatchery
Light retrofit (a few extra tanks, etc.)	50,000	
Medium retrofit	150,000	
Heavy retrofitting with extensive new infrastructure	500,000	

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Conservation Partners

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Illinois Valley Soil and Water Conservation District PO Box 352 Cave Junction, OR 97523 (541) 592-3731 http://www.oregon.gov/ODA/SWCD/																										✔															
Illinois Valley Watershed Council PO Box 352 Cave Junction, OR 97523 (541) 592-3731 http://oregonwatersheds.org/oregoncouncils/illinoisvalley																										✔															

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Kalmiopsis Audubon Society P.O. Box 1265 Port Orford, OR 97465 (541) 332-0261 http://kalmiopsisaudubon.org/																																									
Karuk Tribal Fisheries Department and Restoration Division 64236 Second Avenue Happy Camp, CA 96039 (530) 493-1600 http://www.karuk.us														✓															✓	✓	✓	✓	✓								
Lindsay Creek Watershed Group 904 G Street Eureka, CA 95501 (707) 269-2063 http://www.naturalresourcesservices.org																				✓																					
Little Butte Creek Watershed Council P.O. Box 89 Eagle Point, OR Eagle Point, OR 97524 (541) 646-1684 http://www.roguebasinwatersheds.org/SectionIndex.asp?SectionID=10																												✓													
Lower Rogue Watershed Council http://www.currywatersheds.org						✓																																			
Mad River Alliance http://www.madriveralliance.org/																				✓																					

Organization	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Mad River Stakeholders Group 904 G Street Eureka, CA 95501 (707) 269-2063 http://www.naturalresourcesservices.org																				✔																					
Mattole Restoration Council PO Box 160 Petrolia, CA 95558 (707) 629-3514 http://www.mattole.org																									✔																
Mattole Salmon Group PO Box 188 Petrolia, CA 95558 (707) 629-3433 http://www.mattolesalmon.org																									✔																
Mendocino Redwood Company PO Box 996 Ukiah, CA 95482 (707) 463-5110 http://www.mrc.com/Key-Policies-HCP.aspx																																					✔				
Mendocino Resource Conservation District 206 Mason Street, Suite F Ukiah, CA 95482 (707) 462-3664 http://www.mcrcd.org																																					✔		✔	✔	✔

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Mid-Klamath Watershed Council PO Box 409 Orleans, CA 95556 (530) 627-3202 http://www.mkwc.org														✓															✓	✓	✓	✓	✓								
Montague Water Conservation District PO Box 247 Montague, CA 96064 (530) 459-3371																																	✓								
Natural Resources Conservation Service 430 G Street #4164 Davis, CA 95616 (530) 792-5600 http://www.nrcs.usda.gov/wps/portal/nrcs/site/ca/home/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
North Coast Regional Water Quality Control Board 5550 Skylane Blvd, Suite A Santa Rosa, CA 95403 (707) 576-2220 http://www.waterboards.ca.gov/northcoast											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Northern California Resource Center PO Box 342 Fort Jones, CA 96032 (530) 468-2888 http://www.californiaresourcecenter.org/home.php																																✓									

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Oregon Department of Environmental Quality 165 E. 7th Avenue Eugene, OR 97401 (503) 229-5696 http://www.oregon.gov/DEQ/	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔											
Oregon Department of Fish and Wildlife (503) 947-6000 http://www.dfw.state.or.us/	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔											
Oregon Department of Fish and Wildlife (503) 947-6000 http://www.dfw.state.or.us/																					
Oregon State University 1500 SW Jefferson Way Corvallis, OR 97331 (541) 737-1000 www.oregonstate.edu	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔											
Oregon Watershed Enhancement Board 775 Summer Street NE, Suite 360 Salem, OR 97301 (503) 986-0178 www.oregon.gov/OWEB/	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔											
Orleans/Somes Bar Fire Safe Council PO Box 766 Somes Bar, CA 95568 (530) 469-3216 http://www.firesafecouncil.org/find/view_council.cfm?c=69														✔							

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Oregon Department of Environmental Quality					✔	✔	✔		✔											
Oregon Department of Fish and Wildlife																				
Oregon Department of Fish and Wildlife					✔	✔	✔													
Oregon State University					✔	✔	✔													
Oregon Watershed Enhancement Board					✔	✔	✔													
Orleans/Somes Bar Fire Safe Council								✔	✔	✔	✔	✔								

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
Pacific Coast Federation of Fishermen's Associations PO Box 29370 San Francisco, CA 94129 (415) 561-5080 http://www.pcffa.org/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Fish Wildlife and Wetlands Restoration Association PO Box 4574 Arcata, CA 95518 (707) 839-5664 http://www.pcfwwra.org										✓	✓
Pacific Coast Joint Venture (707) 826-3208 http://www.pcjv.org/california/	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacificorps 825 NE Multnomah Street Portland, OR 97232 http://www.pacificorp.com/index.html											
Quartz Valley Indian Reservation 13601 Quartz Valley Road Fort Jones, CA 96032 (530) 468-5907 www.qvir.com											
Redwood Community Action Agency 904 G Street Eureka, CA 95501 (707) 269-2001 http://www.rcaa.org/											

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Pacific Coast Federation of Fishermen's Associations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Fish Wildlife and Wetlands Restoration Association	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Joint Venture	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacificorps										
Quartz Valley Indian Reservation										
Redwood Community Action Agency					✓	✓	✓	✓	✓	✓

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
Pacific Coast Federation of Fishermen's Associations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Fish Wildlife and Wetlands Restoration Association	✓	✓	✓	✓				✓	✓	✓
Pacific Coast Joint Venture	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacificorps								✓	✓	
Quartz Valley Indian Reservation										
Redwood Community Action Agency	✓	✓	✓	✓						

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Pacific Coast Federation of Fishermen's Associations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Fish Wildlife and Wetlands Restoration Association	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacific Coast Joint Venture	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pacificorps										
Quartz Valley Indian Reservation	✓									
Redwood Community Action Agency							✓			

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Redwood Creek Watershed Group PO Box 4574 Arcata, CA 95518 (707) 839-5664															✔																										
Redwood National and State Park 1111 Second Street Crescent City, CA 95531 (707) 464-1812 http://www.nps.gov/redw/index.htm											✔	✔	✔	✔	✔																										
Round Valley Tribes 77826 Covelo Road Covelo, CA 95428 (707) 983-6126 www.rvit.org																																							✔		
Rural Human Services 286 M Street Crescent City, CA 95531 (707) 464-7441 http://www.ruralhumanservices.com/											✔	✔																													
Salmon River Fire Safe Council Sawyers Bar, CA 96027 (530) 462-4665 http://www.firesafecouncil.org/find/view_council.cfm?c=58																															✔										
Salmon River Restoration Council PO Box 1089 Sawyers Bar, CA 96027 (530) 462-4665 www.srrc.org																															✔										

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Salmon Safe 805 SE 32nd Avenue Portland, OR 97214 (503) 232-3750 http://www.salmonsafe.org/	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔	✔	✔	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Sanctuary Forest PO Box 166 Whitehorn, CA 95589 (707) 986-1087 http://www.sanctuaryforest.org	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Save-the-Redwoods League 114 Sansome Street, Suite 1200 San Francisco, CA 94104 (415) 362-2352 http://www.savetheredwoods.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Scott River Fire Safe Councils (530) 468-2888 http://www.firesafecouncil.org/find/index.cfm	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐	☐	☐	☐	☐	☐
Scott River Water Trust PO Box 591 Etna, CA 96027 (530) 467-5783 http://www.scottwatertrust.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐	☐	☐	☐	☐	☐
Scott River Watershed Council PO Box 355 Etna, CA 96027 (530) 467-5511 http://www.scottriver.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
Shasta Valley Coordinated Resources Management and Planning 450 Main Street Etna, CA 96027 (530) 467-3975 http://www.siskiyourcd.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shasta Valley Resource Conservation District 215 Executive Court, Suite A Yreka, CA 96097 (530) 842-6121 http://www.svrcd.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Field Institute / Deer Creek Center PO Box 207 Selma, OR 97538 (541) 597-8530 http://www.thesfi.org/index.asp	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Land Conservancy PO Box 4209 Arcata, CA 95518 (707) 498-4900 http://siskiyouland.wordpress.com/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑
Siskiyou Resource Conservation District 450 Main Street Etna, CA 96027 (530) 467-3975 http://www.siskiyourcd.org/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
Shasta Valley Coordinated Resources Management and Planning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shasta Valley Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Field Institute / Deer Creek Center	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Land Conservancy	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
Shasta Valley Coordinated Resources Management and Planning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Shasta Valley Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Field Institute / Deer Creek Center	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
Siskiyou Land Conservancy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Shasta Valley Coordinated Resources Management and Planning	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
Shasta Valley Resource Conservation District	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Field Institute / Deer Creek Center	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Land Conservancy	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Siskiyou Resource Conservation District	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Smith River Advisory Council 586 G Street Crescent City, CA 95531 (707) 464-4711 http://www.coastal.ca.gov/publiced/directory/resdirectory/s_orgs/smithriveradvisory.html											✔	✔																													
Smith River Alliance PO Box 2129 Crescent City, CA 95531 (916) 715-9898 www.smithriveralliance.org											✔	✔																													
Smith River Rancheria 140 Rowdy Creek Road Smith River, CA 95567 (707) 487-9255 http://www.tolowa-nsn.gov/											✔																														
South Coast Watersheds Council PO Box 1614 Gold Beach, OR 97444 (541) 247-2755 http://oregonwatersheds.org/oregoncouncils/southcoast	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔																															
South Fork Trinity River Coordinated Resource Management Plan Committee PO Box 1 Hyampom, CA 96046 (530) 623-6004 http://www.tcrcd.net/sfcrmp.htm																																		✔	✔	✔					

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Southern Oregon Land Conservancy 84 Fourth Street Ashland, OR 97520 (541) 482-3069 http://www.landconserve.org/	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔																✔	✔	✔													
Stream Restoration Alliance of the Middle Rogue 543 NE 'E' Street, Suite 201 Grants Pass, OR 97526 (541) 474-6799 http://www.roguebasinwatersheds.org/SectionIndex.asp?SectionID=6	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔																✔	✔	✔													
The Nature Conservancy (703) 841-5300 www.tnc.org	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
The Salmon River Restoration Council PO Box 1089 Sawyers Bar, CA 96027 (530) 462-4665 http://www.srrc.org/																													✔	✔	✔										
Trinity County Resource Conservation District PO Box 1450 Weaverville, CA 96093 (530) 623-6004 http://www.tcrcd.net																																		✔	✔	✔					
Trinity River Restoration Program PO Box 1300 Weaverville, CA 96093 (530) 623-1800 www.trrp.net																																		✔	✔	✔					

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
U.S. Bureau of Land Management, Arcata Office 1695 Heindon Road Arcata, CA 95521 (707) 825-2301 http://www.blm.gov/ca/st/en/fo/arcata.html											
U.S. Bureau of Land Management, Coos Bay Office 1300 Airport Lane North Bend, OR 97459 (503) 808-6002 http://www.blm.gov/or/districts/coosbay/index.php	✓		✓		✓	✓	✓	✓	✓	✓	
U.S. Bureau of Land Management, Medford Office 3040 Biddle Road Medford, OR 97504 (503) 808-6002 http://www.blm.gov/or/						✓					
U.S. Bureau of Land Management, Redding Office 355 Hemsted Drive Redding, CA 96002 (530) 224-2100 http://www.blm.gov/ca/st/en/fo/redding.html											
U.S. Bureau of Reclamation 6600 Washburn Way Klamath Falls, OR 97603 (541) 883-6935 www.usbr.gov/mp/kbao											

Partner	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
U.S. Bureau of Land Management, Arcata Office				✓						✓
U.S. Bureau of Land Management, Coos Bay Office										
U.S. Bureau of Land Management, Medford Office										
U.S. Bureau of Land Management, Redding Office										
U.S. Bureau of Reclamation			✓							

Partner	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
U.S. Bureau of Land Management, Arcata Office	✓	✓		✓						
U.S. Bureau of Land Management, Coos Bay Office										
U.S. Bureau of Land Management, Medford Office					✓	✓	✓			
U.S. Bureau of Land Management, Redding Office									✓	
U.S. Bureau of Reclamation								✓	✓	

Partner	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
U.S. Bureau of Land Management, Arcata Office						✓		✓		
U.S. Bureau of Land Management, Coos Bay Office										
U.S. Bureau of Land Management, Medford Office										
U.S. Bureau of Land Management, Redding Office	✓	✓		✓						
U.S. Bureau of Reclamation			✓	✓						

Partner	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
U.S. Fish and Wildlife Service, Arcata Field Office 1655 Heindon Rd. Arcata, CA 95521 (707) 822-7201 http://www.fws.gov/arcata/default.htm																																									
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge 1020 Ranch Road Loleta, CA 95551 (707) 733-5406 http://www.fws.gov/humboldtbay/																					✔																				
U.S. Fish and Wildlife Service, Klamath Basin National Wildlife Refuges 4009 Hill Road Tulelake, CA 96134 (530) 667-2231 http://www.fws.gov/klamathbasinrefuges/																																									
U.S. Fish and Wildlife Service, Klamath Falls Field Office 1936 California Avenue Klamath Falls, OR 97601 (541) 885-8481 http://www.fws.gov/klamathfallsfwo/																																									
U.S. Fish and Wildlife Service, Newport Field Office 2127 SE Marine Science Drive Newport, OR 97365 (541) 867-4558 http://www.fws.gov/oregonfwo/FieldOffices/Newport/default.asp																																									

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
U.S. Fish and Wildlife Service, Roseburg Field Office 2900 N.W. Stewart Parkway Roseburg, OR 97471 (541) 957-3470 http://www.fws.gov/oregonfwo/fieldoffices/roseburg/																																									
U.S. Fish and Wildlife Service, Yreka Field Office 1829 South Oregon Street Yreka, CA 96097 (530) 842-5763 http://www.fws.gov/yreka/																																									
U.S. Forest Service, Klamath National Forest 1312 Fairlane Road Yreka, CA 96097 (530) 842-6131 http://www.fs.fed.us/r5/klamath/																													✓	✓	✓	✓	✓								
U.S. Forest Service, Mendocino National Forest 825 N. Humboldt Ave. Willows, CA 95988 (530) 934-3316 http://www.fs.usda.gov/main/mendocino/home																																					✓	✓	✓	✓	✓
U.S. Forest Service, Rogue River-Siskiyou National Forest 3040 Biddle Road Medford, OR 97504 (541) 618-2200 http://www.fs.fed.us/r6/rogue-siskiyou/	✓				✓	✓	✓	✓	✓	✓	✓															✓	✓	✓													

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R
U.S. Forest Service, Shasta-Trinity National Forest 3644 Avtech Parkway Redding, CA 96002 (530) 226-2500 http://www.fs.fed.us/r5/shastatrinity/	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
U.S. Forest Service, Six Rivers National Forest 1330 Bayshore Way Eureka, CA 95501 (707) 442-1721 http://www.fs.usda.gov/srnf	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑
Upper Rogue Watershed Association P.O. Box 1128 Shady Cove, OR 97539 (541) 878-7404 http://www.roguebasinwatersheds.org/SectionIndex.asp?SectionID=2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Western Rivers Conservancy 71 SW Oak Street Suite 100 Portland, OR 97204 (503) 241-0151 http://www.westernrivers.org/	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Wiyot Tribe 1000 Wiyot Drive Loleta, CA 95551 (707) 733-5055 www.wiyot.us	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs
U.S. Forest Service, Shasta-Trinity National Forest	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
U.S. Forest Service, Six Rivers National Forest	☐	☑	☑	☑	☐	☑	☑	☐	☑	☐
Upper Rogue Watershed Association	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Western Rivers Conservancy	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Wiyot Tribe	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑

	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R
U.S. Forest Service, Shasta-Trinity National Forest	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
U.S. Forest Service, Six Rivers National Forest	☑	☐	☐	☐	☐	☐	☐	☑	☐	☑
Upper Rogue Watershed Association	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐
Western Rivers Conservancy	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Wiyot Tribe	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
U.S. Forest Service, Shasta-Trinity National Forest	☑	☑	☑	☑	☑	☐	☐	☐	☐	☐
U.S. Forest Service, Six Rivers National Forest	☐	☐	☑	☐	☑	☐	☑	☐	☐	☐
Upper Rogue Watershed Association	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Western Rivers Conservancy	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Wiyot Tribe	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Elk R	Hubbard Ck	Brush Ck	Mussel Ck	Euchre Ck	Lower Rogue R	Hunter Ck	Pistol R	Chetco R	Winchuck R	Smith R	Elk Ck	Wilson Ck	Lower Klamath R	Redwood Ck	Maple Ck	Little R	Strawberry Ck	Norton/Widow White Ck	Mad R	Humboldt Bay Tribs	Lower Eel/Van Duzen	Guthrie Ck	Bear R	Mattole R	Illinois R	Middle Rogue/Applegate	Upper Rogue R	Middle Klamath R	Upper Klamath R	Salmon R	Scott R	Shasta R	Lower Trinity R	Upper Trinity R	South Fork Trinity R	South Fork Eel R	Mainstem Eel R	Middle Fork Eel R	Middle Mainstem Eel R	Upper Mainstem Eel R
Yurok Tribal Fisheries Program														✔															✔	✔	✔	✔	✔	✔	✔	✔					

190 Klamath Blvd
Klamath, CA 95548
(707) 482-0439
http://www.yuroktribe.org/departments/fisheries/FisheriesHome.htm

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Appendix G. Cost and Potential Lead for Recovery Actions

G.1 Cost of Recovery

This appendix contains an estimated cost for all recovery actions, as well as the potential lead for each recovery action. The methods used to calculate cost are described in Appendix D. No cost was estimated for actions rated priority BR, as these actions, although helpful, are not considered necessary to achieve ESA recovery of the SONCC coho salmon ESU. Cost is estimated in accordance with the year the action would occur relative to when implementation of this plan begins (year 1). Costs are broken into five-year increments (i.e., 1-5, 6-10, 11-15, 16-20, and 21-25) except for the last category, 26+, which includes all costs after year 25. The calculation of cost estimates does not imply funding availability.

The summarized cost of SONCC coho salmon recovery actions is presented by population and diversity stratum in Table G-1.

Table G-1. Summary of estimated cost of recovery actions for each population and diversity stratum.

Stratum	Population	Recovery Role	Cost for Recovery Actions
Southern Coast	Mattole River	Independent; Non-Core 1	$82,281,985
	Bear River	Potentially Independent, Non-Core 2	$20,752,335
	Lower Eel/Van Duzen rivers	Independent; Core	$565,862,528
	Humboldt Bay Tributaries	Independent; Core	$97,948,038
	Guthrie Creek	Dependent	$6,875,130
Stratum Total			*$773,720,015*
Interior Eel	Mainstem Eel River	Potentially Independent, Core	$128,010,151
	Middle Mainstem Eel River	Potentially Independent, Core	$162,780,123
	Upper Mainstem Eel River	Potentially Independent, Non-Core 2	$35,579,288
	South Fork Eel River	Independent, Core	$249,938,315
	Middle Fork Eel River	Independent, Non-Core 2	$162,780,123
	North Fork Eel River	Independent, Non-Core 2	$24,329,957
Stratum Total			*$763,417,956*

Stratum	Population	Recovery Role	Cost for Recovery Actions
Central Coast	Smith River	Independent, Core	$135,806,107
	Lower Klamath River	Independent, Core	$157,651,770
	Redwood Creek	Independent, Core	$139,011,838
	Maple Creek/Big Lagoon	Dependent	$25,991,878
	Little River	Potentially Independent, Non-Core 1	$23,482,027
	Mad River	Independent, Non-Core 1	$116,004,701
	Elk Creek	Dependent	$13,750,603
Central Coast	Wilson Creek	Dependent	$10,788,489
	Strawberry Creek	Dependent	$6,974,869
	Norton/Widow White creeks	Dependent	$6,874,280
Stratum Total			*$636,336,562*
Trinity	Upper Trinity River	Independent, Core	$32,712,356
	Lower Trinity River	Independent, Core	$68,418,044
	South Fork Trinity River	Independent, Non-Core 1	$122,568,350
Stratum Total			*$223,698,750*
Interior Klamath	Upper Klamath River	Independent, Core	$667,538,879
	Middle Klamath River	Potentially Independent, Non–Core 1	$49,891,616
	Salmon River	Potentially Independent, Non-Core 1	$24,953,023
	Shasta River	Independent, Core	$203,230,901
	Scott River	Independent, Core	$296,222,569
Stratum Total			*$1,241,836,987*
Interior Rogue	Illinois River	Independent, Core	$251,749,457
	Middle Rogue/Applegate rivers	Independent, Non-Core 1	$454,638,891
	Upper Rogue River	Independent, Core	$509,141,079
Stratum Total			*$1,215,529,427*
Northern Coast	Elk River	Independent, Core	$19,804,725
	Lower Rogue River	Potentially Independent, Non-Core 1	$30,470,952
	Chetco River	Independent, Core	$27,412,139
	Winchuck River	Potentially Independent, Non-Core 1	$14,035,354
	Brush Creek	Dependent	$5,406,057
	Mussel Creek	Dependent	$6,502,511
	Hunter Creek	Dependent	$10,038,866
	Pistol River	Dependent	$12,234,024
Stratum Total			*$125,904,627*
ESU Total			**$4,949,689,924**

G.2 Explanation of fields

Recovery Action Step Number

The unique recovery action step identifier, composed of the recovery action number followed by an additional number which refers to the sequential order of the action step (e.g., 1, 2, 3, or 4). E.g., recovery action number SONCC-HBT.2.2, recovery action step number SONCC-HBT.2.2.1 refers to first recovery action step of that recovery action number). The recovery action step number is provided in Appendix F so the reader can cross reference information about a particular recovery action between the tables in the profiles and Appendix F.

Potential Lead

The "Potential Lead" is the entity most likely to carry out a recovery action based on its authority, expertise, or other factors. Identification of a candidate "Potential Lead" does not require the identified party to implement an action or to secure funding for such, nor does it preclude any other party from implementing the action or obtaining funds to do so.

5 Year Cost

The 5 year cost is the estimated cost to carry out the subject action in years 1 to 5. The method used to estimate cost is described in Section G.1 and Appendix D.

10 Year Cost

The 10 year cost is the estimated cost to carry out the subject action in years 6 to 10. The method used to estimate cost is described in Section G.1 and Appendix D.

15 Year Cost

The 15 years cost is the estimated cost to carry out the subject action in years 11 to 15. The method used to estimate cost is described in Section G.1 and Appendix D.

20 Year Cost

The 20 year cost is the estimated cost to carry out the subject action for years 16 to 20. The method used to estimate cost is described in Section G.1 and Appendix D.

25 Year Cost

The 25 year cost is the estimated cost to carry out the subject action for years 21 to 25. The method used to estimate cost is described in Section G.1 and Appendix D.

26+ Year Cost

The 26+ year cost is the estimated cost to carry out the subject action for years 26 and after. The method used to estimate cost is described in Section G.1 and Appendix D.

Total Cost

The total cost is the estimated cost to carry out the subject action over all years. The method used to estimate cost is described in Section G.1 and Appendix D.

Table G-2. Recovery action cost schedule

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
Population: Bear River									
SONCC-BeaR.7.1.7									
	SONCC-BeaR.7.1.7.1	$0						$0	CDF
	Action Total:	*$0*						*$0*	
SONCC-BeaR.2.1.1									
	SONCC-BeaR.2.1.1.1	$17,008						$17,008	CDFW
	SONCC-BeaR.2.1.1.2	$547,850						$547,850	CDFW
	Action Total:	*$564,858*						*$564,858*	
SONCC-BeaR.2.1.41									
	SONCC-BeaR.2.1.41.1	$17,008						$17,008	CDFW
	SONCC-BeaR.2.1.41.2	$547,850						$547,850	CDFW
	Action Total:	*$564,858*						*$564,858*	
SONCC-BeaR.2.2.25									
	SONCC-BeaR.2.2.25.1	$17,008						$17,008	CDFW
	SONCC-BeaR.2.2.25.2	$102,258						$102,258	CDFW
	Action Total:	*$119,266*						*$119,266*	
SONCC-BeaR.2.2.42									
	SONCC-BeaR.2.2.42.1	$17,008						$17,008	CDFW
	SONCC-BeaR.2.2.42.2	$102,258						$102,258	CDFW
	Action Total:	*$119,266*						*$119,266*	
SONCC-BeaR.8.1.2									
	SONCC-BeaR.8.1.2.1	$163,728						$163,728	CDFW
	SONCC-BeaR.8.1.2.2	$4,546,092						$4,546,092	CDFW
	SONCC-BeaR.8.1.2.3	$151,169						$151,169	CDFW
	SONCC-BeaR.8.1.2.4	$199,482				$199,482		$398,963	CDFW
	Action Total:	*$5,060,470*				*$199,482*		*$5,259,951*	
SONCC-BeaR.8.1.44									
	SONCC-BeaR.8.1.44.1	$163,728						$163,728	CDFW
	SONCC-BeaR.8.1.44.2	$4,546,092						$4,546,092	CDFW
	SONCC-BeaR.8.1.44.3	$151,169						$151,169	CDFW
	SONCC-BeaR.8.1.44.4	$199,482				$199,482		$398,963	CDFW
	Action Total:	*$5,060,470*				*$199,482*		*$5,259,951*	
SONCC-BeaR.7.1.6									
	SONCC-BeaR.7.1.6.1	$0						$0	County
	SONCC-BeaR.7.1.6.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-BeaR.7.1.27									
	SONCC-BeaR.7.1.27.1	$34,015						$34,015	NRCS/RCD
	SONCC-BeaR.7.1.27.2	$1,702,339						$1,702,339	NRCS/RCD
	SONCC-BeaR.7.1.27.3	$572,098						$572,098	NRCS/RCD
	Action Total:	*$2,308,452*						*$2,308,452*	
SONCC-BeaR.7.1.5									
	SONCC-BeaR.7.1.5.1	$17,008						$17,008	NRCS/RCD
	SONCC-BeaR.7.1.5.2	$17,008						$17,008	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-BeaR.7.1.5.3	$64,383						$64,383	NRCS/RCD
	Action Total:	*$98,398*						*$98,398*	
SONCC-BeaR.7.1.43									
	SONCC-BeaR.7.1.43.1	$17,008						$17,008	NRCS/RCD
	SONCC-BeaR.7.1.43.2	$17,008						$17,008	NRCS/RCD
	SONCC-BeaR.7.1.43.3	$64,383						$64,383	NRCS/RCD
	Action Total:	*$98,398*						*$98,398*	
SONCC-BeaR.2.2.32									
	SONCC-BeaR.2.2.32.1	$34,015						$34,015	CDFW
	SONCC-BeaR.2.2.32.2	$170,075	$170,075	$170,075	$170,075	$170,075	$170,075	$1,020,450	CDFW
	SONCC-BeaR.2.2.32.3	$10,000						$10,000	CDFW
	Action Total:	*$214,090*	*$170,075*	*$170,075*	*$170,075*	*$170,075*	*$170,075*	*$1,064,465*	
SONCC-BeaR.2.2.36									
	SONCC-BeaR.2.2.36.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-BeaR.8.1.3									
	SONCC-BeaR.8.1.3.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-BeaR.10.2.28									
	SONCC-BeaR.10.2.28.1	$45,925						$45,925	CDFW
	SONCC-BeaR.10.2.28.2	$114,813						$114,813	CDFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-BeaR.10.2.39									
	SONCC-BeaR.10.2.39.1	$45,925						$45,925	CDFW
	SONCC-BeaR.10.2.39.2	$114,813						$114,813	CDFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-BeaR.10.7.38									
	SONCC-BeaR.10.7.38.1	$8,504						$8,504	CDFW
	SONCC-BeaR.10.7.38.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-BeaR.10.7.40									
	SONCC-BeaR.10.7.40.1	$8,504						$8,504	CDFW
	SONCC-BeaR.10.7.40.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-BeaR.1.2.26									
	SONCC-BeaR.1.2.26.1	$34,015						$34,015	CDFW
	SONCC-BeaR.1.2.26.2	$34,015						$34,015	CDFW
	SONCC-BeaR.1.2.26.3	$6,000						$6,000	CDFW
	Action Total:	*$74,030*						*$74,030*	
SONCC-BeaR.16.1.10									
	SONCC-BeaR.16.1.10.1	$34,015						$34,015	NMFS
	SONCC-BeaR.16.1.10.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-BeaR.16.1.11									
	SONCC-BeaR.16.1.11.1	$34,015						$34,015	NMFS
	SONCC-BeaR.16.1.11.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-BeaR.16.2.12									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-BeaR.16.2.12.1	$34,015						$34,015	NMFS
	SONCC-BeaR.16.2.12.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-BeaR.16.2.13									
	SONCC-BeaR.16.2.13.1	$34,015						$34,015	NMFS
	SONCC-BeaR.16.2.13.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-BeaR.10.1.33									
	SONCC-BeaR.10.1.33.1	$0						$0	RWQCB
	SONCC-BeaR.10.1.33.2	$0						$0	RWQCB
	Action Total:	*$0*						*$0*	
SONCC-BeaR.27.2.24									
	SONCC-BeaR.27.2.24.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-BeaR.27.2.29									
	SONCC-BeaR.27.2.29.1	$76,292		$76,292		$76,292		$228,876	CDFW
	Action Total:	*$76,292*		*$76,292*		*$76,292*		*$228,876*	
SONCC-BeaR.27.2.30									
	SONCC-BeaR.27.2.30.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-BeaR.27.2.35									
	SONCC-BeaR.27.2.35.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-BeaR.27.2.17									
	SONCC-BeaR.27.2.17.1	$136,060						$136,060	CDFW
	SONCC-BeaR.27.2.17.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-BeaR.27.2.18									
	SONCC-BeaR.27.2.18.1	$76,292		$76,292		$76,292		$228,876	CDFW
	Action Total:	*$76,292*		*$76,292*		*$76,292*		*$228,876*	
SONCC-BeaR.27.2.19									
	SONCC-BeaR.27.2.19.1	$76,292		$76,292		$76,292		$228,876	CDFW
	Action Total:	*$76,292*		*$76,292*		*$76,292*		*$228,876*	
SONCC-BeaR.27.2.21									
	SONCC-BeaR.27.2.21.1	$76,292		$76,292		$76,292		$228,876	CDFW
	Action Total:	*$76,292*		*$76,292*		*$76,292*		*$228,876*	
SONCC-BeaR.27.2.22									
	SONCC-BeaR.27.2.22.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-BeaR.27.2.37									
	SONCC-BeaR.27.2.37.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-BeaR.27.1.23									
	SONCC-BeaR.27.1.23.1	$34,015						$34,015	NMFS
	SONCC-BeaR.27.1.23.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-BeaR.27.1.15									
	SONCC-BeaR.27.1.15.1	$23,921	$23,921	$23,921	$23,921	$23,921	$23,921	$143,526	CDFW
	Action Total:	*$23,921*	*$23,921*	*$23,921*	*$23,921*	*$23,921*	*$23,921*	*$143,526*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-BeaR.27.1.16									
	SONCC-BeaR.27.1.16.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-BeaR.27.4.34									
	SONCC-BeaR.27.4.34.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-BeaR.3.1.8									
	SONCC-BeaR.3.1.8.1							$0	SWRCB
	SONCC-BeaR.3.1.8.2							$0	SWRCB
	Action Total:							*$0*	
SONCC-BeaR.3.1.9									
	SONCC-BeaR.3.1.9.1							$0	SWRCB
	SONCC-BeaR.3.1.9.2							$0	SWRCB
	Action Total:							*$0*	
SONCC-BeaR.8.1.4									
	SONCC-BeaR.8.1.4.1							$0	CCC
	SONCC-BeaR.8.1.4.2							$0	CCC
	Action Total:							*$0*	
	Population Total:	***$15,990,463***	***$769,629***	***$1,027,012***	***$769,629***	***$1,425,975***	***$769,629***	***$20,752,335***	

Population: Brush Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-BruC.2.1.29									
	SONCC-BruC.2.1.29.1	$17,008						$17,008	OSP
	SONCC-BruC.2.1.29.2	$175,312						$175,312	OSP
	Action Total:	*$192,320*						*$192,320*	
SONCC-BruC.19.1.2									
	SONCC-BruC.19.1.2.1	$68,030						$68,030	ODF
	SONCC-BruC.19.1.2.2	$0						$0	ODF
	SONCC-BruC.19.1.2.3	$0						$0	ODF
	SONCC-BruC.19.1.2.4	$0						$0	ODF
	SONCC-BruC.19.1.2.5	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	
SONCC-BruC.2.1.1									
	SONCC-BruC.2.1.1.1	$17,008						$17,008	OSP
	SONCC-BruC.2.1.1.2	$175,312						$175,312	OSP
	Action Total:	*$192,320*						*$192,320*	
SONCC-BruC.28.2.11									
	SONCC-BruC.28.2.11.1	$36,770						$36,770	OSP
	Action Total:	*$36,770*						*$36,770*	
SONCC-BruC.2.1.18									
	SONCC-BruC.2.1.18.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-BruC.2.2.9									
	SONCC-BruC.2.2.9.1	$17,008						$17,008	ODFW
	SONCC-BruC.2.2.9.2	$51,129						$51,129	ODFW
	Action Total:	*$68,137*						*$68,137*	
SONCC-BruC.2.2.3									
	SONCC-BruC.2.2.3.1	$17,008						$17,008	OSP

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-BruC.2.2.3.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-BruC.2.2.3.3	$10,000						$10,000	OSP
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-BruC.2.2.30									
	SONCC-BruC.2.2.30.1	$17,008						$17,008	OSP
	SONCC-BruC.2.2.30.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-BruC.2.2.30.3	$10,000						$10,000	OSP
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-BruC.2.2.31									
	SONCC-BruC.2.2.31.1	$17,008						$17,008	ODFW
	SONCC-BruC.2.2.31.2	$51,129						$51,129	ODFW
	Action Total:	*$68,137*						*$68,137*	
SONCC-BruC.28.2.20									
	SONCC-BruC.28.2.20.1	$0						$0	County
	SONCC-BruC.28.2.20.2	$0						$0	County
	SONCC-BruC.28.2.20.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-BruC.8.1.10									
	SONCC-BruC.8.1.10.1	$13,719						$13,719	NGO
	SONCC-BruC.8.1.10.2	$199,390						$199,390	NGO
	SONCC-BruC.8.1.10.3	$17,442						$17,442	NGO
	SONCC-BruC.8.1.10.4	$28,668						$28,668	NGO
	Action Total:	*$259,219*						*$259,219*	
SONCC-BruC.8.1.33									
	SONCC-BruC.8.1.33.1	$13,719						$13,719	NGO
	SONCC-BruC.8.1.33.2	$199,390						$199,390	NGO
	SONCC-BruC.8.1.33.3	$17,442						$17,442	NGO
	SONCC-BruC.8.1.33.4	$28,668						$28,668	NGO
	Action Total:	*$259,219*						*$259,219*	
SONCC-BruC.7.1.19									
	SONCC-BruC.7.1.19.1	$0						$0	County
	SONCC-BruC.7.1.19.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-BruC.7.1.6									
	SONCC-BruC.7.1.6.1	$34,015						$34,015	OSP
	SONCC-BruC.7.1.6.2	$7,271						$7,271	OSP
	SONCC-BruC.7.1.6.3	$13,954						$13,954	OSP
	Action Total:	*$55,240*						*$55,240*	
SONCC-BruC.5.1.7									
	SONCC-BruC.5.1.7.1	$22,270						$22,270	OSP
	SONCC-BruC.5.1.7.2	$79,940						$79,940	OSP
	Action Total:	*$102,210*						*$102,210*	
SONCC-BruC.5.1.32									
	SONCC-BruC.5.1.32.1	$22,270						$22,270	OSP
	SONCC-BruC.5.1.32.2	$79,940						$79,940	OSP
	Action Total:	*$102,210*						*$102,210*	
SONCC-BruC.10.7.27									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-BruC.10.7.27.1	$8,504						$8,504	ODFW
	SONCC-BruC.10.7.27.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-BruC.10.7.28									
	SONCC-BruC.10.7.28.1	$8,504						$8,504	ODFW
	SONCC-BruC.10.7.28.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-BruC.10.2.17									
	SONCC-BruC.10.2.17.1	$0						$0	ODEQ
	SONCC-BruC.10.2.17.2	$0						$0	ODEQ
	Action Total:	*$0*						*$0*	
SONCC-BruC.27.2.13									
	SONCC-BruC.27.2.13.1	$1,077		$1,077		$1,077		$3,231	ODFW
	Action Total:	*$1,077*		*$1,077*		*$1,077*		*$3,231*	
SONCC-BruC.27.2.14									
	SONCC-BruC.27.2.14.1	$1,077		$1,077		$1,077		$3,231	ODFW
	Action Total:	*$1,077*		*$1,077*		*$1,077*		*$3,231*	
SONCC-BruC.27.2.25									
	SONCC-BruC.27.2.25.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-BruC.27.2.26									
	SONCC-BruC.27.2.26.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-BruC.27.2.8									
	SONCC-BruC.27.2.8.1	$136,060						$136,060	ODFW
	SONCC-BruC.27.2.8.2			$81,800			$81,800	$163,600	ODFW
	Action Total:	*$136,060*		*$81,800*			*$81,800*	*$299,660*	
SONCC-BruC.27.1.12									
	SONCC-BruC.27.1.12.1	$2,842	$2,842	$2,842	$2,842	$2,842	$2,842	$17,052	ODFW
	Action Total:	*$2,842*	*$2,842*	*$2,842*	*$2,842*	*$2,842*	*$2,842*	*$17,052*	
SONCC-BruC.27.1.15									
	SONCC-BruC.27.1.15.1	$34,015						$34,015	NMFS
	SONCC-BruC.27.1.15.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-BruC.27.1.24									
	SONCC-BruC.27.1.24.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-BruC.27.4.21									
	SONCC-BruC.27.4.21.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-BruC.27.4.22									
	SONCC-BruC.27.4.22.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-BruC.27.4.23									
	SONCC-BruC.27.4.23.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
	Population Total:	***$2,245,576***	***$598,515***	***$682,469***	***$598,515***	***$600,669***	***$680,315***	***$5,406,057***	

Population: Chetco River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-CheR.2.8.4									
	SONCC-CheR.2.8.4.1	$68,030						$68,030	ODF
	SONCC-CheR.2.8.4.2	$0						$0	ODF
	SONCC-CheR.2.8.4.3	$0						$0	ODF
	SONCC-CheR.2.8.4.4	$0						$0	ODF
	SONCC-CheR.2.8.4.5	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	
SONCC-CheR.2.4.9									
	SONCC-CheR.2.4.9.1	$17,008						$17,008	ODFW
	SONCC-CheR.2.4.9.2	$167,500						$167,500	ODFW
	Action Total:	*$184,508*						*$184,508*	
SONCC-CheR.2.4.69									
	SONCC-CheR.2.4.69.1	$17,008						$17,008	ODFW
	SONCC-CheR.2.4.69.2	$167,500						$167,500	ODFW
	Action Total:	*$184,508*						*$184,508*	
SONCC-CheR.22.2.43									
	SONCC-CheR.22.2.43.1	$36,770						$36,770	OWRD
	SONCC-CheR.22.2.43.2	$36,770						$36,770	OWRD
	SONCC-CheR.22.2.43.3	$0						$0	OWRD
	SONCC-CheR.22.2.43.4	$0						$0	OWRD
	Action Total:	*$73,540*						*$73,540*	
SONCC-CheR.2.5.8									
	SONCC-CheR.2.5.8.1	$22,270						$22,270	ODFW
	SONCC-CheR.2.5.8.2	$10,049						$10,049	ODFW
	Action Total:	*$32,319*						*$32,319*	
SONCC-CheR.2.5.70									
	SONCC-CheR.2.5.70.1	$22,270						$22,270	ODFW
	SONCC-CheR.2.5.70.2	$10,049						$10,049	ODFW
	Action Total:	*$32,319*						*$32,319*	
SONCC-CheR.7.1.75									
	SONCC-CheR.7.1.75.1	$17,008						$17,008	NRCS/RCD
	SONCC-CheR.7.1.75.2	$85,038						$85,038	NRCS/RCD
	SONCC-CheR.7.1.75.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-CheR.7.1.46									
	SONCC-CheR.7.1.46.1	$17,008						$17,008	NRCS/RCD
	SONCC-CheR.7.1.46.2	$85,038						$85,038	NRCS/RCD
	SONCC-CheR.7.1.46.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-CheR.7.1.3									
	SONCC-CheR.7.1.3.1	$0						$0	County
	SONCC-CheR.7.1.3.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-CheR.2.1.44									
	SONCC-CheR.2.1.44.1	$470,000						$470,000	USFS
	Action Total:	*$470,000*						*$470,000*	
SONCC-CheR.2.1.6									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-CheR.2.1.6.1	$17,008						$17,008	USFS
	SONCC-CheR.2.1.6.2	$438,280						$438,280	USFS
	Action Total:	*$455,288*						*$455,288*	
SONCC-CheR.2.1.66									
	SONCC-CheR.2.1.66.1	$17,008						$17,008	USFS
	SONCC-CheR.2.1.66.2	$438,280						$438,280	USFS
	Action Total:	*$455,288*						*$455,288*	
SONCC-CheR.2.2.32									
	SONCC-CheR.2.2.32.1	$17,008						$17,008	ODFW
	SONCC-CheR.2.2.32.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-CheR.2.2.32.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-CheR.2.2.5									
	SONCC-CheR.2.2.5.1	$17,008						$17,008	USFS
	SONCC-CheR.2.2.5.2	$81,806						$81,806	USFS
	Action Total:	*$98,814*						*$98,814*	
SONCC-CheR.2.2.67									
	SONCC-CheR.2.2.67.1	$17,008						$17,008	ODFW
	SONCC-CheR.2.2.67.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-CheR.2.2.67.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-CheR.2.2.68									
	SONCC-CheR.2.2.68.1	$17,008						$17,008	USFS
	SONCC-CheR.2.2.68.2	$81,806						$81,806	USFS
	Action Total:	*$98,814*						*$98,814*	
SONCC-CheR.22.5.10									
	SONCC-CheR.22.5.10.1	$73,540						$73,540	Watershed Cnsl
	SONCC-CheR.22.5.10.2	$17,077						$17,077	Watershed Cnsl
	Action Total:	*$90,617*						*$90,617*	
SONCC-CheR.7.1.36									
	SONCC-CheR.7.1.36.1	$34,015						$34,015	USFS
	SONCC-CheR.7.1.36.2	$222,263						$222,263	USFS
	Action Total:	*$256,278*						*$256,278*	
SONCC-CheR.22.3.48									
	SONCC-CheR.22.3.48.1	$0						$0	County
	SONCC-CheR.22.3.48.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-CheR.2.1.42									
	SONCC-CheR.2.1.42.1	$17,008						$17,008	ODFW
	SONCC-CheR.2.1.42.2	$0						$0	ODFW
	SONCC-CheR.2.1.42.3	$38,068						$38,068	ODFW
	SONCC-CheR.2.1.42.4	$0						$0	ODFW
	Action Total:	*$55,076*						*$55,076*	
SONCC-CheR.2.1.7									
	SONCC-CheR.2.1.7.1	$0						$0	County
	SONCC-CheR.2.1.7.2	$0						$0	County
	Action Total:	*$0*						*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-CheR.22.1.45									
	SONCC-CheR.22.1.45.1	$76,136						$76,136	ODEQ
	SONCC-CheR.22.1.45.2	$0						$0	ODEQ
	Action Total:	*$76,136*						*$76,136*	
SONCC-CheR.22.1.49									
	SONCC-CheR.22.1.49.1	$0						$0	County
	SONCC-CheR.22.1.49.2	$0						$0	County
	SONCC-CheR.22.1.49.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-CheR.26.1.62									
	SONCC-CheR.26.1.62.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-CheR.2.2.58									
	SONCC-CheR.2.2.58.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-CheR.3.1.11									
	SONCC-CheR.3.1.11.1	$17,008						$17,008	OWRD
	SONCC-CheR.3.1.11.2	$18,385						$18,385	OWRD
	SONCC-CheR.3.1.11.3	$38,068						$38,068	OWRD
	Action Total:	*$73,461*						*$73,461*	
SONCC-CheR.3.1.72									
	SONCC-CheR.3.1.72.1	$17,008						$17,008	OWRD
	SONCC-CheR.3.1.72.2	$18,385						$18,385	OWRD
	SONCC-CheR.3.1.72.3	$38,068						$38,068	OWRD
	Action Total:	*$73,461*						*$73,461*	
SONCC-CheR.10.2.16									
	SONCC-CheR.10.2.16.1	$0						$0	EPA
	Action Total:	*$0*						*$0*	
SONCC-CheR.2.1.65									
	SONCC-CheR.2.1.65.1	$17,008						$17,008	ODFW
	SONCC-CheR.2.1.65.2	$0						$0	ODFW
	SONCC-CheR.2.1.65.3	$38,068						$38,068	ODFW
	SONCC-CheR.2.1.65.4	$0						$0	ODFW
	Action Total:	*$55,076*						*$55,076*	
SONCC-CheR.7.1.33									
	SONCC-CheR.7.1.33.1	$0						$0	BLM
	Action Total:	*$0*						*$0*	
SONCC-CheR.7.1.47									
	SONCC-CheR.7.1.47.1	$170,075						$170,075	USFS
	Action Total:	*$170,075*						*$170,075*	
SONCC-CheR.5.1.37									
	SONCC-CheR.5.1.37.1	$34,015						$34,015	BLM
	SONCC-CheR.5.1.37.2	$654,068						$654,068	BLM
	Action Total:	*$688,083*						*$688,083*	
SONCC-CheR.5.1.74									
	SONCC-CheR.5.1.74.1	$17,008						$17,008	County
	SONCC-CheR.5.1.74.2	$327,034						$327,034	County
	Action Total:	*$344,042*						*$344,042*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-CheR.5.1.12									
	SONCC-CheR.5.1.12.1	$17,008						$17,008	County
	SONCC-CheR.5.1.12.2	$327,034						$327,034	County
	Action Total:	*$344,042*						*$344,042*	
SONCC-CheR.3.1.51									
	SONCC-CheR.3.1.51.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-CheR.3.1.73									
	SONCC-CheR.3.1.73.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-CheR.3.1.61									
	SONCC-CheR.3.1.61.1	$36,770						$36,770	OWRD
	Action Total:	*$36,770*						*$36,770*	
SONCC-CheR.28.1.13									
	SONCC-CheR.28.1.13.1	$271,959						$271,959	USFS
	SONCC-CheR.28.1.13.2	$677,926						$677,926	USFS
	SONCC-CheR.28.1.13.3	$14,535						$14,535	USFS
	SONCC-CheR.28.1.13.4	$191,120					$191,120	$382,240	USFS
	Action Total:	*$1,155,540*					*$191,120*	*$1,346,660*	
SONCC-CheR.28.1.71									
	SONCC-CheR.28.1.71.1	$271,959						$271,959	USFS
	SONCC-CheR.28.1.71.2	$677,926						$677,926	USFS
	SONCC-CheR.28.1.71.3	$14,535						$14,535	USFS
	SONCC-CheR.28.1.71.4	$191,120					$191,120	$382,240	USFS
	Action Total:	*$1,155,540*					*$191,120*	*$1,346,660*	
SONCC-CheR.10.2.41									
	SONCC-CheR.10.2.41.1	$22,963						$22,963	ODFW
	SONCC-CheR.10.2.41.2	$38,068						$38,068	ODFW
	Action Total:	*$61,031*						*$61,031*	
SONCC-CheR.10.2.63									
	SONCC-CheR.10.2.63.1	$22,963						$22,963	ODFW
	SONCC-CheR.10.2.63.2	$38,068						$38,068	ODFW
	Action Total:	*$61,031*						*$61,031*	
SONCC-CheR.10.7.60									
	SONCC-CheR.10.7.60.1	$8,504						$8,504	ODFW
	SONCC-CheR.10.7.60.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-CheR.10.7.64									
	SONCC-CheR.10.7.64.1	$8,504						$8,504	ODFW
	SONCC-CheR.10.7.64.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-CheR.1.2.31									
	SONCC-CheR.1.2.31.1	$34,015						$34,015	ODFW
	SONCC-CheR.1.2.31.2	$34,015						$34,015	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-CheR.16.1.17									
	SONCC-CheR.16.1.17.1	$34,015						$34,015	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-CheR.16.1.17.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-CheR.16.1.18									
	SONCC-CheR.16.1.18.1	$34,015						$34,015	NMFS
	SONCC-CheR.16.1.18.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-CheR.16.2.19									
	SONCC-CheR.16.2.19.1	$34,015						$34,015	NMFS
	SONCC-CheR.16.2.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-CheR.16.2.20									
	SONCC-CheR.16.2.20.1	$34,015						$34,015	NMFS
	SONCC-CheR.16.2.20.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-CheR.10.2.15									
	SONCC-CheR.10.2.15.1	$76,136						$76,136	OWRD
	Action Total:	*$76,136*						*$76,136*	
SONCC-CheR.27.2.34									
	SONCC-CheR.27.2.34.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-CheR.27.2.35									
	SONCC-CheR.27.2.35.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-CheR.27.2.40									
	SONCC-CheR.27.2.40.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-CheR.27.2.57									
	SONCC-CheR.27.2.57.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-CheR.27.2.59									
	SONCC-CheR.27.2.59.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-CheR.27.2.25									
	SONCC-CheR.27.2.25.1	$136,060						$136,060	ODFW
	SONCC-CheR.27.2.25.2		$81,800		$81,800		$81,800	$245,400	ODFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-CheR.27.2.26									
	SONCC-CheR.27.2.26.1	$609,211		$609,211		$609,211		$1,827,633	ODFW
	Action Total:	*$609,211*		*$609,211*		*$609,211*		*$1,827,633*	
SONCC-CheR.27.2.27									
	SONCC-CheR.27.2.27.1	$609,211		$609,211		$609,211		$1,827,633	ODFW
	Action Total:	*$609,211*		*$609,211*		*$609,211*		*$1,827,633*	
SONCC-CheR.27.2.28									
	SONCC-CheR.27.2.28.1	$609,211		$609,211		$609,211		$1,827,633	ODFW
	Action Total:	*$609,211*		*$609,211*		*$609,211*		*$1,827,633*	
SONCC-CheR.27.2.29									
	SONCC-CheR.27.2.29.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	ODFW
	Action Total:	*$65,911*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$264,786*	
SONCC-CheR.27.2.30									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-CheR.27.2.30.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-CheR.27.1.38									
	SONCC-CheR.27.1.38.1	$34,015						$34,015	NMFS
	SONCC-CheR.27.1.38.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-CheR.27.1.39									
	SONCC-CheR.27.1.39.1	$34,015						$34,015	ODFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-CheR.27.1.52									
	SONCC-CheR.27.1.52.1	$67,595	$67,595	$67,595	$67,595	$67,595	$67,595	$405,570	ODFW
	Action Total:	*$67,595*	*$67,595*	*$67,595*	*$67,595*	*$67,595*	*$67,595*	*$405,570*	
SONCC-CheR.27.1.21									
	SONCC-CheR.27.1.21.1	$202,785	$202,785	$202,785	$202,785	$202,785	$202,785	$1,216,710	ODFW
	Action Total:	*$202,785*	*$202,785*	*$202,785*	*$202,785*	*$202,785*	*$202,785*	*$1,216,710*	
SONCC-CheR.27.1.22									
	SONCC-CheR.27.1.22.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	ODFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-CheR.27.1.23									
	SONCC-CheR.27.1.23.1	$68,030		$68,030		$68,030		$204,090	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-CheR.27.1.24									
	SONCC-CheR.27.1.24.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-CheR.27.4.53									
	SONCC-CheR.27.4.53.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-CheR.27.4.54									
	SONCC-CheR.27.4.54.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-CheR.27.4.55									
	SONCC-CheR.27.4.55.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-CheR.27.4.56									
	SONCC-CheR.27.4.56.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-CheR.7.1.2									
	SONCC-CheR.7.1.2.1							$0	USFS
	SONCC-CheR.7.1.2.2							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$12,120,438***	***$2,229,135***	***$4,111,028***	***$2,229,135***	***$4,111,028***	***$2,611,375***	***$27,412,139***	

Population: Elk Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ElkC.7.1.15									
	SONCC-ElkC.7.1.15.1	$15,673						$15,673	City
	Action Total:	*$15,673*						*$15,673*	
SONCC-ElkC.7.1.35									
	SONCC-ElkC.7.1.35.1	$15,673						$15,673	NGO
	Action Total:	*$15,673*						*$15,673*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ElkC.2.1.1									
	SONCC-ElkC.2.1.1.1	$17,008						$17,008	CDFW
	SONCC-ElkC.2.1.1.2	$616,331						$616,331	CDFW
	Action Total:	*$633,339*						*$633,339*	
SONCC-ElkC.2.1.31									
	SONCC-ElkC.2.1.31.1	$17,008						$17,008	CDFW
	SONCC-ElkC.2.1.31.2	$616,331						$616,331	CDFW
	Action Total:	*$633,339*						*$633,339*	
SONCC-ElkC.2.2.3									
	SONCC-ElkC.2.2.3.1	$17,008						$17,008	CDFW
	SONCC-ElkC.2.2.3.2	$581,400						$581,400	CDFW
	Action Total:	*$598,408*						*$598,408*	
SONCC-ElkC.2.2.32									
	SONCC-ElkC.2.2.32.1	$17,008						$17,008	CDFW
	SONCC-ElkC.2.2.32.2	$581,400						$581,400	CDFW
	Action Total:	*$598,408*						*$598,408*	
SONCC-ElkC.7.1.16									
	SONCC-ElkC.7.1.16.1	$34,015						$34,015	City
	SONCC-ElkC.7.1.16.2	$34,015						$34,015	City
	Action Total:	*$68,030*						*$68,030*	
SONCC-ElkC.7.1.17									
	SONCC-ElkC.7.1.17.1	$0						$0	County
	SONCC-ElkC.7.1.17.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-ElkC.5.1.20									
	SONCC-ElkC.5.1.20.1	$44,540						$44,540	County
	SONCC-ElkC.5.1.20.2	$159,880						$159,880	County
	Action Total:	*$204,420*						*$204,420*	
SONCC-ElkC.5.1.21									
	SONCC-ElkC.5.1.21.1	$79,940						$79,940	County
	Action Total:	*$79,940*						*$79,940*	
SONCC-ElkC.5.1.34									
	SONCC-ElkC.5.1.34.1	$79,940						$79,940	County
	Action Total:	*$79,940*						*$79,940*	
SONCC-ElkC.3.1.4									
	SONCC-ElkC.3.1.4.1	$73,540						$73,540	CDFW
	SONCC-ElkC.3.1.4.2	$0						$0	CDFW
	Action Total:	*$73,540*						*$73,540*	
SONCC-ElkC.3.2.9									
	SONCC-ElkC.3.2.9.1	$0						$0	County
	SONCC-ElkC.3.2.9.2	$18,335						$18,335	County
	Action Total:	*$18,335*						*$18,335*	
SONCC-ElkC.3.2.33									
	SONCC-ElkC.3.2.33.1	$0						$0	County
	SONCC-ElkC.3.2.33.2	$18,335						$18,335	County
	Action Total:	*$18,335*						*$18,335*	
SONCC-ElkC.8.1.12									
	SONCC-ElkC.8.1.12.1	$52,455						$52,455	County

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ElkC.8.1.12.2	$2,253,107						$2,253,107	County
	SONCC-ElkC.8.1.12.3	$15,388						$15,388	County
	SONCC-ElkC.8.1.12.4	$20,307					$20,307	$40,613	County
	Action Total:	*$2,341,257*					*$20,307*	*$2,361,563*	
SONCC-ElkC.8.1.36									
	SONCC-ElkC.8.1.36.1	$52,455						$52,455	County
	SONCC-ElkC.8.1.36.2	$2,253,107						$2,253,107	County
	SONCC-ElkC.8.1.36.3	$15,388						$15,388	County
	SONCC-ElkC.8.1.36.4	$20,307					$20,307	$40,613	County
	Action Total:	*$2,341,257*					*$20,307*	*$2,361,563*	
SONCC-ElkC.10.2.18									
	SONCC-ElkC.10.2.18.1	$22,963						$22,963	RWQCB
	SONCC-ElkC.10.2.18.2	$2,108,812						$2,108,812	RWQCB
	Action Total:	*$2,131,774*						*$2,131,774*	
SONCC-ElkC.10.2.29									
	SONCC-ElkC.10.2.29.1	$22,963						$22,963	RWQCB
	SONCC-ElkC.10.2.29.2	$2,108,812						$2,108,812	RWQCB
	Action Total:	*$2,131,774*						*$2,131,774*	
SONCC-ElkC.10.7.30									
	SONCC-ElkC.10.7.30.1	$8,504						$8,504	CDFW
	SONCC-ElkC.10.7.30.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-ElkC.10.7.28									
	SONCC-ElkC.10.7.28.1	$8,504						$8,504	CDFW
	SONCC-ElkC.10.7.28.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-ElkC.27.2.22									
	SONCC-ElkC.27.2.22.1	$136,060						$136,060	CDFW
	SONCC-ElkC.27.2.22.2			$81,800			$81,800	$163,600	CDFW
	Action Total:	*$136,060*		*$81,800*			*$81,800*	*$299,660*	
SONCC-ElkC.27.2.24									
	SONCC-ElkC.27.2.24.1	$10,069		$10,069		$10,069		$30,207	CDFW
	Action Total:	*$10,069*		*$10,069*		*$10,069*		*$30,207*	
SONCC-ElkC.27.2.26									
	SONCC-ElkC.27.2.26.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-ElkC.27.1.23									
	SONCC-ElkC.27.1.23.1	$31,320	$31,320	$31,320	$31,320	$31,320	$31,320	$187,920	CDFW
	Action Total:	*$31,320*	*$31,320*	*$31,320*	*$31,320*	*$31,320*	*$31,320*	*$187,920*	
SONCC-ElkC.27.1.25									
	SONCC-ElkC.27.1.25.1	$34,015						$34,015	NMFS
	SONCC-ElkC.27.1.25.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-ElkC.7.1.14									
	SONCC-ElkC.7.1.14.1							$0	NRCS/RCD
	SONCC-ElkC.7.1.14.2							$0	NRCS/RCD
	SONCC-ElkC.7.1.14.3							$0	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ElkC.7.1.14.4							$0	NRCS/RCD
	SONCC-ElkC.7.1.14.5							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-ElkC.2.2.2									
	SONCC-ElkC.2.2.2.1							$0	CDFW
	SONCC-ElkC.2.2.2.2							$0	CDFW
	SONCC-ElkC.2.2.2.3							$0	CDFW
	Action Total:							*$0*	
SONCC-ElkC.1.2.10									
	SONCC-ElkC.1.2.10.1							$0	CDFW
	SONCC-ElkC.1.2.10.2							$0	CDFW
	Action Total:							*$0*	
SONCC-ElkC.3.1.5									
	SONCC-ElkC.3.1.5.1							$0	NGO
	Action Total:							*$0*	
SONCC-ElkC.3.1.6									
	SONCC-ElkC.3.1.6.1							$0	SWRCB
	SONCC-ElkC.3.1.6.2							$0	SWRCB
	Action Total:							*$0*	
SONCC-ElkC.3.1.8									
	SONCC-ElkC.3.1.8.1							$0	SWRCB
	Action Total:							*$0*	
SONCC-ElkC.2.2.27									
	SONCC-ElkC.2.2.27.1							$0	CDFW
	Action Total:							*$0*	
SONCC-ElkC.8.1.11									
	SONCC-ElkC.8.1.11.1							$0	CDFW
	Action Total:							*$0*	
SONCC-ElkC.10.2.19									
	SONCC-ElkC.10.2.19.1							$0	RWQCB
	Action Total:							*$0*	
	Population Total:	***$12,399,200***	***$218,608***	***$310,477***	***$218,608***	***$228,677***	***$341,021***	***$13,716,588***	

Population: Elk River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ElkR.12.1.41									
	SONCC-ElkR.12.1.41.1	$0						$0	ODA
	SONCC-ElkR.12.1.41.2	$0						$0	ODA
	SONCC-ElkR.12.1.41.3	$0						$0	ODA
	SONCC-ElkR.12.1.41.4	$0						$0	ODA
	SONCC-ElkR.12.1.41.5	$0						$0	ODA
	Action Total:	*$0*						*$0*	
SONCC-ElkR.2.8.4									
	SONCC-ElkR.2.8.4.1	$68,030						$68,030	ODF
	SONCC-ElkR.2.8.4.2	$0						$0	ODF
	SONCC-ElkR.2.8.4.3	$0						$0	ODF
	SONCC-ElkR.2.8.4.4	$0						$0	ODF
	SONCC-ElkR.2.8.4.5	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ElkR.2.7.3									
	SONCC-ElkR.2.7.3.1	$34,015						$34,015	FSA
	SONCC-ElkR.2.7.3.2	$34,015						$34,015	FSA
	SONCC-ElkR.2.7.3.3	$219,248						$219,248	FSA
	SONCC-ElkR.2.7.3.4	$7,416						$7,416	FSA
	SONCC-ElkR.2.7.3.5	$607						$607	FSA
	Action Total:	*$295,301*						*$295,301*	
SONCC-ElkR.2.1.51									
	SONCC-ElkR.2.1.51.1	$17,008						$17,008	USFS
	SONCC-ElkR.2.1.51.2	$621,810						$621,810	USFS
	Action Total:	*$638,817*						*$638,817*	
SONCC-ElkR.2.1.6									
	SONCC-ElkR.2.1.6.1	$17,008						$17,008	USFS
	SONCC-ElkR.2.1.6.2	$621,810						$621,810	USFS
	Action Total:	*$638,817*						*$638,817*	
SONCC-ElkR.2.2.53									
	SONCC-ElkR.2.2.53.1	$17,008						$17,008	NGO
	SONCC-ElkR.2.2.53.2	$116,063						$116,063	NGO
	Action Total:	*$133,070*						*$133,070*	
SONCC-ElkR.2.2.5									
	SONCC-ElkR.2.2.5.1	$17,008						$17,008	NGO
	SONCC-ElkR.2.2.5.2	$116,063						$116,063	NGO
	Action Total:	*$133,070*						*$133,070*	
SONCC-ElkR.10.2.15									
	SONCC-ElkR.10.2.15.1	$0						$0	EPA
	Action Total:	*$0*						*$0*	
SONCC-ElkR.10.1.37									
	SONCC-ElkR.10.1.37.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-ElkR.2.2.52									
	SONCC-ElkR.2.2.52.1	$17,008						$17,008	ODFW
	SONCC-ElkR.2.2.52.2	$116,063						$116,063	ODFW
	Action Total:	*$133,071*						*$133,071*	
SONCC-ElkR.2.2.49									
	SONCC-ElkR.2.2.49.1	$17,008						$17,008	ODFW
	SONCC-ElkR.2.2.49.2	$116,063						$116,063	ODFW
	Action Total:	*$133,071*						*$133,071*	
SONCC-ElkR.2.7.1									
	SONCC-ElkR.2.7.1.1	$34,015						$34,015	USFS
	SONCC-ElkR.2.7.1.2	$627,912						$627,912	USFS
	Action Total:	*$661,927*						*$661,927*	
SONCC-ElkR.2.1.38									
	SONCC-ElkR.2.1.38.1	$34,015						$34,015	NRCS/RCD
	SONCC-ElkR.2.1.38.2	$170,075						$170,075	NRCS/RCD
	SONCC-ElkR.2.1.38.3	$170,075						$170,075	NRCS/RCD
	Action Total:	*$374,165*						*$374,165*	
SONCC-ElkR.2.2.29									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ElkR.2.2.29.1	$34,015						$34,015	ODFW
	SONCC-ElkR.2.2.29.2	$170,075	$170,075	$170,075	$170,075	$170,075	$170,075	$1,020,450	ODFW
	SONCC-ElkR.2.2.29.3	$20,000						$20,000	ODFW
	Action Total:	*$224,090*	*$170,075*	*$170,075*	*$170,075*	*$170,075*	*$170,075*	*$1,074,465*	
SONCC-ElkR.10.2.36									
	SONCC-ElkR.10.2.36.1	$76,136						$76,136	ODEQ
	SONCC-ElkR.10.2.36.2	$0						$0	ODEQ
	Action Total:	*$76,136*						*$76,136*	
SONCC-ElkR.10.2.40									
	SONCC-ElkR.10.2.40.1	$0						$0	County
	SONCC-ElkR.10.2.40.2	$0						$0	County
	SONCC-ElkR.10.2.40.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-ElkR.26.1.48									
	SONCC-ElkR.26.1.48.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-ElkR.2.2.45									
	SONCC-ElkR.2.2.45.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-ElkR.2.4.8									
	SONCC-ElkR.2.4.8.1	$34,015						$34,015	ODFW
	SONCC-ElkR.2.4.8.2	$335,000						$335,000	ODFW
	Action Total:	*$369,015*						*$369,015*	
SONCC-ElkR.10.4.50									
	SONCC-ElkR.10.4.50.1	$17,008						$17,008	OWRD
	SONCC-ElkR.10.4.50.2	$18,385						$18,385	OWRD
	Action Total:	*$35,393*						*$35,393*	
SONCC-ElkR.10.4.12									
	SONCC-ElkR.10.4.12.1	$17,008						$17,008	OWRD
	SONCC-ElkR.10.4.12.2	$18,385						$18,385	OWRD
	Action Total:	*$35,393*						*$35,393*	
SONCC-ElkR.10.4.13									
	SONCC-ElkR.10.4.13.1	$76,136						$76,136	ODEQ
	Action Total:	*$76,136*						*$76,136*	
SONCC-ElkR.2.7.30									
	SONCC-ElkR.2.7.30.1	$0						$0	BLM
	Action Total:	*$0*						*$0*	
SONCC-ElkR.2.7.2									
	SONCC-ElkR.2.7.2.1	$0						$0	County
	SONCC-ElkR.2.7.2.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-ElkR.2.2.28									
	SONCC-ElkR.2.2.28.1	$34,015						$34,015	ODFW
	SONCC-ElkR.2.2.28.2	$34,015						$34,015	ODFW
	SONCC-ElkR.2.2.28.3	$34,015						$34,015	ODFW
	Action Total:	*$102,045*						*$102,045*	
SONCC-ElkR.5.1.54									
	SONCC-ElkR.5.1.54.1	$22,270						$22,270	Watershed Cnsl

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ElkR.5.1.54.2	$218,023						$218,023	Watershed Cnsl
	Action Total:	*$240,293*						*$240,293*	
SONCC-ElkR.5.1.11									
	SONCC-ElkR.5.1.11.1	$22,270						$22,270	Watershed Cnsl
	SONCC-ElkR.5.1.11.2	$218,023						$218,023	Watershed Cnsl
	Action Total:	*$240,293*						*$240,293*	
SONCC-ElkR.7.1.39									
	SONCC-ElkR.7.1.39.1	$0						$0	County
	SONCC-ElkR.7.1.39.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-ElkR.8.1.55									
	SONCC-ElkR.8.1.55.1	$79,490						$79,490	USFS
	SONCC-ElkR.8.1.55.2	$219,329						$219,329	USFS
	SONCC-ElkR.8.1.55.3	$7,995						$7,995	USFS
	SONCC-ElkR.8.1.55.4	$222,177					$222,177	$444,354	USFS
	Action Total:	*$528,990*					*$222,177*	*$751,167*	
SONCC-ElkR.8.1.9									
	SONCC-ElkR.8.1.9.1	$79,490						$79,490	USFS
	SONCC-ElkR.8.1.9.2	$219,329						$219,329	USFS
	SONCC-ElkR.8.1.9.3	$7,995						$7,995	USFS
	SONCC-ElkR.8.1.9.4	$222,177					$222,177	$444,354	USFS
	Action Total:	*$528,990*					*$222,177*	*$751,167*	
SONCC-ElkR.10.2.35									
	SONCC-ElkR.10.2.35.1	$45,925						$45,925	ODFW
	SONCC-ElkR.10.2.35.2	$76,136						$76,136	ODFW
	Action Total:	*$122,061*						*$122,061*	
SONCC-ElkR.10.2.14									
	SONCC-ElkR.10.2.14.1	$76,136						$76,136	OWRD
	Action Total:	*$76,136*						*$76,136*	
SONCC-ElkR.16.1.16									
	SONCC-ElkR.16.1.16.1	$34,015						$34,015	NMFS
	SONCC-ElkR.16.1.16.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ElkR.16.1.17									
	SONCC-ElkR.16.1.17.1	$34,015						$34,015	NMFS
	SONCC-ElkR.16.1.17.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ElkR.16.2.18									
	SONCC-ElkR.16.2.18.1	$34,015						$34,015	NMFS
	SONCC-ElkR.16.2.18.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ElkR.16.2.19									
	SONCC-ElkR.16.2.19.1	$34,015						$34,015	NMFS
	SONCC-ElkR.16.2.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ElkR.1.4.7									
	SONCC-ElkR.1.4.7.1	$0						$0	County

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ElkR.1.4.7.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-ElkR.10.7.47									
	SONCC-ElkR.10.7.47.1	$17,008						$17,008	ODFW
	SONCC-ElkR.10.7.47.2	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$119,258*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$630,508*	
SONCC-ElkR.27.2.32									
	SONCC-ElkR.27.2.32.1	$130,792		$130,792		$130,792		$392,376	ODFW
	Action Total:	*$130,792*		*$130,792*		*$130,792*		*$392,376*	
SONCC-ElkR.27.2.34									
	SONCC-ElkR.27.2.34.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-ElkR.27.2.23									
	SONCC-ElkR.27.2.23.1	$136,060						$136,060	ODFW
	SONCC-ElkR.27.2.23.2		$81,800		$81,800		$81,800	$245,400	ODFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-ElkR.27.2.24									
	SONCC-ElkR.27.2.24.1	$130,792		$130,792		$130,792		$392,376	ODFW
	Action Total:	*$130,792*		*$130,792*		*$130,792*		*$392,376*	
SONCC-ElkR.27.2.25									
	SONCC-ElkR.27.2.25.1	$130,792		$130,792		$130,792		$392,376	ODFW
	Action Total:	*$130,792*		*$130,792*		*$130,792*		*$392,376*	
SONCC-ElkR.27.2.26									
	SONCC-ElkR.27.2.26.1	$130,792		$130,792		$130,792		$392,376	ODFW
	Action Total:	*$130,792*		*$130,792*		*$130,792*		*$392,376*	
SONCC-ElkR.27.2.27									
	SONCC-ElkR.27.2.27.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	ODFW
	Action Total:	*$65,911*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$264,786*	
SONCC-ElkR.27.2.46									
	SONCC-ElkR.27.2.46.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-ElkR.27.1.31									
	SONCC-ElkR.27.1.31.1	$31,320	$31,320	$31,320	$31,320	$31,320	$31,320	$187,920	ODFW
	Action Total:	*$31,320*	*$31,320*	*$31,320*	*$31,320*	*$31,320*	*$31,320*	*$187,920*	
SONCC-ElkR.27.1.33									
	SONCC-ElkR.27.1.33.1	$34,015						$34,015	NMFS
	SONCC-ElkR.27.1.33.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-ElkR.27.1.44									
	SONCC-ElkR.27.1.44.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	ODFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-ElkR.27.1.20									
	SONCC-ElkR.27.1.20.1	$93,960	$93,960	$93,960	$93,960	$93,960	$93,960	$563,760	ODFW
	Action Total:	*$93,960*	*$93,960*	*$93,960*	*$93,960*	*$93,960*	*$93,960*	*$563,760*	
SONCC-ElkR.27.1.21									
	SONCC-ElkR.27.1.21.1	$68,030		$68,030		$68,030		$204,090	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-ElkR.27.1.22									
	SONCC-ElkR.27.1.22.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-ElkR.27.4.42									
	SONCC-ElkR.27.4.42.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-ElkR.27.4.43									
	SONCC-ElkR.27.4.43.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$8,687,762***	***$1,930,763***	***$2,440,161***	***$1,930,763***	***$2,440,161***	***$2,375,117***	***$19,804,725***	

Population: Example

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-Exam.29.2.24									
	SONCC-Exam.29.2.24.1	$17,008						$17,008	NMFS
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.2.25									
	SONCC-Exam.29.2.25.1							$0	
	Action Total:							*$0*	
SONCC-Exam.29.2.17									
	SONCC-Exam.29.2.17.1	$17,008						$17,008	CDFW
	SONCC-Exam.29.2.17.2	$0						$0	CDFW
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.1.1									
	SONCC-Exam.29.1.1.1	$17,008						$17,008	CDFW
	SONCC-Exam.29.1.1.2	$17,008						$17,008	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-Exam.29.1.2									
	SONCC-Exam.29.1.2.1	$17,008						$17,008	NMFS
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.1.3									
	SONCC-Exam.29.1.3.1	$5,670						$5,670	NMFS
	SONCC-Exam.29.1.3.2	$5,670						$5,670	NMFS
	Action Total:	*$11,340*						*$11,340*	
SONCC-Exam.29.1.4									
	SONCC-Exam.29.1.4.1	$0						$0	CDFW
	SONCC-Exam.29.1.4.2	$17,008						$17,008	CDFW
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.1.5									
	SONCC-Exam.29.1.5.1	$17,008						$17,008	CDFW
	SONCC-Exam.29.1.5.2	$17,008						$17,008	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-Exam.29.1.6									
	SONCC-Exam.29.1.6.1	$17,008						$17,008	CDFW
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.1.7									
	SONCC-Exam.29.1.7.1	$5,670						$5,670	CDFW
	SONCC-Exam.29.1.7.2	$5,670						$5,670	CDFW
	SONCC-Exam.29.1.7.3	$34,015						$34,015	CDFW
	Action Total:	*$45,355*						*$45,355*	
SONCC-Exam.29.1.8									
	SONCC-Exam.29.1.8.1	$5,670						$5,670	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-Exam.29.1.8.2	$5,670						$5,670	CDFW
	SONCC-Exam.29.1.8.3	$5,670						$5,670	CDFW
	Action Total:	*$17,010*						*$17,010*	
SONCC-Exam.29.1.9									
	SONCC-Exam.29.1.9.1	$5,670						$5,670	CDFW
	SONCC-Exam.29.1.9.2	$5,670						$5,670	CDFW
	Action Total:	*$11,340*						*$11,340*	
SONCC-Exam.29.1.10									
	SONCC-Exam.29.1.10.1	$5,670						$5,670	CDFW
	SONCC-Exam.29.1.10.2	$5,670						$5,670	CDFW
	Action Total:	*$11,340*						*$11,340*	
SONCC-Exam.29.1.11									
	SONCC-Exam.29.1.11.1	$5,670						$5,670	CDFW
	SONCC-Exam.29.1.11.2	$5,670						$5,670	CDFW
	Action Total:	*$11,340*						*$11,340*	
SONCC-Exam.29.1.12									
	SONCC-Exam.29.1.12.1	$5,670						$5,670	ODFW
	SONCC-Exam.29.1.12.2	$5,670						$5,670	ODFW
	SONCC-Exam.29.1.12.3	$34,015						$34,015	ODFW
	Action Total:	*$45,355*						*$45,355*	
SONCC-Exam.29.1.13									
	SONCC-Exam.29.1.13.1	$5,670						$5,670	NMFS
	SONCC-Exam.29.1.13.2	$5,670						$5,670	NMFS
	SONCC-Exam.29.1.13.3	$5,670						$5,670	NMFS
	Action Total:	*$17,010*						*$17,010*	
SONCC-Exam.29.1.18									
	SONCC-Exam.29.1.18.1	$17,008						$17,008	CDFW
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.3.14									
	SONCC-Exam.29.3.14.1	$17,008						$17,008	NMFS
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.3.15									
	SONCC-Exam.29.3.15.1	$17,008						$17,008	NMFS
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.3.16									
	SONCC-Exam.29.3.16.1	$5,670						$5,670	CDFW
	Action Total:	*$5,670*						*$5,670*	
SONCC-Exam.29.3.19									
	SONCC-Exam.29.3.19.1	$17,008						$17,008	CDFW
	SONCC-Exam.29.3.19.2	$0						$0	CDFW
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.3.20									
	SONCC-Exam.29.3.20.1	$17,008						$17,008	CDFW
	SONCC-Exam.29.3.20.2	$0						$0	CDFW
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.3.21									
	SONCC-Exam.29.3.21.1	$17,008						$17,008	CDFW
	SONCC-Exam.29.3.21.2	$0						$0	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$17,008*						*$17,008*	
SONCC-Exam.29.3.22									
	SONCC-Exam.29.3.22.1	$17,008						$17,008	CDFW
	SONCC-Exam.29.3.22.2	$34,015						$34,015	CDFW
	Action Total:	*$51,023*						*$51,023*	
SONCC-Exam.29.3.23									
	SONCC-Exam.29.3.23.1	$17,008						$17,008	CDFW
	Action Total:	*$17,008*						*$17,008*	
	Population Total:	***$498,904***						***$498,904***	

Population: Guthrie Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-GutC.12.1.20									
	SONCC-GutC.12.1.20.1	$17,008						$17,008	NRCS/RCD
	SONCC-GutC.12.1.20.2	$17,053						$17,053	NRCS/RCD
	SONCC-GutC.12.1.20.3	$39,385						$39,385	NRCS/RCD
	Action Total:	*$73,445*						*$73,445*	
SONCC-GutC.12.1.1									
	SONCC-GutC.12.1.1.1	$17,008						$17,008	NRCS/RCD
	SONCC-GutC.12.1.1.2	$17,053						$17,053	NRCS/RCD
	SONCC-GutC.12.1.1.3	$39,385						$39,385	NRCS/RCD
	Action Total:	*$73,445*						*$73,445*	
SONCC-GutC.2.1.14									
	SONCC-GutC.2.1.14.1	$17,008						$17,008	NGO
	SONCC-GutC.2.1.14.2	$328,710						$328,710	NGO
	Action Total:	*$345,718*						*$345,718*	
SONCC-GutC.2.1.21									
	SONCC-GutC.2.1.21.1	$17,008						$17,008	NGO
	SONCC-GutC.2.1.21.2	$328,710						$328,710	NGO
	Action Total:	*$345,718*						*$345,718*	
SONCC-GutC.8.1.24									
	SONCC-GutC.8.1.24.1	$15,766						$15,766	NGO
	SONCC-GutC.8.1.24.2	$371,046						$371,046	NGO
	SONCC-GutC.8.1.24.3	$38,068						$38,068	NGO
	Action Total:	*$424,880*						*$424,880*	
SONCC-GutC.8.1.3									
	SONCC-GutC.8.1.3.1	$15,766						$15,766	NGO
	SONCC-GutC.8.1.3.2	$371,046						$371,046	NGO
	SONCC-GutC.8.1.3.3	$38,068						$38,068	NGO
	Action Total:	*$424,880*						*$424,880*	
SONCC-GutC.7.1.11									
	SONCC-GutC.7.1.11.1	$0						$0	CDF
	Action Total:	*$0*						*$0*	
SONCC-GutC.2.2.13									
	SONCC-GutC.2.2.13.1	$17,008						$17,008	NGO
	SONCC-GutC.2.2.13.2	$61,355						$61,355	NGO
	Action Total:	*$78,363*						*$78,363*	
SONCC-GutC.2.2.22									
	SONCC-GutC.2.2.22.1	$17,008						$17,008	NGO

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-GutC.2.2.22.2	$61,355						$61,355	NGO
	Action Total:	*$78,363*						*$78,363*	
SONCC-GutC.8.1.10									
	SONCC-GutC.8.1.10.1	$36,719						$36,719	NGO
	SONCC-GutC.8.1.10.2	$977,011						$977,011	NGO
	SONCC-GutC.8.1.10.3	$37,113						$37,113	NGO
	SONCC-GutC.8.1.10.4	$48,975				$48,975		$97,949	NGO
	Action Total:	*$1,099,817*				*$48,975*		*$1,148,792*	
SONCC-GutC.8.1.23									
	SONCC-GutC.8.1.23.1	$36,719						$36,719	NGO
	SONCC-GutC.8.1.23.2	$977,011						$977,011	NGO
	SONCC-GutC.8.1.23.3	$37,113						$37,113	NGO
	SONCC-GutC.8.1.23.4	$48,975				$48,975		$97,949	NGO
	Action Total:	*$1,099,817*				*$48,975*		*$1,148,792*	
SONCC-GutC.8.1.25									
	SONCC-GutC.8.1.25.1	$37,720						$37,720	NGO
	SONCC-GutC.8.1.25.2	$79,625						$79,625	NGO
	Action Total:	*$117,345*						*$117,345*	
SONCC-GutC.8.1.4									
	SONCC-GutC.8.1.4.1	$37,720						$37,720	NGO
	SONCC-GutC.8.1.4.2	$79,625						$79,625	NGO
	Action Total:	*$117,345*						*$117,345*	
SONCC-GutC.10.7.19									
	SONCC-GutC.10.7.19.1	$8,504						$8,504	CDFW
	SONCC-GutC.10.7.19.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-GutC.10.7.18									
	SONCC-GutC.10.7.18.1	$8,504						$8,504	CDFW
	SONCC-GutC.10.7.18.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-GutC.7.1.2									
	SONCC-GutC.7.1.2.1	$348,840						$348,840	NRCS/RCD
	Action Total:	*$348,840*						*$348,840*	
SONCC-GutC.27.2.7									
	SONCC-GutC.27.2.7.1	$6,684		$6,684		$6,684		$20,052	CDFW
	Action Total:	*$6,684*		*$6,684*		*$6,684*		*$20,052*	
SONCC-GutC.27.2.5									
	SONCC-GutC.27.2.5.1	$136,060						$136,060	CDFW
	SONCC-GutC.27.2.5.2			$81,800			$81,800	$163,600	CDFW
	Action Total:	*$136,060*		*$81,800*			*$81,800*	*$299,660*	
SONCC-GutC.27.2.17									
	SONCC-GutC.27.2.17.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-GutC.27.1.6									
	SONCC-GutC.27.1.6.1	$7,080	$7,080	$7,080	$7,080	$7,080	$7,080	$42,480	CDFW
	Action Total:	*$7,080*	*$7,080*	*$7,080*	*$7,080*	*$7,080*	*$7,080*	*$42,480*	
SONCC-GutC.27.1.8									
	SONCC-GutC.27.1.8.1	$34,015						$34,015	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-GutC.27.1.8.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-GutC.27.1.16									
	SONCC-GutC.27.1.16.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-GutC.27.4.15									
	SONCC-GutC.27.4.15.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
	Population Total:	***$5,118,151***	***$296,413***	***$384,896***	***$296,413***	***$401,046***	***$378,213***	***$6,875,130***	

Population: Humboldt Bay Tributaries

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-HBT.1.1.5									
	SONCC-HBT.1.1.5.1	$44,540						$44,540	CDFW
	SONCC-HBT.1.1.5.2	$137,521						$137,521	CDFW
	Action Total:	*$182,061*						*$182,061*	
SONCC-HBT.1.2.40									
	SONCC-HBT.1.2.40.1	$34,015						$34,015	CDFW
	SONCC-HBT.1.2.40.2	$34,015						$34,015	CDFW
	SONCC-HBT.1.2.40.3	$682,150						$682,150	CDFW
	Action Total:	*$750,180*						*$750,180*	
SONCC-HBT.1.2.45									
	SONCC-HBT.1.2.45.1	$0						$0	NGO
	Action Total:	*$0*						*$0*	
SONCC-HBT.1.2.62									
	SONCC-HBT.1.2.62.1	$0						$0	NGO
	Action Total:	*$0*						*$0*	
SONCC-HBT.2.1.1									
	SONCC-HBT.2.1.1.1	$17,008						$17,008	CDFW
	SONCC-HBT.2.1.1.2	$5,012,828						$5,012,828	CDFW
	Action Total:	*$5,029,835*						*$5,029,835*	
SONCC-HBT.1.3.4									
	SONCC-HBT.1.3.4.2	$600,570						$600,570	CDFW
	Action Total:	*$600,570*						*$600,570*	
SONCC-HBT.2.2.2									
	SONCC-HBT.2.2.2.1	$17,008						$17,008	CDFW
	SONCC-HBT.2.2.2.2	$935,661						$935,661	CDFW
	Action Total:	*$952,668*						*$952,668*	
SONCC-HBT.3.1.66									
	SONCC-HBT.3.1.66.1	$36,770						$36,770	CDFW
	SONCC-HBT.3.1.66.2	$0						$0	CDFW
	Action Total:	*$36,770*						*$36,770*	
SONCC-HBT.3.1.21									
	SONCC-HBT.3.1.21.1	$36,770						$36,770	CDFW
	SONCC-HBT.3.1.21.2	$0						$0	CDFW
	Action Total:	*$36,770*						*$36,770*	
SONCC-HBT.7.1.46									
	SONCC-HBT.7.1.46.1	$68,030						$68,030	NGO
	SONCC-HBT.7.1.46.2	$174,420						$174,420	NGO
	Action Total:	*$242,450*						*$242,450*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-HBT.26.1.56									
	SONCC-HBT.26.1.56.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-HBT.8.1.68									
	SONCC-HBT.8.1.68.1	$17,008						$17,008	NRCS/RCD
	SONCC-HBT.8.1.68.2	$85,038						$85,038	NRCS/RCD
	SONCC-HBT.8.1.68.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-HBT.8.1.11									
	SONCC-HBT.8.1.11.1	$17,008						$17,008	NRCS/RCD
	SONCC-HBT.8.1.11.2	$85,038						$85,038	NRCS/RCD
	SONCC-HBT.8.1.11.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-HBT.8.1.12									
	SONCC-HBT.8.1.12.1	$59,788						$59,788	CDFW
	SONCC-HBT.8.1.12.2	$441,620						$441,620	CDFW
	Action Total:	*$501,408*						*$501,408*	
SONCC-HBT.1.1.57									
	SONCC-HBT.1.1.57.1	$44,540						$44,540	CDFW
	SONCC-HBT.1.1.57.2	$137,521						$137,521	CDFW
	Action Total:	*$182,061*						*$182,061*	
SONCC-HBT.2.1.59									
	SONCC-HBT.2.1.59.1	$17,008						$17,008	CDFW
	SONCC-HBT.2.1.59.2	$5,012,828						$5,012,828	CDFW
	Action Total:	*$5,029,835*						*$5,029,835*	
SONCC-HBT.1.3.58									
	SONCC-HBT.1.3.58.2	$600,570						$600,570	CDFW
	Action Total:	*$600,570*						*$600,570*	
SONCC-HBT.2.2.60									
	SONCC-HBT.2.2.60.1	$17,008						$17,008	CDFW
	SONCC-HBT.2.2.60.2	$935,661						$935,661	CDFW
	Action Total:	*$952,668*						*$952,668*	
SONCC-HBT.8.1.61									
	SONCC-HBT.8.1.61.1	$59,788						$59,788	CDFW
	SONCC-HBT.8.1.61.2	$441,620						$441,620	CDFW
	Action Total:	*$501,408*						*$501,408*	
SONCC-HBT.2.2.65									
	SONCC-HBT.2.2.65.1	$17,008						$17,008	City
	SONCC-HBT.2.2.65.2	$2,340,175						$2,340,175	City
	Action Total:	*$2,357,183*						*$2,357,183*	
SONCC-HBT.2.2.3									
	SONCC-HBT.2.2.3.1	$17,008						$17,008	City
	SONCC-HBT.2.2.3.2	$2,340,175						$2,340,175	City
	Action Total:	*$2,357,183*						*$2,357,183*	
SONCC-HBT.5.1.43									
	SONCC-HBT.5.1.43.1	$114,807						$114,807	NGO
	Action Total:	*$114,807*						*$114,807*	
SONCC-HBT.5.1.67									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-HBT.5.1.67.1	$114,807						$114,807	NGO
	Action Total:	*$114,807*						*$114,807*	
SONCC-HBT.5.1.10									
	SONCC-HBT.5.1.10.1	$34,015						$34,015	CDFW
	SONCC-HBT.5.1.10.2	$1,308,135						$1,308,135	CDFW
	Action Total:	*$1,342,150*						*$1,342,150*	
SONCC-HBT.8.1.69									
	SONCC-HBT.8.1.69.1	$821,125						$821,125	NGO
	SONCC-HBT.8.1.69.2	$17,441,354						$17,441,354	NGO
	SONCC-HBT.8.1.69.3	$712,845						$712,845	NGO
	SONCC-HBT.8.1.69.4	$376,268	$376,268	$376,268	$376,268	$376,268	$376,268	$2,257,605	NGO
	Action Total:	*$19,351,591*	*$376,268*	*$376,268*	*$376,268*	*$376,268*	*$376,268*	*$21,232,929*	
SONCC-HBT.8.1.70									
	SONCC-HBT.8.1.70.1	$59,788						$59,788	CDFW
	SONCC-HBT.8.1.70.2	$441,620						$441,620	CDFW
	Action Total:	*$501,408*						*$501,408*	
SONCC-HBT.8.1.13									
	SONCC-HBT.8.1.13.1	$821,125						$821,125	NGO
	SONCC-HBT.8.1.13.2	$17,441,354						$17,441,354	NGO
	SONCC-HBT.8.1.13.3	$712,845						$712,845	NGO
	SONCC-HBT.8.1.13.4	$376,268	$376,268	$376,268	$376,268	$376,268	$376,268	$2,257,605	NGO
	Action Total:	*$19,351,591*	*$376,268*	*$376,268*	*$376,268*	*$376,268*	*$376,268*	*$21,232,929*	
SONCC-HBT.8.1.55									
	SONCC-HBT.8.1.55.1	$59,788						$59,788	CDFW
	SONCC-HBT.8.1.55.2	$441,620						$441,620	CDFW
	Action Total:	*$501,408*						*$501,408*	
SONCC-HBT.10.2.63									
	SONCC-HBT.10.2.63.1	$17,008						$17,008	County
	SONCC-HBT.10.2.63.2	$17,008						$17,008	County
	Action Total:	*$34,015*						*$34,015*	
SONCC-HBT.10.2.16									
	SONCC-HBT.10.2.16.1	$17,008						$17,008	County
	SONCC-HBT.10.2.16.2	$17,008						$17,008	County
	Action Total:	*$34,015*						*$34,015*	
SONCC-HBT.10.7.64									
	SONCC-HBT.10.7.64.1	$8,504						$8,504	CDFW
	SONCC-HBT.10.7.64.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-HBT.10.7.54									
	SONCC-HBT.10.7.54.1	$8,504						$8,504	CDFW
	SONCC-HBT.10.7.54.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-HBT.3.1.47									
	SONCC-HBT.3.1.47.1	$73,540						$73,540	CDFW
	SONCC-HBT.3.1.47.2	$36,770						$36,770	CDFW
	SONCC-HBT.3.1.47.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-HBT.7.1.7									
	SONCC-HBT.7.1.7.1	$8,503						$8,503	County
	SONCC-HBT.7.1.7.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-HBT.7.1.8									
	SONCC-HBT.7.1.8.1	$34,015						$34,015	CDFW
	SONCC-HBT.7.1.8.2	$701,842						$701,842	CDFW
	SONCC-HBT.7.1.8.3	$5,107,018						$5,107,018	CDFW
	Action Total:	*$5,842,874*						*$5,842,874*	
SONCC-HBT.7.1.9									
	SONCC-HBT.7.1.9.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-HBT.3.2.22									
	SONCC-HBT.3.2.22.1	$34,015						$34,015	County
	SONCC-HBT.3.2.22.2	$0						$0	County
	Action Total:	*$34,015*						*$34,015*	
SONCC-HBT.16.1.24									
	SONCC-HBT.16.1.24.1	$34,015						$34,015	NMFS
	SONCC-HBT.16.1.24.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-HBT.16.1.25									
	SONCC-HBT.16.1.25.1	$34,015						$34,015	NMFS
	SONCC-HBT.16.1.25.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-HBT.16.2.26									
	SONCC-HBT.16.2.26.1	$34,015						$34,015	NMFS
	SONCC-HBT.16.2.26.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-HBT.16.2.27									
	SONCC-HBT.16.2.27.1	$34,015						$34,015	NMFS
	SONCC-HBT.16.2.27.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-HBT.8.1.14									
	SONCC-HBT.8.1.14.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-HBT.10.2.18									
	SONCC-HBT.10.2.18.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
SONCC-HBT.27.2.42									
	SONCC-HBT.27.2.42.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-HBT.27.2.48									
	SONCC-HBT.27.2.48.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-HBT.27.2.28									
	SONCC-HBT.27.2.28.1	$34,015						$34,015	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-HBT.27.2.29									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-HBT.27.2.29.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-HBT.27.2.34									
	SONCC-HBT.27.2.34.1	$136,060						$136,060	CDFW
	SONCC-HBT.27.2.34.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-HBT.27.2.35									
	SONCC-HBT.27.2.35.1	$1,214,888		$1,214,888		$1,214,888		$3,644,664	CDFW
	Action Total:	*$1,214,888*		*$1,214,888*		*$1,214,888*		*$3,644,664*	
SONCC-HBT.27.2.36									
	SONCC-HBT.27.2.36.1	$1,214,888		$1,214,888		$1,214,888		$3,644,664	CDFW
	Action Total:	*$1,214,888*		*$1,214,888*		*$1,214,888*		*$3,644,664*	
SONCC-HBT.27.2.37									
	SONCC-HBT.27.2.37.1	$1,214,888		$1,214,888		$1,214,888		$3,644,664	CDFW
	Action Total:	*$1,214,888*		*$1,214,888*		*$1,214,888*		*$3,644,664*	
SONCC-HBT.27.2.38									
	SONCC-HBT.27.2.38.1	$1,214,888		$1,214,888		$1,214,888		$3,644,664	CDFW
	Action Total:	*$1,214,888*		*$1,214,888*		*$1,214,888*		*$3,644,664*	
SONCC-HBT.27.2.39									
	SONCC-HBT.27.2.39.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-HBT.27.2.53									
	SONCC-HBT.27.2.53.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-HBT.27.1.41									
	SONCC-HBT.27.1.41.1	$34,015						$34,015	NMFS
	SONCC-HBT.27.1.41.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-HBT.27.1.52									
	SONCC-HBT.27.1.52.1	$95,455	$95,455	$95,455	$95,455	$95,455	$95,455	$572,730	CDFW
	Action Total:	*$95,455*	*$95,455*	*$95,455*	*$95,455*	*$95,455*	*$95,455*	*$572,730*	
SONCC-HBT.27.1.30									
	SONCC-HBT.27.1.30.1	$286,365	$286,365	$286,365	$286,365	$286,365	$286,365	$1,718,190	CDFW
	Action Total:	*$286,365*	*$286,365*	*$286,365*	*$286,365*	*$286,365*	*$286,365*	*$1,718,190*	
SONCC-HBT.27.1.31									
	SONCC-HBT.27.1.31.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-HBT.27.1.32									
	SONCC-HBT.27.1.32.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-HBT.27.1.33									
	SONCC-HBT.27.1.33.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-HBT.27.4.49									
	SONCC-HBT.27.4.49.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-HBT.27.4.50									
	SONCC-HBT.27.4.50.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-HBT.27.4.51									
	SONCC-HBT.27.4.51.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-HBT.3.1.19									
	SONCC-HBT.3.1.19.1							$0	CDFW
	Action Total:							*$0*	
SONCC-HBT.7.1.6									
	SONCC-HBT.7.1.6.1							$0	NGO
	Action Total:							*$0*	
SONCC-HBT.3.2.23									
	SONCC-HBT.3.2.23.2							$0	County
	Action Total:							*$0*	
	Population Total:	***$75,750,145***	***$2,746,790***	***$7,660,602***	***$2,746,790***	***$7,660,602***	***$2,746,790***	***$99,311,718***	

Population: Hunter Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-HunC.2.4.15									
	SONCC-HunC.2.4.15.1	$157,110						$157,110	ODOT
	SONCC-HunC.2.4.15.2	$103,093						$103,093	ODOT
	Action Total:	*$260,203*						*$260,203*	
SONCC-HunC.2.4.17									
	SONCC-HunC.2.4.17.1	$34,015						$34,015	ODFW
	SONCC-HunC.2.4.17.2	$335,000						$335,000	ODFW
	Action Total:	*$369,015*						*$369,015*	
SONCC-HunC.19.1.4									
	SONCC-HunC.19.1.4.1	$68,030						$68,030	ODF
	SONCC-HunC.19.1.4.2	$0						$0	ODF
	SONCC-HunC.19.1.4.3	$0						$0	ODF
	SONCC-HunC.19.1.4.4	$0						$0	ODF
	SONCC-HunC.19.1.4.5	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	
SONCC-HunC.7.1.1									
	SONCC-HunC.7.1.1.1	$0						$0	County
	SONCC-HunC.7.1.1.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-HunC.2.1.13									
	SONCC-HunC.2.1.13.1	$17,008						$17,008	ODFW
	SONCC-HunC.2.1.13.2	$78,069						$78,069	ODFW
	Action Total:	*$95,076*						*$95,076*	
SONCC-HunC.2.1.42									
	SONCC-HunC.2.1.42.1	$17,008						$17,008	ODFW
	SONCC-HunC.2.1.42.2	$78,069						$78,069	ODFW
	Action Total:	*$95,076*						*$95,076*	
SONCC-HunC.2.2.10									
	SONCC-HunC.2.2.10.1	$17,008						$17,008	ODFW
	SONCC-HunC.2.2.10.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-HunC.2.2.10.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-HunC.2.2.11									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-HunC.2.2.11.1	$17,008						$17,008	Watershed Cnsl
	SONCC-HunC.2.2.11.2	$51,129						$51,129	Watershed Cnsl
	Action Total:	*$68,137*						*$68,137*	
SONCC-HunC.2.2.16									
	SONCC-HunC.2.2.16.1	$89,080						$89,080	Watershed Cnsl
	SONCC-HunC.2.2.16.2	$95,100						$95,100	Watershed Cnsl
	Action Total:	*$184,180*						*$184,180*	
SONCC-HunC.2.2.43									
	SONCC-HunC.2.2.43.1	$17,008						$17,008	ODFW
	SONCC-HunC.2.2.43.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-HunC.2.2.43.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-HunC.2.2.44									
	SONCC-HunC.2.2.44.1	$17,008						$17,008	Watershed Cnsl
	SONCC-HunC.2.2.44.2	$51,129						$51,129	Watershed Cnsl
	Action Total:	*$68,137*						*$68,137*	
SONCC-HunC.28.2.27									
	SONCC-HunC.28.2.27.1	$0						$0	County
	SONCC-HunC.28.2.27.2	$0						$0	County
	SONCC-HunC.28.2.27.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-HunC.28.1.12									
	SONCC-HunC.28.1.12.1	$57,701						$57,701	NGO
	SONCC-HunC.28.1.12.2	$1,096,645						$1,096,645	NGO
	SONCC-HunC.28.1.12.3	$64,681						$64,681	NGO
	SONCC-HunC.28.1.12.4	$106,311						$106,311	NGO
	Action Total:	*$1,325,337*						*$1,325,337*	
SONCC-HunC.28.1.46									
	SONCC-HunC.28.1.46.1	$57,701						$57,701	NGO
	SONCC-HunC.28.1.46.2	$1,096,645						$1,096,645	NGO
	SONCC-HunC.28.1.46.3	$64,681						$64,681	NGO
	SONCC-HunC.28.1.46.4	$106,311						$106,311	NGO
	Action Total:	*$1,325,337*						*$1,325,337*	
SONCC-HunC.12.1.28									
	SONCC-HunC.12.1.28.1	$0						$0	ODA
	SONCC-HunC.12.1.28.2	$0						$0	ODA
	SONCC-HunC.12.1.28.3	$0						$0	ODA
	SONCC-HunC.12.1.28.4	$0						$0	ODA
	SONCC-HunC.12.1.28.5	$0						$0	ODA
	Action Total:	*$0*						*$0*	
SONCC-HunC.2.2.38									
	SONCC-HunC.2.2.38.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-HunC.10.2.8									
	SONCC-HunC.10.2.8.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
SONCC-HunC.7.1.26									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-HunC.7.1.26.1	$0						$0	County
	SONCC-HunC.7.1.26.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-HunC.22.2.25									
	SONCC-HunC.22.2.25.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-HunC.22.2.45									
	SONCC-HunC.22.2.45.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-HunC.7.1.2									
	SONCC-HunC.7.1.2.1	$34,015						$34,015	USFS
	SONCC-HunC.7.1.2.2	$83,722						$83,722	USFS
	Action Total:	*$117,737*						*$117,737*	
SONCC-HunC.10.7.41									
	SONCC-HunC.10.7.41.1	$8,504						$8,504	ODFW
	SONCC-HunC.10.7.41.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-HunC.10.7.40									
	SONCC-HunC.10.7.40.1	$8,504						$8,504	ODFW
	SONCC-HunC.10.7.40.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-HunC.7.1.3									
	SONCC-HunC.7.1.3.1	$760,373						$760,373	USFS
	SONCC-HunC.7.1.3.2	$76,136						$76,136	USFS
	Action Total:	*$836,509*						*$836,509*	
SONCC-HunC.10.2.14									
	SONCC-HunC.10.2.14.1	$76,136						$76,136	ODOT
	Action Total:	*$76,136*						*$76,136*	
SONCC-HunC.10.2.23									
	SONCC-HunC.10.2.23.1	$45,925						$45,925	ODFW
	SONCC-HunC.10.2.23.2	$76,136						$76,136	ODFW
	Action Total:	*$122,061*						*$122,061*	
SONCC-HunC.10.2.24									
	SONCC-HunC.10.2.24.1	$0						$0	ODEQ
	SONCC-HunC.10.2.24.2	$0						$0	ODEQ
	Action Total:	*$0*						*$0*	
SONCC-HunC.27.2.19									
	SONCC-HunC.27.2.19.1	$7,136		$7,136		$7,136		$21,408	ODFW
	Action Total:	*$7,136*		*$7,136*		*$7,136*		*$21,408*	
SONCC-HunC.27.2.20									
	SONCC-HunC.27.2.20.1	$7,136		$7,136		$7,136		$21,408	ODFW
	Action Total:	*$7,136*		*$7,136*		*$7,136*		*$21,408*	
SONCC-HunC.27.2.22									
	SONCC-HunC.27.2.22.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-HunC.27.2.33									
	SONCC-HunC.27.2.33.1	$7,136		$7,136		$7,136		$21,408	ODFW
	Action Total:	*$7,136*		*$7,136*		*$7,136*		*$21,408*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-HunC.27.2.34									
	SONCC-HunC.27.2.34.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-HunC.27.2.35									
	SONCC-HunC.27.2.35.1	$7,136		$7,136		$7,136		$21,408	ODFW
	Action Total:	*$7,136*		*$7,136*		*$7,136*		*$21,408*	
SONCC-HunC.27.2.36									
	SONCC-HunC.27.2.36.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-HunC.27.2.37									
	SONCC-HunC.27.2.37.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-HunC.27.2.39									
	SONCC-HunC.27.2.39.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-HunC.27.2.9									
	SONCC-HunC.27.2.9.1	$136,060						$136,060	ODFW
	SONCC-HunC.27.2.9.2			$81,800			$81,800	$163,600	ODFW
	Action Total:	*$136,060*		*$81,800*			*$81,800*	*$299,660*	
SONCC-HunC.27.1.18									
	SONCC-HunC.27.1.18.1	$7,316	$7,316	$7,316	$7,316	$7,316	$7,316	$43,896	ODFW
	Action Total:	*$7,316*	*$7,316*	*$7,316*	*$7,316*	*$7,316*	*$7,316*	*$43,896*	
SONCC-HunC.27.1.21									
	SONCC-HunC.27.1.21.1	$34,015						$34,015	NMFS
	SONCC-HunC.27.1.21.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-HunC.27.1.32									
	SONCC-HunC.27.1.32.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-HunC.27.4.29									
	SONCC-HunC.27.4.29.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-HunC.27.4.30									
	SONCC-HunC.27.4.30.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-HunC.27.4.31									
	SONCC-HunC.27.4.31.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-HunC.3.1.5									
	SONCC-HunC.3.1.5.1							$0	City
	Action Total:							*$0*	
SONCC-HunC.3.1.6									
	SONCC-HunC.3.1.6.1							$0	OWRD
	Action Total:							*$0*	
	Population Total:	***$6,223,955***	***$705,239***	***$849,598***	***$705,239***	***$767,798***	***$787,039***	***$10,038,866***	

Population: Illinois River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-IllR.7.3.52									
	SONCC-IllR.7.3.52.1	$0						$0	ODA

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-IIIR.7.3.52.2	$0						$0	ODA
	SONCC-IIIR.7.3.52.3	$0						$0	ODA
	SONCC-IIIR.7.3.52.4	$0						$0	ODA
	SONCC-IIIR.7.3.52.5	$0						$0	ODA
	SONCC-IIIR.7.3.52.6	$0						$0	ODA
	Action Total:	*$0*						*$0*	
SONCC-IIIR.7.2.53									
	SONCC-IIIR.7.2.53.1	$68,030						$68,030	ODF
	SONCC-IIIR.7.2.53.2	$0						$0	ODF
	SONCC-IIIR.7.2.53.3	$0						$0	ODF
	SONCC-IIIR.7.2.53.4	$0						$0	ODF
	SONCC-IIIR.7.2.53.5	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	
SONCC-IIIR.3.1.46									
	SONCC-IIIR.3.1.46.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-IIIR.3.1.77									
	SONCC-IIIR.3.1.77.1	$18,385						$18,385	OWRD
	SONCC-IIIR.3.1.77.2	$36,770						$36,770	OWRD
	Action Total:	*$55,155*						*$55,155*	
SONCC-IIIR.3.1.78									
	SONCC-IIIR.3.1.78.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-IIIR.3.1.79									
	SONCC-IIIR.3.1.79.1	$18,385						$18,385	OWRD
	Action Total:	*$18,385*						*$18,385*	
SONCC-IIIR.3.1.4									
	SONCC-IIIR.3.1.4.1	$18,385						$18,385	OWRD
	SONCC-IIIR.3.1.4.2	$36,770						$36,770	OWRD
	Action Total:	*$55,155*						*$55,155*	
SONCC-IIIR.3.1.5									
	SONCC-IIIR.3.1.5.1	$18,385						$18,385	OWRD
	Action Total:	*$18,385*						*$18,385*	
SONCC-IIIR.2.1.34									
	SONCC-IIIR.2.1.34.1	$17,008						$17,008	ODFW
	SONCC-IIIR.2.1.34.2	$11,826,712						$11,826,712	ODFW
	Action Total:	*$11,843,720*						*$11,843,720*	
SONCC-IIIR.2.1.71									
	SONCC-IIIR.2.1.71.1	$17,008						$17,008	ODFW
	SONCC-IIIR.2.1.71.2	$11,826,712						$11,826,712	ODFW
	Action Total:	*$11,843,720*						*$11,843,720*	
SONCC-IIIR.2.1.72									
	SONCC-IIIR.2.1.72.1	$17,008						$17,008	BLM
	Action Total:	*$17,008*						*$17,008*	
SONCC-IIIR.2.1.9									
	SONCC-IIIR.2.1.9.1	$17,008						$17,008	BLM
	Action Total:	*$17,008*						*$17,008*	
SONCC-IIIR.2.2.74									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-IIIR.2.2.74.1	$17,008						$17,008	NGO
	SONCC-IIIR.2.2.74.2	$2,198,547						$2,198,547	NGO
	Action Total:	*$2,215,555*						*$2,215,555*	
SONCC-IIIR.2.2.75									
	SONCC-IIIR.2.2.75.1	$17,008						$17,008	ODFW
	SONCC-IIIR.2.2.75.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-IIIR.2.2.75.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-IIIR.2.2.64									
	SONCC-IIIR.2.2.64.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-IIIR.2.2.7									
	SONCC-IIIR.2.2.7.1	$17,008						$17,008	NGO
	SONCC-IIIR.2.2.7.2	$2,198,547						$2,198,547	NGO
	Action Total:	*$2,215,555*						*$2,215,555*	
SONCC-IIIR.2.2.8									
	SONCC-IIIR.2.2.8.1	$17,008						$17,008	ODFW
	SONCC-IIIR.2.2.8.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-IIIR.2.2.8.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-IIIR.28.1.76									
	SONCC-IIIR.28.1.76.1	$1,090,257						$1,090,257	NGO
	SONCC-IIIR.28.1.76.2	$14,435,836						$14,435,836	NGO
	SONCC-IIIR.28.1.76.3	$1,437,512						$1,437,512	NGO
	SONCC-IIIR.28.1.76.4	$2,363,916					$2,363,916	$4,727,831	NGO
	Action Total:	*$19,327,520*					*$2,363,916*	*$21,691,436*	
SONCC-IIIR.28.1.1									
	SONCC-IIIR.28.1.1.1	$1,090,257						$1,090,257	NGO
	SONCC-IIIR.28.1.1.2	$14,435,836						$14,435,836	NGO
	SONCC-IIIR.28.1.1.3	$1,437,512						$1,437,512	NGO
	SONCC-IIIR.28.1.1.4	$2,363,916					$2,363,916	$4,727,831	NGO
	Action Total:	*$19,327,520*					*$2,363,916*	*$21,691,436*	
SONCC-IIIR.3.1.80									
	SONCC-IIIR.3.1.80.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	OWRD
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-IIIR.3.1.81									
	SONCC-IIIR.3.1.81.1	$18,385						$18,385	OWRD
	SONCC-IIIR.3.1.81.2	$36,770						$36,770	OWRD
	Action Total:	*$55,155*						*$55,155*	
SONCC-IIIR.3.1.67									
	SONCC-IIIR.3.1.67.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	OWRD
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-IIIR.3.1.69									
	SONCC-IIIR.3.1.69.1	$18,385						$18,385	OWRD
	SONCC-IIIR.3.1.69.2	$36,770						$36,770	OWRD
	Action Total:	*$55,155*						*$55,155*	
SONCC-IIIR.3.1.6									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-IIIR.3.1.6.1	$0						$0	NGO
	Action Total:	*$0*						*$0*	
SONCC-IIIR.28.2.50									
	SONCC-IIIR.28.2.50.1	$0						$0	County
	SONCC-IIIR.28.2.50.2	$0						$0	County
	SONCC-IIIR.28.2.50.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-IIIR.28.1.2									
	SONCC-IIIR.28.1.2.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-IIIR.2.3.43									
	SONCC-IIIR.2.3.43.1	$76,136						$76,136	ODFW
	SONCC-IIIR.2.3.43.2	$0						$0	ODFW
	Action Total:	*$76,136*						*$76,136*	
SONCC-IIIR.7.1.47									
	SONCC-IIIR.7.1.47.1	$17,008						$17,008	NRCS/RCD
	SONCC-IIIR.7.1.47.2	$17,008						$17,008	NRCS/RCD
	SONCC-IIIR.7.1.47.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$119,053*						*$119,053*	
SONCC-IIIR.7.1.83									
	SONCC-IIIR.7.1.83.1	$17,008						$17,008	NRCS/RCD
	SONCC-IIIR.7.1.83.2	$17,008						$17,008	NRCS/RCD
	SONCC-IIIR.7.1.83.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$119,053*						*$119,053*	
SONCC-IIIR.26.1.68									
	SONCC-IIIR.26.1.68.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-IIIR.7.1.48									
	SONCC-IIIR.7.1.48.1	$170,075						$170,075	USFS
	Action Total:	*$170,075*						*$170,075*	
SONCC-IIIR.7.1.11									
	SONCC-IIIR.7.1.11.1	$34,015						$34,015	USFS
	SONCC-IIIR.7.1.11.3	$12,000,096						$12,000,096	USFS
	Action Total:	*$12,034,111*						*$12,034,111*	
SONCC-IIIR.2.2.51									
	SONCC-IIIR.2.2.51.1	$17,008						$17,008	NRCS/RCD
	SONCC-IIIR.2.2.51.2	$170,036						$170,036	NRCS/RCD
	SONCC-IIIR.2.2.51.3	$988,370						$988,370	NRCS/RCD
	Action Total:	*$1,175,414*						*$1,175,414*	
SONCC-IIIR.2.2.73									
	SONCC-IIIR.2.2.73.1	$17,008						$17,008	NRCS/RCD
	SONCC-IIIR.2.2.73.2	$170,036						$170,036	NRCS/RCD
	SONCC-IIIR.2.2.73.3	$988,370						$988,370	NRCS/RCD
	Action Total:	*$1,175,414*						*$1,175,414*	
SONCC-IIIR.5.1.36									
	SONCC-IIIR.5.1.36.1	$34,015						$34,015	BLM
	SONCC-IIIR.5.1.36.2	$1,526,158						$1,526,158	BLM
	Action Total:	*$1,560,173*						*$1,560,173*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-IIIR.5.1.82									
	SONCC-IIIR.5.1.82.1	$17,008						$17,008	County
	SONCC-IIIR.5.1.82.2	$763,079						$763,079	County
	Action Total:	*$780,087*						*$780,087*	
SONCC-IIIR.5.1.16									
	SONCC-IIIR.5.1.16.1	$17,008						$17,008	County
	SONCC-IIIR.5.1.16.2	$763,079						$763,079	County
	Action Total:	*$780,087*						*$780,087*	
SONCC-IIIR.10.7.70									
	SONCC-IIIR.10.7.70.1	$8,504						$8,504	ODFW
	SONCC-IIIR.10.7.70.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-IIIR.10.7.66									
	SONCC-IIIR.10.7.66.1	$8,504						$8,504	ODFW
	SONCC-IIIR.10.7.66.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-IIIR.1.2.35									
	SONCC-IIIR.1.2.35.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-IIIR.7.1.33									
	SONCC-IIIR.7.1.33.1	$0						$0	BLM
	Action Total:	*$0*						*$0*	
SONCC-IIIR.7.1.49									
	SONCC-IIIR.7.1.49.1	$0						$0	County
	SONCC-IIIR.7.1.49.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-IIIR.7.1.10									
	SONCC-IIIR.7.1.10.1	$0						$0	County
	SONCC-IIIR.7.1.10.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-IIIR.16.1.18									
	SONCC-IIIR.16.1.18.1	$34,015						$34,015	NMFS
	SONCC-IIIR.16.1.18.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-IIIR.16.1.17									
	SONCC-IIIR.16.1.17.1	$34,015						$34,015	NMFS
	SONCC-IIIR.16.1.17.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-IIIR.16.2.19									
	SONCC-IIIR.16.2.19.1	$34,015						$34,015	NMFS
	SONCC-IIIR.16.2.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-IIIR.16.2.20									
	SONCC-IIIR.16.2.20.1	$34,015						$34,015	NMFS
	SONCC-IIIR.16.2.20.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-IIIR.10.2.41									
	SONCC-IIIR.10.2.41.1	$91,850						$91,850	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-IIIR.10.2.41.2	$229,625						$229,625	ODFW
	Action Total:	*$321,475*						*$321,475*	
SONCC-IIIR.10.2.45									
	SONCC-IIIR.10.2.45.1	$76,136						$76,136	ODEQ
	SONCC-IIIR.10.2.45.2	$0						$0	ODEQ
	Action Total:	*$76,136*						*$76,136*	
SONCC-IIIR.10.2.13									
	SONCC-IIIR.10.2.13.1	$76,136						$76,136	NRCS/RCD
	Action Total:	*$76,136*						*$76,136*	
SONCC-IIIR.14.2.15									
	SONCC-IIIR.14.2.15.1	$68,030						$68,030	ODFW
	SONCC-IIIR.14.2.15.2	$1,148,522						$1,148,522	ODFW
	Action Total:	*$1,216,552*						*$1,216,552*	
SONCC-IIIR.27.2.25									
	SONCC-IIIR.27.2.25.1	$136,060						$136,060	ODFW
	SONCC-IIIR.27.2.25.2		$81,800		$81,800		$81,800	$245,400	ODFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-IIIR.27.2.26									
	SONCC-IIIR.27.2.26.1	$11,591,143		$11,591,143		$11,591,143		$34,773,429	ODFW
	Action Total:	*$11,591,143*		*$11,591,143*		*$11,591,143*		*$34,773,429*	
SONCC-IIIR.27.2.27									
	SONCC-IIIR.27.2.27.1	$11,591,143		$11,591,143		$11,591,143		$34,773,429	ODFW
	Action Total:	*$11,591,143*		*$11,591,143*		*$11,591,143*		*$34,773,429*	
SONCC-IIIR.27.2.28									
	SONCC-IIIR.27.2.28.1	$11,591,143		$11,591,143		$11,591,143		$34,773,429	ODFW
	Action Total:	*$11,591,143*		*$11,591,143*		*$11,591,143*		*$34,773,429*	
SONCC-IIIR.27.2.29									
	SONCC-IIIR.27.2.29.1	$11,591,143		$11,591,143		$11,591,143		$34,773,429	ODFW
	Action Total:	*$11,591,143*		*$11,591,143*		*$11,591,143*		*$34,773,429*	
SONCC-IIIR.27.2.30									
	SONCC-IIIR.27.2.30.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	ODFW
	Action Total:	*$65,911*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$264,786*	
SONCC-IIIR.27.2.58									
	SONCC-IIIR.27.2.58.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-IIIR.27.2.59									
	SONCC-IIIR.27.2.59.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-IIIR.27.2.60									
	SONCC-IIIR.27.2.60.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-IIIR.27.2.61									
	SONCC-IIIR.27.2.61.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-IIIR.27.2.65									
	SONCC-IIIR.27.2.65.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-IIIR.27.1.21									
	SONCC-IIIR.27.1.21.1	$884,535	$884,535	$884,535	$884,535	$884,535	$884,535	$5,307,210	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$884,535*	*$884,535*	*$884,535*	*$884,535*	*$884,535*	*$884,535*	*$5,307,210*	
SONCC-IllR.27.1.22									
	SONCC-IllR.27.1.22.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	ODFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-IllR.27.1.23									
	SONCC-IllR.27.1.23.1	$68,030		$68,030		$68,030		$204,090	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-IllR.27.1.24									
	SONCC-IllR.27.1.24.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-IllR.27.1.39									
	SONCC-IllR.27.1.39.1	$34,015						$34,015	NMFS
	SONCC-IllR.27.1.39.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-IllR.27.1.40									
	SONCC-IllR.27.1.40.1	$34,015						$34,015	ODFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-IllR.27.1.62									
	SONCC-IllR.27.1.62.1	$294,845	$294,845	$294,845	$294,845	$294,845	$294,845	$1,769,070	ODFW
	Action Total:	*$294,845*	*$294,845*	*$294,845*	*$294,845*	*$294,845*	*$294,845*	*$1,769,070*	
SONCC-IllR.27.4.54									
	SONCC-IllR.27.4.54.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-IllR.27.4.55									
	SONCC-IllR.27.4.55.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-IllR.27.4.56									
	SONCC-IllR.27.4.56.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-IllR.27.4.57									
	SONCC-IllR.27.4.57.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-IllR.27.4.63									
	SONCC-IllR.27.4.63.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$137,258,287***	***$3,385,135***	***$49,803,967***	***$3,385,135***	***$49,803,967***	***$8,112,966***	***$251,749,457***	
Population: Little River									
SONCC-LitR.2.1.2									
	SONCC-LitR.2.1.2.1	$17,008						$17,008	NGO
	SONCC-LitR.2.1.2.2	$667,692						$667,692	NGO
	Action Total:	*$684,700*						*$684,700*	
SONCC-LitR.2.1.33									
	SONCC-LitR.2.1.33.1	$17,008						$17,008	NGO
	SONCC-LitR.2.1.33.2	$667,692						$667,692	NGO
	Action Total:	*$684,700*						*$684,700*	
SONCC-LitR.8.1.1									
	SONCC-LitR.8.1.1.1	$195,644						$195,644	NGO
	SONCC-LitR.8.1.1.2	$7,576,820						$7,576,820	NGO

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LitR.8.1.1.3	$83,278						$83,278	NGO
	SONCC-LitR.8.1.1.4	$109,894					$109,894	$219,788	NGO
	Action Total:	*$7,965,636*					*$109,894*	*$8,075,530*	
SONCC-LitR.8.1.37									
	SONCC-LitR.8.1.37.1	$195,644						$195,644	NGO
	SONCC-LitR.8.1.37.2	$7,576,820						$7,576,820	NGO
	SONCC-LitR.8.1.37.3	$83,278						$83,278	NGO
	SONCC-LitR.8.1.37.4	$109,894					$109,894	$219,788	NGO
	Action Total:	*$7,965,636*					*$109,894*	*$8,075,530*	
SONCC-LitR.2.2.34									
	SONCC-LitR.2.2.34.1	$34,015						$34,015	CDFW
	SONCC-LitR.2.2.34.2	$102,258						$102,258	CDFW
	Action Total:	*$136,273*						*$136,273*	
SONCC-LitR.2.2.30									
	SONCC-LitR.2.2.30.1	$34,015						$34,015	CDFW
	SONCC-LitR.2.2.30.2	$102,258						$102,258	CDFW
	Action Total:	*$136,273*						*$136,273*	
SONCC-LitR.2.2.3									
	SONCC-LitR.2.2.3.1	$89,080						$89,080	CDFW
	SONCC-LitR.2.2.3.2	$357,360						$357,360	CDFW
	Action Total:	*$446,440*						*$446,440*	
SONCC-LitR.1.2.4									
	SONCC-LitR.1.2.4.1	$34,015						$34,015	CDFW
	SONCC-LitR.1.2.4.2	$420,000						$420,000	CDFW
	Action Total:	*$454,015*						*$454,015*	
SONCC-LitR.26.1.29									
	SONCC-LitR.26.1.29.1	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$306,750*	
SONCC-LitR.5.1.8									
	SONCC-LitR.5.1.8.1	$22,270						$22,270	NRCS/RCD
	SONCC-LitR.5.1.8.2	$79,940						$79,940	NRCS/RCD
	Action Total:	*$102,210*						*$102,210*	
SONCC-LitR.5.1.35									
	SONCC-LitR.5.1.35.1	$22,270						$22,270	NRCS/RCD
	SONCC-LitR.5.1.35.2	$79,940						$79,940	NRCS/RCD
	Action Total:	*$102,210*						*$102,210*	
SONCC-LitR.7.1.6									
	SONCC-LitR.7.1.6.1	$34,015						$34,015	Private
	SONCC-LitR.7.1.6.2	$95,880						$95,880	Private
	SONCC-LitR.7.1.6.3	$697,680						$697,680	Private
	Action Total:	*$827,575*						*$827,575*	
SONCC-LitR.7.1.7									
	SONCC-LitR.7.1.7.1	$17,008						$17,008	NRCS/RCD
	SONCC-LitR.7.1.7.2	$17,008						$17,008	NRCS/RCD
	SONCC-LitR.7.1.7.3	$10,000						$10,000	NRCS/RCD
	SONCC-LitR.7.1.7.4	$16,368						$16,368	NRCS/RCD
	SONCC-LitR.7.1.7.5	$2,500						$2,500	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$62,883*						*$62,883*	
SONCC-LitR.7.1.36									
	SONCC-LitR.7.1.36.1	$17,008						$17,008	NRCS/RCD
	SONCC-LitR.7.1.36.2	$17,008						$17,008	NRCS/RCD
	SONCC-LitR.7.1.36.3	$10,000						$10,000	NRCS/RCD
	SONCC-LitR.7.1.36.4	$16,368						$16,368	NRCS/RCD
	SONCC-LitR.7.1.36.5	$2,500						$2,500	NRCS/RCD
	Action Total:	*$62,883*						*$62,883*	
SONCC-LitR.10.2.25									
	SONCC-LitR.10.2.25.1	$22,963						$22,963	CDFW
	SONCC-LitR.10.2.25.2	$38,068						$38,068	CDFW
	Action Total:	*$61,031*						*$61,031*	
SONCC-LitR.10.2.31									
	SONCC-LitR.10.2.31.1	$22,963						$22,963	CDFW
	SONCC-LitR.10.2.31.2	$38,068						$38,068	CDFW
	Action Total:	*$61,031*						*$61,031*	
SONCC-LitR.10.7.32									
	SONCC-LitR.10.7.32.1	$8,504						$8,504	CDFW
	SONCC-LitR.10.7.32.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-LitR.10.7.28									
	SONCC-LitR.10.7.28.1	$8,504						$8,504	CDFW
	SONCC-LitR.10.7.28.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-LitR.16.1.9									
	SONCC-LitR.16.1.9.1	$34,015						$34,015	NMFS
	SONCC-LitR.16.1.9.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LitR.16.1.10									
	SONCC-LitR.16.1.10.1	$34,015						$34,015	NMFS
	SONCC-LitR.16.1.10.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LitR.16.2.11									
	SONCC-LitR.16.2.11.1	$34,015						$34,015	NMFS
	SONCC-LitR.16.2.11.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LitR.16.2.12									
	SONCC-LitR.16.2.12.1	$34,015						$34,015	NMFS
	SONCC-LitR.16.2.12.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LitR.27.2.16									
	SONCC-LitR.27.2.16.1	$136,060						$136,060	CDFW
	SONCC-LitR.27.2.16.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-LitR.27.2.17									
	SONCC-LitR.27.2.17.1	$38,995		$38,995		$38,995		$116,985	CDFW
	Action Total:	*$38,995*		*$38,995*		*$38,995*		*$116,985*	
SONCC-LitR.27.2.18									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LitR.27.2.18.1	$38,995		$38,995		$38,995		$116,985	CDFW
	Action Total:	*$38,995*		*$38,995*		*$38,995*		*$116,985*	
SONCC-LitR.27.2.19									
	SONCC-LitR.27.2.19.1	$38,995		$38,995		$38,995		$116,985	CDFW
	Action Total:	*$38,995*		*$38,995*		*$38,995*		*$116,985*	
SONCC-LitR.27.2.27									
	SONCC-LitR.27.2.27.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LitR.27.1.13									
	SONCC-LitR.27.1.13.1	$51,305	$51,305	$51,305	$51,305	$51,305	$51,305	$307,830	CDFW
	Action Total:	*$51,305*	*$51,305*	*$51,305*	*$51,305*	*$51,305*	*$51,305*	*$307,830*	
SONCC-LitR.27.1.14									
	SONCC-LitR.27.1.14.1	$17,102	$17,102	$17,102	$17,102	$17,102	$17,102	$102,612	CDFW
	Action Total:	*$17,102*	*$17,102*	*$17,102*	*$17,102*	*$17,102*	*$17,102*	*$102,612*	
SONCC-LitR.27.1.15									
	SONCC-LitR.27.1.15.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LitR.27.1.23									
	SONCC-LitR.27.1.23.1	$34,015						$34,015	NMFS
	SONCC-LitR.27.1.23.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-LitR.27.4.26									
	SONCC-LitR.27.4.26.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LitR.1.4.5									
	SONCC-LitR.1.4.5.1							$0	CSP
	Action Total:							*$0*	
	Population Total:	***$20,738,547***	***$490,665***	***$525,850***	***$490,665***	***$525,850***	***$710,453***	***$23,482,027***	

Population: Lower Eel and Van Duzen

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LEVR.1.1.65									
	SONCC-LEVR.1.1.65.1	$17,008						$17,008	CDFW
	SONCC-LEVR.1.1.65.2	$117,011						$117,011	CDFW
	Action Total:	*$134,018*						*$134,018*	
SONCC-LEVR.1.1.66									
	SONCC-LEVR.1.1.66.1	$17,008						$17,008	NMFS
	SONCC-LEVR.1.1.66.2	$600,570						$600,570	NMFS
	Action Total:	*$617,578*						*$617,578*	
SONCC-LEVR.1.1.12									
	SONCC-LEVR.1.1.12.1	$17,008						$17,008	CDFW
	SONCC-LEVR.1.1.12.2	$117,011						$117,011	CDFW
	Action Total:	*$134,018*						*$134,018*	
SONCC-LEVR.1.1.13									
	SONCC-LEVR.1.1.13.1	$17,008						$17,008	NMFS
	SONCC-LEVR.1.1.13.2	$600,570						$600,570	NMFS
	Action Total:	*$617,578*						*$617,578*	
SONCC-LEVR.1.2.38									
	SONCC-LEVR.1.2.38.1	$34,015						$34,015	CDFW
	SONCC-LEVR.1.2.38.2	$34,015						$34,015	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LEVR.1.2.38.3	$8,700,000						$8,700,000	CDFW
	Action Total:	*$8,768,030*						*$8,768,030*	
SONCC-LEVR.1.2.14									
	SONCC-LEVR.1.2.14.1	$34,015						$34,015	CDFW
	SONCC-LEVR.1.2.14.2	$8,700,000						$8,700,000	CDFW
	Action Total:	*$8,734,015*						*$8,734,015*	
SONCC-LEVR.1.2.15									
	SONCC-LEVR.1.2.15.1	$34,015						$34,015	CDFW
	SONCC-LEVR.1.2.15.2	$8,700,000						$8,700,000	CDFW
	SONCC-LEVR.1.2.15.3	$8,700,000						$8,700,000	CDFW
	Action Total:	*$17,434,015*						*$17,434,015*	
SONCC-LEVR.1.2.16									
	SONCC-LEVR.1.2.16.1	$34,015						$34,015	CDFW
	SONCC-LEVR.1.2.16.2	$8,700,000						$8,700,000	CDFW
	Action Total:	*$8,734,015*						*$8,734,015*	
SONCC-LEVR.2.1.36									
	SONCC-LEVR.2.1.36.1	$17,008						$17,008	CDFW
	SONCC-LEVR.2.1.36.2	$1,553,500						$1,553,500	CDFW
	Action Total:	*$1,570,508*						*$1,570,508*	
SONCC-LEVR.2.1.72									
	SONCC-LEVR.2.1.72.1	$17,008						$17,008	CDFW
	SONCC-LEVR.2.1.72.2	$1,553,500						$1,553,500	CDFW
	Action Total:	*$1,570,508*						*$1,570,508*	
SONCC-LEVR.2.2.45									
	SONCC-LEVR.2.2.45.1	$68,030						$68,030	CDFW
	SONCC-LEVR.2.2.45.2	$197,674						$197,674	CDFW
	Action Total:	*$265,704*						*$265,704*	
SONCC-LEVR.2.2.47									
	SONCC-LEVR.2.2.47.1	$68,030						$68,030	CDFW
	SONCC-LEVR.2.2.47.2	$197,674						$197,674	CDFW
	Action Total:	*$265,704*						*$265,704*	
SONCC-LEVR.3.1.48									
	SONCC-LEVR.3.1.48.1	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-LEVR.3.1.74									
	SONCC-LEVR.3.1.74.1	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-LEVR.3.1.20									
	SONCC-LEVR.3.1.20.1	$76,136						$76,136	SWRCB
	SONCC-LEVR.3.1.20.2	$34,015						$34,015	SWRCB
	Action Total:	*$110,151*						*$110,151*	
SONCC-LEVR.14.2.4									
	SONCC-LEVR.14.2.4.1	$68,030						$68,030	CDFW
	SONCC-LEVR.14.2.4.2	$27,697	$27,697	$27,697	$27,697	$27,697	$27,697	$166,184	CDFW
	Action Total:	*$95,727*	*$27,697*	*$27,697*	*$27,697*	*$27,697*	*$27,697*	*$234,214*	
SONCC-LEVR.2.1.71									
	SONCC-LEVR.2.1.71.1	$17,008						$17,008	CDFW
	SONCC-LEVR.2.1.71.2	$8,354,713						$8,354,713	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$8,371,720*						*$8,371,720*	
SONCC-LEVR.2.1.17									
	SONCC-LEVR.2.1.17.1	$17,008						$17,008	CDFW
	SONCC-LEVR.2.1.17.2	$8,354,713						$8,354,713	CDFW
	Action Total:	*$8,371,720*						*$8,371,720*	
SONCC-LEVR.3.1.52									
	SONCC-LEVR.3.1.52.1	$73,540						$73,540	CDFW
	SONCC-LEVR.3.1.52.2	$36,770						$36,770	CDFW
	SONCC-LEVR.3.1.52.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-LEVR.26.1.64									
	SONCC-LEVR.26.1.64.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LEVR.8.1.77									
	SONCC-LEVR.8.1.77.1	$1,450,986						$1,450,986	CDF
	SONCC-LEVR.8.1.77.2	$183,852,909						$183,852,909	CDF
	SONCC-LEVR.8.1.77.3	$2,367,705						$2,367,705	CDF
	SONCC-LEVR.8.1.77.4	$1,734,414					$1,734,414	$3,468,828	CDF
	Action Total:	*$189,406,014*					*$1,734,414*	*$191,140,428*	
SONCC-LEVR.10.1.51									
	SONCC-LEVR.10.1.51.1	$17,008						$17,008	CDFW
	SONCC-LEVR.10.1.51.2	$8,354,713						$8,354,713	CDFW
	SONCC-LEVR.10.1.51.3	$4,255,848						$4,255,848	CDFW
	Action Total:	*$12,627,568*						*$12,627,568*	
SONCC-LEVR.10.1.67									
	SONCC-LEVR.10.1.67.1	$17,008						$17,008	CDFW
	SONCC-LEVR.10.1.67.2	$8,354,713						$8,354,713	CDFW
	SONCC-LEVR.10.1.67.3	$4,255,848						$4,255,848	CDFW
	Action Total:	*$12,627,568*						*$12,627,568*	
SONCC-LEVR.8.1.49									
	SONCC-LEVR.8.1.49.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-LEVR.8.1.76									
	SONCC-LEVR.8.1.76.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-LEVR.8.1.5									
	SONCC-LEVR.8.1.5.1	$1,450,986						$1,450,986	CDF
	SONCC-LEVR.8.1.5.2	$183,852,909						$183,852,909	CDF
	SONCC-LEVR.8.1.5.3	$2,367,705						$2,367,705	CDF
	SONCC-LEVR.8.1.5.4	$1,734,414					$1,734,414	$3,468,828	CDF
	Action Total:	*$189,406,014*					*$1,734,414*	*$191,140,428*	
SONCC-LEVR.5.1.46									
	SONCC-LEVR.5.1.46.1	$159,090						$159,090	CDFW
	Action Total:	*$159,090*						*$159,090*	
SONCC-LEVR.5.1.37									
	SONCC-LEVR.5.1.37.1	$18,385						$18,385	CDFW
	SONCC-LEVR.5.1.37.2	$130,815						$130,815	CDFW
	Action Total:	*$149,200*						*$149,200*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LEVR.5.1.75									
	SONCC-LEVR.5.1.75.1	$18,385						$18,385	CDFW
	SONCC-LEVR.5.1.75.2	$130,815						$130,815	CDFW
	Action Total:	*$149,200*						*$149,200*	
SONCC-LEVR.7.1.2									
	SONCC-LEVR.7.1.2.1	$34,015						$34,015	CDF
	SONCC-LEVR.7.1.2.2	$1,168,458						$1,168,458	CDF
	SONCC-LEVR.7.1.2.3	$8,372,160						$8,372,160	CDF
	Action Total:	*$9,574,633*						*$9,574,633*	
SONCC-LEVR.7.1.3									
	SONCC-LEVR.7.1.3.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-LEVR.7.1.1									
	SONCC-LEVR.7.1.1.1	$8,503						$8,503	County
	SONCC-LEVR.7.1.1.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-LEVR.10.2.42									
	SONCC-LEVR.10.2.42.1	$45,925						$45,925	RWQCB
	SONCC-LEVR.10.2.42.2	$114,813						$114,813	RWQCB
	Action Total:	*$160,738*						*$160,738*	
SONCC-LEVR.10.2.68									
	SONCC-LEVR.10.2.68.1	$45,925						$45,925	RWQCB
	SONCC-LEVR.10.2.68.2	$114,813						$114,813	RWQCB
	Action Total:	*$160,738*						*$160,738*	
SONCC-LEVR.10.7.70									
	SONCC-LEVR.10.7.70.1	$8,504						$8,504	CDFW
	SONCC-LEVR.10.7.70.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-LEVR.10.7.63									
	SONCC-LEVR.10.7.63.1	$8,504						$8,504	CDFW
	SONCC-LEVR.10.7.63.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-LEVR.7.1.43									
	SONCC-LEVR.7.1.43.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-LEVR.16.1.22									
	SONCC-LEVR.16.1.22.1	$34,015						$34,015	NMFS
	SONCC-LEVR.16.1.22.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LEVR.16.1.23									
	SONCC-LEVR.16.1.23.1	$34,015						$34,015	NMFS
	SONCC-LEVR.16.1.23.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LEVR.16.2.24									
	SONCC-LEVR.16.2.24.1	$34,015						$34,015	NMFS
	SONCC-LEVR.16.2.24.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LEVR.16.2.25									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LEVR.16.2.25.1	$34,015						$34,015	NMFS
	SONCC-LEVR.16.2.25.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LEVR.8.1.44									
	SONCC-LEVR.8.1.44.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-LEVR.8.1.6									
	SONCC-LEVR.8.1.6.1	$2,376						$2,376	County
	Action Total:	*$2,376*						*$2,376*	
SONCC-LEVR.8.1.7									
	SONCC-LEVR.8.1.7.1	$34,015						$34,015	CDF
	Action Total:	*$34,015*						*$34,015*	
SONCC-LEVR.8.1.9									
	SONCC-LEVR.8.1.9.1	$34,015						$34,015	NRCS/RCD
	SONCC-LEVR.8.1.9.2	$34,015						$34,015	NRCS/RCD
	Action Total:	*$68,030*						*$68,030*	
SONCC-LEVR.8.1.11									
	SONCC-LEVR.8.1.11.1	$182,000						$182,000	CDF
	SONCC-LEVR.8.1.11.2	$12,169,248						$12,169,248	CDF
	Action Total:	*$12,351,248*						*$12,351,248*	
SONCC-LEVR.27.2.41									
	SONCC-LEVR.27.2.41.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-LEVR.27.2.58									
	SONCC-LEVR.27.2.58.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LEVR.27.2.59									
	SONCC-LEVR.27.2.59.1	$34,015						$34,015	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-LEVR.27.2.30									
	SONCC-LEVR.27.2.30.1	$136,060						$136,060	CDFW
	SONCC-LEVR.27.2.30.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-LEVR.27.2.31									
	SONCC-LEVR.27.2.31.1	$5,161,933		$5,161,933		$5,161,933		$15,485,799	CDFW
	Action Total:	*$5,161,933*		*$5,161,933*		*$5,161,933*		*$15,485,799*	
SONCC-LEVR.27.2.32									
	SONCC-LEVR.27.2.32.1	$5,161,933		$5,161,933		$5,161,933		$15,485,799	CDFW
	Action Total:	*$5,161,933*		*$5,161,933*		*$5,161,933*		*$15,485,799*	
SONCC-LEVR.27.2.33									
	SONCC-LEVR.27.2.33.1	$5,161,933		$5,161,933		$5,161,933		$15,485,799	CDFW
	Action Total:	*$5,161,933*		*$5,161,933*		*$5,161,933*		*$15,485,799*	
SONCC-LEVR.27.2.34									
	SONCC-LEVR.27.2.34.1	$5,161,933		$5,161,933		$5,161,933		$15,485,799	CDFW
	Action Total:	*$5,161,933*		*$5,161,933*		*$5,161,933*		*$15,485,799*	
SONCC-LEVR.27.2.35									
	SONCC-LEVR.27.2.35.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-LEVR.27.2.62									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LEVR.27.2.62.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LEVR.27.1.39									
	SONCC-LEVR.27.1.39.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-LEVR.27.1.40									
	SONCC-LEVR.27.1.40.1	$34,015						$34,015	NMFS
	SONCC-LEVR.27.1.40.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-LEVR.27.1.26									
	SONCC-LEVR.27.1.26.1	$590,280	$590,280	$590,280	$590,280	$590,280	$590,280	$3,541,680	CDFW
	Action Total:	*$590,280*	*$590,280*	*$590,280*	*$590,280*	*$590,280*	*$590,280*	*$3,541,680*	
SONCC-LEVR.27.1.27									
	SONCC-LEVR.27.1.27.1	$196,760	$196,760	$196,760	$196,760	$196,760	$196,760	$1,180,560	CDFW
	Action Total:	*$196,760*	*$196,760*	*$196,760*	*$196,760*	*$196,760*	*$196,760*	*$1,180,560*	
SONCC-LEVR.27.1.28									
	SONCC-LEVR.27.1.28.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LEVR.27.1.29									
	SONCC-LEVR.27.1.29.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-LEVR.27.1.29.2	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	CDFW
	Action Total:	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$612,270*	
SONCC-LEVR.27.1.61									
	SONCC-LEVR.27.1.61.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	ODFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-LEVR.27.4.54									
	SONCC-LEVR.27.4.54.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LEVR.27.4.55									
	SONCC-LEVR.27.4.55.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LEVR.27.4.56									
	SONCC-LEVR.27.4.56.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LEVR.27.4.57									
	SONCC-LEVR.27.4.57.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LEVR.27.4.60									
	SONCC-LEVR.27.4.60.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$516,838,720***	***$2,733,717***	***$23,401,694***	***$2,733,717***	***$23,401,694***	***$6,202,545***	***$575,312,088***	

Population: Lower Klamath River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LKR.2.2.8									
	SONCC-LKR.2.2.8.1	$89,080						$89,080	BIA/Tribe
	SONCC-LKR.2.2.8.2	$636,029						$636,029	BIA/Tribe
	Action Total:	*$725,109*						*$725,109*	
SONCC-LKR.1.2.39									
	SONCC-LKR.1.2.39.1	$34,015						$34,015	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LKR.1.2.39.2	$34,015						$34,015	CDFW
	SONCC-LKR.1.2.39.3	$682,150						$682,150	CDFW
	Action Total:	*$750,180*						*$750,180*	
SONCC-LKR.2.1.1									
	SONCC-LKR.2.1.1.1	$17,008						$17,008	BIA/Tribe
	SONCC-LKR.2.1.1.2	$2,465,325						$2,465,325	BIA/Tribe
	Action Total:	*$2,482,333*						*$2,482,333*	
SONCC-LKR.2.1.60									
	SONCC-LKR.2.1.60.1	$17,008						$17,008	BIA/Tribe
	SONCC-LKR.2.1.60.2	$2,465,325						$2,465,325	BIA/Tribe
	Action Total:	*$2,482,333*						*$2,482,333*	
SONCC-LKR.2.2.2									
	SONCC-LKR.2.2.2.1	$17,008						$17,008	BIA/Tribe
	SONCC-LKR.2.2.2.2	$460,161						$460,161	BIA/Tribe
	Action Total:	*$477,169*						*$477,169*	
SONCC-LKR.2.2.4									
	SONCC-LKR.2.2.4.1	$17,008						$17,008	BIA/Tribe
	SONCC-LKR.2.2.4.2	$203,490						$203,490	BIA/Tribe
	SONCC-LKR.2.2.4.3	$117,612						$117,612	BIA/Tribe
	Action Total:	*$338,110*						*$338,110*	
SONCC-LKR.2.2.6									
	SONCC-LKR.2.2.6.1	$17,008						$17,008	CDFW
	SONCC-LKR.2.2.6.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-LKR.2.2.6.3	$20,000						$20,000	CDFW
	Action Total:	*$122,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$547,233*	
SONCC-LKR.2.2.61									
	SONCC-LKR.2.2.61.1	$17,008						$17,008	BIA/Tribe
	SONCC-LKR.2.2.61.2	$460,161						$460,161	BIA/Tribe
	Action Total:	*$477,169*						*$477,169*	
SONCC-LKR.2.2.62									
	SONCC-LKR.2.2.62.1	$17,008						$17,008	BIA/Tribe
	SONCC-LKR.2.2.62.2	$203,490						$203,490	BIA/Tribe
	SONCC-LKR.2.2.62.3	$117,612						$117,612	BIA/Tribe
	Action Total:	*$338,110*						*$338,110*	
SONCC-LKR.2.2.63									
	SONCC-LKR.2.2.63.1	$17,008						$17,008	CDFW
	SONCC-LKR.2.2.63.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-LKR.2.2.63.3	$20,000						$20,000	CDFW
	Action Total:	*$122,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$547,233*	
SONCC-LKR.8.1.11									
	SONCC-LKR.8.1.11.1	$1,279,147						$1,279,147	BIA/Tribe
	SONCC-LKR.8.1.11.2	$41,911,778						$41,911,778	BIA/Tribe
	SONCC-LKR.8.1.11.3	$1,437,411						$1,437,411	BIA/Tribe
	SONCC-LKR.8.1.11.4	$1,176,583					$1,176,583	$2,353,165	BIA/Tribe
	Action Total:	*$45,804,918*					*$1,176,583*	*$46,981,501*	
SONCC-LKR.8.1.68									
	SONCC-LKR.8.1.68.1	$1,279,147						$1,279,147	BIA/Tribe

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LKR.8.1.68.2	$41,911,778						$41,911,778	BIA/Tribe
	SONCC-LKR.8.1.68.3	$1,437,411						$1,437,411	BIA/Tribe
	SONCC-LKR.8.1.68.4	$1,176,583					$1,176,583	$2,353,165	BIA/Tribe
	Action Total:	*$45,804,918*					*$1,176,583*	*$46,981,501*	
SONCC-LKR.7.1.14									
	SONCC-LKR.7.1.14.1	$34,015						$34,015	BIA/Tribe
	SONCC-LKR.7.1.14.2	$347,086						$347,086	BIA/Tribe
	SONCC-LKR.7.1.14.3	$2,525,602						$2,525,602	BIA/Tribe
	Action Total:	*$2,906,702*						*$2,906,702*	
SONCC-LKR.3.1.64									
	SONCC-LKR.3.1.64.1	$18,385						$18,385	SWRCB
	SONCC-LKR.3.1.64.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-LKR.3.1.57									
	SONCC-LKR.3.1.57.1	$18,385						$18,385	SWRCB
	SONCC-LKR.3.1.57.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-LKR.8.1.9									
	SONCC-LKR.8.1.9.1	$126,908						$126,908	BIA/Tribe
	Action Total:	*$126,908*						*$126,908*	
SONCC-LKR.8.1.70									
	SONCC-LKR.8.1.70.1	$126,908						$126,908	BIA/Tribe
	Action Total:	*$126,908*						*$126,908*	
SONCC-LKR.7.1.16									
	SONCC-LKR.7.1.16.1	$34,015						$34,015	BIA/Tribe
	Action Total:	*$34,015*						*$34,015*	
SONCC-LKR.8.1.13									
	SONCC-LKR.8.1.13.1	$17,008						$17,008	NRCS/RCD
	SONCC-LKR.8.1.13.2	$271,220						$271,220	NRCS/RCD
	Action Total:	*$288,228*						*$288,228*	
SONCC-LKR.8.1.69									
	SONCC-LKR.8.1.69.1	$17,008						$17,008	NRCS/RCD
	SONCC-LKR.8.1.69.2	$271,220						$271,220	NRCS/RCD
	Action Total:	*$288,228*						*$288,228*	
SONCC-LKR.2.2.3									
	SONCC-LKR.2.2.3.1	$80,000						$80,000	BIA/Tribe
	Action Total:	*$80,000*						*$80,000*	
SONCC-LKR.5.1.40									
	SONCC-LKR.5.1.40.1	$17,008						$17,008	CDFW
	SONCC-LKR.5.1.40.2	$159,090						$159,090	CDFW
	Action Total:	*$176,098*						*$176,098*	
SONCC-LKR.5.1.65									
	SONCC-LKR.5.1.65.1	$17,008						$17,008	CDFW
	SONCC-LKR.5.1.65.2	$159,090						$159,090	CDFW
	Action Total:	*$176,098*						*$176,098*	
SONCC-LKR.3.1.55									
	SONCC-LKR.3.1.55.1	$247,000	$247,000	$247,000	$247,000	$247,000	$247,000	$1,482,000	SWRCB
	Action Total:	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$1,482,000*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LKR.3.1.58									
	SONCC-LKR.3.1.58.1	$36,077						$36,077	CDFW
	SONCC-LKR.3.1.58.2	$36,077						$36,077	CDFW
	SONCC-LKR.3.1.58.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-LKR.7.1.15									
	SONCC-LKR.7.1.15.1	$17,008						$17,008	NRCS/RCD
	SONCC-LKR.7.1.15.2	$17,008						$17,008	NRCS/RCD
	SONCC-LKR.7.1.15.3	$436,650						$436,650	NRCS/RCD
	SONCC-LKR.7.1.15.4	$14,766						$14,766	NRCS/RCD
	SONCC-LKR.7.1.15.5	$607						$607	NRCS/RCD
	Action Total:	*$486,038*						*$486,038*	
SONCC-LKR.7.1.66									
	SONCC-LKR.7.1.66.1	$17,008						$17,008	NRCS/RCD
	SONCC-LKR.7.1.66.2	$17,008						$17,008	NRCS/RCD
	SONCC-LKR.7.1.66.3	$436,650						$436,650	NRCS/RCD
	SONCC-LKR.7.1.66.4	$14,766						$14,766	NRCS/RCD
	SONCC-LKR.7.1.66.5	$607						$607	NRCS/RCD
	Action Total:	*$486,038*						*$486,038*	
SONCC-LKR.7.1.67									
	SONCC-LKR.7.1.67.1	$8,504						$8,504	CDFW
	SONCC-LKR.7.1.67.2	$56,706						$56,706	CDFW
	Action Total:	*$65,210*						*$65,210*	
SONCC-LKR.7.1.54									
	SONCC-LKR.7.1.54.1	$8,504						$8,504	CDFW
	SONCC-LKR.7.1.54.2	$56,706						$56,706	CDFW
	Action Total:	*$65,210*						*$65,210*	
SONCC-LKR.26.1.56									
	SONCC-LKR.26.1.56.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LKR.10.7.59									
	SONCC-LKR.10.7.59.1	$8,504						$8,504	CDFW
	SONCC-LKR.10.7.59.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-LKR.10.7.53									
	SONCC-LKR.10.7.53.1	$8,504						$8,504	CDFW
	SONCC-LKR.10.7.53.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-LKR.8.1.10									
	SONCC-LKR.8.1.10.1	$73,540						$73,540	BIA/Tribe
	SONCC-LKR.8.1.10.2	$20,033,709						$20,033,709	BIA/Tribe
	Action Total:	*$20,107,249*						*$20,107,249*	
SONCC-LKR.8.1.12									
	SONCC-LKR.8.1.12.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-LKR.3.1.20									
	SONCC-LKR.3.1.20.1	$76,136						$76,136	NGO

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$76,136*						*$76,136*	
SONCC-LKR.3.1.21									
	SONCC-LKR.3.1.21.1	$0						$0	SWRCB
	SONCC-LKR.3.1.21.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-LKR.3.1.23									
	SONCC-LKR.3.1.23.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-LKR.7.1.18									
	SONCC-LKR.7.1.18.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-LKR.16.1.25									
	SONCC-LKR.16.1.25.1	$34,015						$34,015	NMFS
	SONCC-LKR.16.1.25.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LKR.16.1.26									
	SONCC-LKR.16.1.26.1	$34,015						$34,015	NMFS
	SONCC-LKR.16.1.26.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LKR.16.1.51									
	SONCC-LKR.16.1.51.1	$34,015						$34,015	NMFS
	SONCC-LKR.16.1.51.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LKR.16.1.52									
	SONCC-LKR.16.1.52.1	$34,015						$34,015	BIA/Tribe
	SONCC-LKR.16.1.52.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-LKR.16.2.27									
	SONCC-LKR.16.2.27.1	$34,015						$34,015	NMFS
	SONCC-LKR.16.2.27.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LKR.16.2.28									
	SONCC-LKR.16.2.28.1	$34,015						$34,015	NMFS
	SONCC-LKR.16.2.28.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LKR.10.2.45									
	SONCC-LKR.10.2.45.1	$45,925						$45,925	CDFW
	SONCC-LKR.10.2.45.2	$76,136						$76,136	CDFW
	Action Total:	*$122,061*						*$122,061*	
SONCC-LKR.27.2.33									
	SONCC-LKR.27.2.33.1	$136,060						$136,060	CDFW
	SONCC-LKR.27.2.33.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-LKR.27.2.34									
	SONCC-LKR.27.2.34.1	$1,396,586		$1,396,586		$1,396,586		$4,189,758	CDFW
	Action Total:	*$1,396,586*		*$1,396,586*		*$1,396,586*		*$4,189,758*	
SONCC-LKR.27.2.35									
	SONCC-LKR.27.2.35.1	$1,396,586		$1,396,586		$1,396,586		$4,189,758	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$1,396,586*		*$1,396,586*		*$1,396,586*		*$4,189,758*	
SONCC-LKR.27.2.36									
	SONCC-LKR.27.2.36.1	$1,396,586		$1,396,586		$1,396,586		$4,189,758	CDFW
	Action Total:	*$1,396,586*		*$1,396,586*		*$1,396,586*		*$4,189,758*	
SONCC-LKR.27.2.37									
	SONCC-LKR.27.2.37.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-LKR.27.2.37.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-LKR.27.2.38									
	SONCC-LKR.27.2.38.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-LKR.27.2.44									
	SONCC-LKR.27.2.44.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-LKR.27.2.50									
	SONCC-LKR.27.2.50.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LKR.27.1.29									
	SONCC-LKR.27.1.29.1	$307,033	$307,033	$307,033	$307,033	$307,033	$307,033	$1,842,198	CDFW
	Action Total:	*$307,033*	*$307,033*	*$307,033*	*$307,033*	*$307,033*	*$307,033*	*$1,842,198*	
SONCC-LKR.27.1.30									
	SONCC-LKR.27.1.30.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-LKR.27.1.31									
	SONCC-LKR.27.1.31.1	$68,030		$68,030		$68,030		$204,090	CDFW
	SONCC-LKR.27.1.31.2	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$1,500,000	BIA/Tribe
	Action Total:	*$318,030*	*$250,000*	*$318,030*	*$250,000*	*$318,030*	*$250,000*	*$1,704,090*	
SONCC-LKR.27.1.32									
	SONCC-LKR.27.1.32.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-LKR.27.1.32.2	$13,084	$13,084	$13,084	$13,084	$13,084	$13,084	$78,504	CDFW
	Action Total:	*$98,122*	*$98,122*	*$98,122*	*$98,122*	*$98,122*	*$98,122*	*$588,729*	
SONCC-LKR.27.1.42									
	SONCC-LKR.27.1.42.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LKR.27.1.43									
	SONCC-LKR.27.1.43.1	$34,015						$34,015	NMFS
	SONCC-LKR.27.1.43.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-LKR.27.1.49									
	SONCC-LKR.27.1.49.1	$102,344	$102,344	$102,344	$102,344	$102,344	$102,344	$614,064	CDFW
	Action Total:	*$102,344*	*$102,344*	*$102,344*	*$102,344*	*$102,344*	*$102,344*	*$614,064*	
SONCC-LKR.27.4.47									
	SONCC-LKR.27.4.47.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LKR.27.4.48									
	SONCC-LKR.27.4.48.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LKR.2.2.7									
	SONCC-LKR.2.2.7.1							$0	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:							*$0*	
SONCC-LKR.7.1.17									
	SONCC-LKR.7.1.17.1							$0	BIA/Tribe
	SONCC-LKR.7.1.17.2							$0	BIA/Tribe
	SONCC-LKR.7.1.17.3							$0	BIA/Tribe
	Action Total:							*$0*	
	Population Total:	***$133,286,917***	***$2,724,739***	***$6,934,742***	***$2,724,739***	***$6,934,742***	***$5,077,904***	***$157,683,781***	

Population: Lower Rogue

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LRR.7.1.4									
	SONCC-LRR.7.1.4.1	$68,030						$68,030	ODF
	SONCC-LRR.7.1.4.2	$0						$0	ODF
	SONCC-LRR.7.1.4.3	$0						$0	ODF
	SONCC-LRR.7.1.4.4	$0						$0	ODF
	SONCC-LRR.7.1.4.5	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	
SONCC-LRR.2.1.50									
	SONCC-LRR.2.1.50.1	$17,008						$17,008	USFS
	SONCC-LRR.2.1.50.2	$839,786						$839,786	USFS
	Action Total:	*$856,793*						*$856,793*	
SONCC-LRR.2.1.9									
	SONCC-LRR.2.1.9.1	$17,008						$17,008	USFS
	SONCC-LRR.2.1.9.2	$839,786						$839,786	USFS
	Action Total:	*$856,793*						*$856,793*	
SONCC-LRR.2.2.51									
	SONCC-LRR.2.2.51.1	$17,008						$17,008	USFS
	SONCC-LRR.2.2.51.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	USFS
	SONCC-LRR.2.2.51.3	$10,000						$10,000	USFS
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-LRR.2.2.10									
	SONCC-LRR.2.2.10.1	$17,008						$17,008	USFS
	SONCC-LRR.2.2.10.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	USFS
	SONCC-LRR.2.2.10.3	$10,000						$10,000	USFS
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-LRR.10.2.26									
	SONCC-LRR.10.2.26.1	$17,008						$17,008	County
	SONCC-LRR.10.2.26.2	$48,346						$48,346	County
	Action Total:	*$65,354*						*$65,354*	
SONCC-LRR.10.2.49									
	SONCC-LRR.10.2.49.1	$17,008						$17,008	County
	SONCC-LRR.10.2.49.2	$48,346						$48,346	County
	Action Total:	*$65,354*						*$65,354*	
SONCC-LRR.28.1.1									
	SONCC-LRR.28.1.1.1	$288,906						$288,906	USFS
	SONCC-LRR.28.1.1.2	$6,380,480						$6,380,480	USFS
	SONCC-LRR.28.1.1.3	$288,520						$288,520	USFS
	SONCC-LRR.28.1.1.4	$474,217					$474,217	$948,433	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$7,432,122*					*$474,217*	*$7,906,339*	
SONCC-LRR.28.1.57									
	SONCC-LRR.28.1.57.1	$288,906						$288,906	USFS
	SONCC-LRR.28.1.57.2	$6,380,480						$6,380,480	USFS
	SONCC-LRR.28.1.57.3	$288,520						$288,520	USFS
	SONCC-LRR.28.1.57.4	$474,217					$474,217	$948,433	USFS
	Action Total:	*$7,432,122*					*$474,217*	*$7,906,339*	
SONCC-LRR.2.4.53									
	SONCC-LRR.2.4.53.1	$17,008						$17,008	ODFW
	SONCC-LRR.2.4.53.2	$335,000						$335,000	ODFW
	Action Total:	*$352,008*						*$352,008*	
SONCC-LRR.2.4.8									
	SONCC-LRR.2.4.8.1	$17,008						$17,008	ODFW
	SONCC-LRR.2.4.8.2	$335,000						$335,000	ODFW
	Action Total:	*$352,008*						*$352,008*	
SONCC-LRR.2.5.6									
	SONCC-LRR.2.5.6.1	$17,008						$17,008	ODFW
	SONCC-LRR.2.5.6.2	$87,210						$87,210	ODFW
	Action Total:	*$104,218*						*$104,218*	
SONCC-LRR.2.5.54									
	SONCC-LRR.2.5.54.1	$17,008						$17,008	ODFW
	SONCC-LRR.2.5.54.2	$87,210						$87,210	ODFW
	Action Total:	*$104,218*						*$104,218*	
SONCC-LRR.2.7.33									
	SONCC-LRR.2.7.33.1	$17,008						$17,008	NRCS/RCD
	SONCC-LRR.2.7.33.2	$85,038						$85,038	NRCS/RCD
	SONCC-LRR.2.7.33.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-LRR.2.7.55									
	SONCC-LRR.2.7.55.1	$17,008						$17,008	NRCS/RCD
	SONCC-LRR.2.7.55.2	$85,038						$85,038	NRCS/RCD
	SONCC-LRR.2.7.55.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-LRR.2.2.52									
	SONCC-LRR.2.2.52.1	$17,008						$17,008	ODFW
	SONCC-LRR.2.2.52.2	$153,387						$153,387	ODFW
	Action Total:	*$170,395*						*$170,395*	
SONCC-LRR.2.2.48									
	SONCC-LRR.2.2.48.1	$17,008						$17,008	ODFW
	SONCC-LRR.2.2.48.2	$153,387						$153,387	ODFW
	Action Total:	*$170,395*						*$170,395*	
SONCC-LRR.22.3.36									
	SONCC-LRR.22.3.36.1	$0						$0	County
	SONCC-LRR.22.3.36.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-LRR.28.1.2									
	SONCC-LRR.28.1.2.1	$0						$0	County
	Action Total:	*$0*						*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LRR.2.4.7									
	SONCC-LRR.2.4.7.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-LRR.2.7.5									
	SONCC-LRR.2.7.5.1	$17,008						$17,008	USFS
	SONCC-LRR.2.7.5.3	$425,585						$425,585	USFS
	Action Total:	*$442,592*						*$442,592*	
SONCC-LRR.2.7.56									
	SONCC-LRR.2.7.56.1	$17,008						$17,008	USFS
	SONCC-LRR.2.7.56.3	$425,585						$425,585	USFS
	Action Total:	*$442,592*						*$442,592*	
SONCC-LRR.26.1.47									
	SONCC-LRR.26.1.47.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LRR.2.2.44									
	SONCC-LRR.2.2.44.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-LRR.10.2.37									
	SONCC-LRR.10.2.37.1	$0						$0	County
	SONCC-LRR.10.2.37.2	$0						$0	County
	SONCC-LRR.10.2.37.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-LRR.7.1.27									
	SONCC-LRR.7.1.27.1	$0						$0	BLM
	Action Total:	*$0*						*$0*	
SONCC-LRR.2.7.34									
	SONCC-LRR.2.7.34.1	$170,075						$170,075	USFS
	Action Total:	*$170,075*						*$170,075*	
SONCC-LRR.5.1.35									
	SONCC-LRR.5.1.35.1	$34,015						$34,015	ODFW
	SONCC-LRR.5.1.35.2	$318,180						$318,180	ODFW
	Action Total:	*$352,195*						*$352,195*	
SONCC-LRR.10.2.32									
	SONCC-LRR.10.2.32.1	$45,925						$45,925	ODFW
	SONCC-LRR.10.2.32.2	$76,136						$76,136	ODFW
	Action Total:	*$122,061*						*$122,061*	
SONCC-LRR.1.2.25									
	SONCC-LRR.1.2.25.1	$34,015						$34,015	ODFW
	SONCC-LRR.1.2.25.2	$34,015						$34,015	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-LRR.16.1.12									
	SONCC-LRR.16.1.12.1	$34,015						$34,015	NMFS
	SONCC-LRR.16.1.12.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LRR.16.1.13									
	SONCC-LRR.16.1.13.1	$34,015						$34,015	NMFS
	SONCC-LRR.16.1.13.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LRR.16.2.14									
	SONCC-LRR.16.2.14.1	$34,015						$34,015	NMFS
	SONCC-LRR.16.2.14.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LRR.16.2.15									
	SONCC-LRR.16.2.15.1	$34,015						$34,015	NMFS
	SONCC-LRR.16.2.15.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LRR.10.7.46									
	SONCC-LRR.10.7.46.1	$17,008						$17,008	ODFW
	SONCC-LRR.10.7.46.2	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$119,258*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$630,508*	
SONCC-LRR.27.2.31									
	SONCC-LRR.27.2.31.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-LRR.27.2.42									
	SONCC-LRR.27.2.42.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LRR.27.2.19									
	SONCC-LRR.27.2.19.1	$136,060						$136,060	ODFW
	SONCC-LRR.27.2.19.2		$81,800		$81,800		$81,800	$245,400	ODFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-LRR.27.2.20									
	SONCC-LRR.27.2.20.1	$218,052		$218,052		$218,052		$654,156	ODFW
	Action Total:	*$218,052*		*$218,052*		*$218,052*		*$654,156*	
SONCC-LRR.27.2.21									
	SONCC-LRR.27.2.21.1	$218,052		$218,052		$218,052		$654,156	ODFW
	Action Total:	*$218,052*		*$218,052*		*$218,052*		*$654,156*	
SONCC-LRR.27.2.22									
	SONCC-LRR.27.2.22.1	$218,052		$218,052		$218,052		$654,156	ODFW
	Action Total:	*$218,052*		*$218,052*		*$218,052*		*$654,156*	
SONCC-LRR.27.2.23									
	SONCC-LRR.27.2.23.1	$218,052		$218,052		$218,052		$654,156	ODFW
	Action Total:	*$218,052*		*$218,052*		*$218,052*		*$654,156*	
SONCC-LRR.27.2.24									
	SONCC-LRR.27.2.24.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-LRR.27.2.45									
	SONCC-LRR.27.2.45.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LRR.27.1.28									
	SONCC-LRR.27.1.28.1	$68,030		$68,030		$68,030		$204,090	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-LRR.27.1.30									
	SONCC-LRR.27.1.30.1	$34,015						$34,015	NMFS
	SONCC-LRR.27.1.30.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-LRR.27.1.16									
	SONCC-LRR.27.1.16.1	$121,320	$121,320	$121,320	$121,320	$121,320	$121,320	$727,920	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$121,320*	*$121,320*	*$121,320*	*$121,320*	*$121,320*	*$121,320*	*$727,920*	
SONCC-LRR.27.1.17									
	SONCC-LRR.27.1.17.1	$40,440	$40,440	$40,440	$40,440	$40,440	$40,440	$242,640	ODFW
	Action Total:	*$40,440*	*$40,440*	*$40,440*	*$40,440*	*$40,440*	*$40,440*	*$242,640*	
SONCC-LRR.27.1.18									
	SONCC-LRR.27.1.18.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LRR.27.4.39									
	SONCC-LRR.27.4.39.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LRR.27.4.40									
	SONCC-LRR.27.4.40.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LRR.27.4.41									
	SONCC-LRR.27.4.41.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LRR.27.4.43									
	SONCC-LRR.27.4.43.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$22,518,950***	***$1,043,733***	***$1,936,186***	***$1,043,733***	***$1,936,186***	***$1,992,166***	***$30,470,952***	

Population: Lower Trinity River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-LTR.3.1.38									
	SONCC-LTR.3.1.38.1	$18,385						$18,385	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-LTR.3.1.58									
	SONCC-LTR.3.1.58.1	$18,385						$18,385	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-LTR.2.1.11									
	SONCC-LTR.2.1.11.1	$17,008						$17,008	CDFW
	SONCC-LTR.2.1.11.2	$7,669,900						$7,669,900	CDFW
	Action Total:	*$7,686,908*						*$7,686,908*	
SONCC-LTR.2.1.53									
	SONCC-LTR.2.1.53.1	$17,008						$17,008	CDFW
	SONCC-LTR.2.1.53.2	$7,669,900						$7,669,900	CDFW
	Action Total:	*$7,686,908*						*$7,686,908*	
SONCC-LTR.2.2.7									
	SONCC-LTR.2.2.7.1	$17,008						$17,008	CDFW
	SONCC-LTR.2.2.7.2	$1,431,612						$1,431,612	CDFW
	Action Total:	*$1,448,620*						*$1,448,620*	
SONCC-LTR.2.2.8									
	SONCC-LTR.2.2.8.1	$17,008						$17,008	CDFW
	SONCC-LTR.2.2.8.2	$895,342						$895,342	CDFW
	Action Total:	*$912,350*						*$912,350*	
SONCC-LTR.2.2.12									
	SONCC-LTR.2.2.12.1	$44,540						$44,540	NGO
	SONCC-LTR.2.2.12.2	$937,369						$937,369	NGO
	Action Total:	*$981,909*						*$981,909*	
SONCC-LTR.2.2.54									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LTR.2.2.54.1	$44,540						$44,540	NGO
	SONCC-LTR.2.2.54.2	$937,369						$937,369	NGO
	Action Total:	*$981,909*						*$981,909*	
SONCC-LTR.2.2.55									
	SONCC-LTR.2.2.55.1	$17,008						$17,008	CDFW
	SONCC-LTR.2.2.55.2	$1,431,612						$1,431,612	CDFW
	Action Total:	*$1,448,620*						*$1,448,620*	
SONCC-LTR.2.2.56									
	SONCC-LTR.2.2.56.1	$17,008						$17,008	CDFW
	SONCC-LTR.2.2.56.2	$895,342						$895,342	CDFW
	Action Total:	*$912,350*						*$912,350*	
SONCC-LTR.17.2.37									
	SONCC-LTR.17.2.37.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-LTR.5.1.31									
	SONCC-LTR.5.1.31.1	$159,090						$159,090	BIA/Tribe
	Action Total:	*$159,090*						*$159,090*	
SONCC-LTR.5.1.36									
	SONCC-LTR.5.1.36.1	$87,209						$87,209	USFS
	Action Total:	*$87,209*						*$87,209*	
SONCC-LTR.1.2.33									
	SONCC-LTR.1.2.33.1	$0						$0	BIA/Tribe
	Action Total:	*$0*						*$0*	
SONCC-LTR.3.1.28									
	SONCC-LTR.3.1.28.1	$34,015						$34,015	CDFW
	SONCC-LTR.3.1.28.2	$34,015						$34,015	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-LTR.3.1.29									
	SONCC-LTR.3.1.29.1	$34,015						$34,015	CDFW
	SONCC-LTR.3.1.29.2	$85,037	$85,037	$85,037	$85,037	$85,037	$85,037	$510,222	CDFW
	Action Total:	*$119,052*	*$85,037*	*$85,037*	*$85,037*	*$85,037*	*$85,037*	*$544,237*	
SONCC-LTR.3.1.4									
	SONCC-LTR.3.1.4.1	$0						$0	SWRCB
	SONCC-LTR.3.1.4.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-LTR.3.1.6									
	SONCC-LTR.3.1.6.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-LTR.5.1.32									
	SONCC-LTR.5.1.32.1	$17,008						$17,008	USFS
	SONCC-LTR.5.1.32.2	$715,905						$715,905	USFS
	Action Total:	*$732,913*						*$732,913*	
SONCC-LTR.5.1.59									
	SONCC-LTR.5.1.59.1	$17,008						$17,008	USFS
	SONCC-LTR.5.1.59.2	$715,905						$715,905	USFS
	Action Total:	*$732,913*						*$732,913*	
SONCC-LTR.3.1.51									
	SONCC-LTR.3.1.51.1	$36,077						$36,077	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LTR.3.1.51.2	$36,077						$36,077	CDFW
	SONCC-LTR.3.1.51.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-LTR.26.1.50									
	SONCC-LTR.26.1.50.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-LTR.14.2.14									
	SONCC-LTR.14.2.14.1	$0						$0	CDFW
	SONCC-LTR.14.2.14.2	$5,112	$5,112	$5,112	$5,112	$5,112	$5,112	$30,672	CDFW
	Action Total:	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$30,672*	
SONCC-LTR.8.1.13									
	SONCC-LTR.8.1.13.1	$743,613						$743,613	USFS
	SONCC-LTR.8.1.13.2	$6,041,517						$6,041,517	USFS
	SONCC-LTR.8.1.13.3	$1,349,653						$1,349,653	USFS
	SONCC-LTR.8.1.13.4	$1,781,000					$1,781,000	$3,561,999	USFS
	Action Total:	*$9,915,783*					*$1,781,000*	*$11,696,782*	
SONCC-LTR.8.1.60									
	SONCC-LTR.8.1.60.1	$743,613						$743,613	USFS
	SONCC-LTR.8.1.60.2	$6,041,517						$6,041,517	USFS
	SONCC-LTR.8.1.60.3	$1,349,653						$1,349,653	USFS
	SONCC-LTR.8.1.60.4	$1,781,000					$1,781,000	$3,561,999	USFS
	Action Total:	*$9,915,783*					*$1,781,000*	*$11,696,782*	
SONCC-LTR.3.1.2									
	SONCC-LTR.3.1.2.1	$36,770						$36,770	DWR
	SONCC-LTR.3.1.2.2	$76,136						$76,136	DWR
	Action Total:	*$112,906*						*$112,906*	
SONCC-LTR.3.1.39									
	SONCC-LTR.3.1.39.1	$73,540						$73,540	CDFW
	SONCC-LTR.3.1.39.2	$36,770						$36,770	CDFW
	SONCC-LTR.3.1.39.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-LTR.2.2.9									
	SONCC-LTR.2.2.9.1	$17,008						$17,008	CDFW
	SONCC-LTR.2.2.9.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-LTR.2.2.9.3	$10,000						$10,000	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-LTR.2.2.57									
	SONCC-LTR.2.2.57.1	$17,008						$17,008	CDFW
	SONCC-LTR.2.2.57.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-LTR.2.2.57.3	$10,000						$10,000	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-LTR.10.7.49									
	SONCC-LTR.10.7.49.1	$8,504						$8,504	CDFW
	SONCC-LTR.10.7.49.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-LTR.10.7.52									
	SONCC-LTR.10.7.52.1	$8,504						$8,504	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-LTR.10.7.52.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-LTR.2.2.10									
	SONCC-LTR.2.2.10.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-LTR.16.1.16									
	SONCC-LTR.16.1.16.1	$34,015						$34,015	NMFS
	SONCC-LTR.16.1.16.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LTR.16.1.17									
	SONCC-LTR.16.1.17.1	$34,015						$34,015	NMFS
	SONCC-LTR.16.1.17.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LTR.16.1.47									
	SONCC-LTR.16.1.47.1	$34,015						$34,015	NMFS
	SONCC-LTR.16.1.47.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LTR.16.1.48									
	SONCC-LTR.16.1.48.1	$34,015						$34,015	BIA/Tribe
	SONCC-LTR.16.1.48.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-LTR.16.2.18									
	SONCC-LTR.16.2.18.1	$34,015						$34,015	NMFS
	SONCC-LTR.16.2.18.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LTR.16.2.19									
	SONCC-LTR.16.2.19.1	$34,015						$34,015	NMFS
	SONCC-LTR.16.2.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-LTR.10.2.30									
	SONCC-LTR.10.2.30.1	$76,136						$76,136	RWQCB
	Action Total:	*$76,136*						*$76,136*	
SONCC-LTR.27.2.24									
	SONCC-LTR.27.2.24.1	$136,060						$136,060	CDFW
	SONCC-LTR.27.2.24.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-LTR.27.2.25									
	SONCC-LTR.27.2.25.1	$418,179		$418,179		$418,179		$1,254,537	CDFW
	Action Total:	*$418,179*		*$418,179*		*$418,179*		*$1,254,537*	
SONCC-LTR.27.2.26									
	SONCC-LTR.27.2.26.1	$1,949,465		$1,949,465		$1,949,465		$5,848,395	CDFW
	Action Total:	*$1,949,465*		*$1,949,465*		*$1,949,465*		*$5,848,395*	
SONCC-LTR.27.2.27									
	SONCC-LTR.27.2.27.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-LTR.27.2.27.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-LTR.27.2.46									
	SONCC-LTR.27.2.46.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LTR.27.1.34									
	SONCC-LTR.27.1.34.1	$34,015						$34,015	NMFS
	SONCC-LTR.27.1.34.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-LTR.27.1.41									
	SONCC-LTR.27.1.41.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-LTR.27.1.45									
	SONCC-LTR.27.1.45.1	$56,003	$56,003	$56,003	$56,003	$56,003	$56,003	$336,018	CDFW
	Action Total:	*$56,003*	*$56,003*	*$56,003*	*$56,003*	*$56,003*	*$56,003*	*$336,018*	
SONCC-LTR.27.1.20									
	SONCC-LTR.27.1.20.1	$168,009	$168,009	$168,009	$168,009	$168,009	$168,009	$1,008,054	CDFW
	Action Total:	*$168,009*	*$168,009*	*$168,009*	*$168,009*	*$168,009*	*$168,009*	*$1,008,054*	
SONCC-LTR.27.1.21									
	SONCC-LTR.27.1.21.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-LTR.27.1.22									
	SONCC-LTR.27.1.22.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-LTR.27.1.23									
	SONCC-LTR.27.1.23.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-LTR.27.1.23.2	$13,084	$13,084	$13,084	$13,084	$13,084	$13,084	$78,504	CDFW
	Action Total:	*$98,122*	*$98,122*	*$98,122*	*$98,122*	*$98,122*	*$98,122*	*$588,729*	
SONCC-LTR.27.4.42									
	SONCC-LTR.27.4.42.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LTR.27.4.43									
	SONCC-LTR.27.4.43.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-LTR.27.4.44									
	SONCC-LTR.27.4.44.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
	Population Total:	***$49,472,801***	***$2,149,530***	***$4,503,404***	***$2,149,530***	***$4,503,404***	***$5,711,529***	***$68,490,198***	

Population: Mad River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MadR.2.1.1									
	SONCC-MadR.2.1.1.1	$17,008						$17,008	CDFW
	SONCC-MadR.2.1.1.2	$3,451,455						$3,451,455	CDFW
	Action Total:	*$3,468,463*						*$3,468,463*	
SONCC-MadR.2.1.50									
	SONCC-MadR.2.1.50.1	$17,008						$17,008	CDFW
	SONCC-MadR.2.1.50.2	$3,451,455						$3,451,455	CDFW
	Action Total:	*$3,468,463*						*$3,468,463*	
SONCC-MadR.2.2.2									
	SONCC-MadR.2.2.2.1	$17,008						$17,008	CDFW
	SONCC-MadR.2.2.2.2	$664,677						$664,677	CDFW
	Action Total:	*$681,685*						*$681,685*	
SONCC-MadR.2.2.51									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MadR.2.2.51.1	$17,008						$17,008	CDFW
	SONCC-MadR.2.2.51.2	$664,677						$664,677	CDFW
	Action Total:	*$681,685*						*$681,685*	
SONCC-MadR.8.1.13									
	SONCC-MadR.8.1.13.1	$375,089						$375,089	NGO
	SONCC-MadR.8.1.13.2	$379,992						$379,992	NGO
	Action Total:	*$755,081*						*$755,081*	
SONCC-MadR.8.1.15									
	SONCC-MadR.8.1.15.1	$1,053,659						$1,053,659	NGO
	SONCC-MadR.8.1.15.2	$31,005,145						$31,005,145	NGO
	SONCC-MadR.8.1.15.3	$2,235,844						$2,235,844	NGO
	SONCC-MadR.8.1.15.4	$1,178,972					$1,178,972	$2,357,943	NGO
	Action Total:	*$35,473,620*					*$1,178,972*	*$36,652,591*	
SONCC-MadR.8.1.16									
	SONCC-MadR.8.1.16.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MadR.8.1.57									
	SONCC-MadR.8.1.57.1	$375,089						$375,089	NGO
	SONCC-MadR.8.1.57.2	$379,992						$379,992	NGO
	Action Total:	*$755,081*						*$755,081*	
SONCC-MadR.8.1.58									
	SONCC-MadR.8.1.58.1	$1,053,659						$1,053,659	NGO
	SONCC-MadR.8.1.58.2	$31,005,145						$31,005,145	NGO
	SONCC-MadR.8.1.58.3	$2,235,844						$2,235,844	NGO
	SONCC-MadR.8.1.58.4	$1,178,972					$1,178,972	$2,357,943	NGO
	Action Total:	*$35,473,620*					*$1,178,972*	*$36,652,591*	
SONCC-MadR.2.2.3									
	SONCC-MadR.2.2.3.1	$34,015						$34,015	NMFS
	SONCC-MadR.2.2.3.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.8.1.14									
	SONCC-MadR.8.1.14.1	$18,200						$18,200	CDF
	SONCC-MadR.8.1.14.2	$5,060,016						$5,060,016	CDF
	Action Total:	*$5,078,216*						*$5,078,216*	
SONCC-MadR.5.1.10									
	SONCC-MadR.5.1.10.1	$22,270						$22,270	Caltrans
	SONCC-MadR.5.1.10.2	$218,023						$218,023	Caltrans
	Action Total:	*$240,293*						*$240,293*	
SONCC-MadR.5.1.37									
	SONCC-MadR.5.1.37.1	$62,640						$62,640	CDFW
	SONCC-MadR.5.1.37.2	$1,779,084						$1,779,084	CDFW
	SONCC-MadR.5.1.37.3	$25,563						$25,563	CDFW
	Action Total:	*$1,867,287*						*$1,867,287*	
SONCC-MadR.5.1.53									
	SONCC-MadR.5.1.53.1	$22,270						$22,270	Caltrans
	SONCC-MadR.5.1.53.2	$218,023						$218,023	Caltrans
	Action Total:	*$240,293*						*$240,293*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MadR.5.1.54									
	SONCC-MadR.5.1.54.1	$62,640						$62,640	CDFW
	SONCC-MadR.5.1.54.2	$1,779,084						$1,779,084	CDFW
	SONCC-MadR.5.1.54.3	$25,563						$25,563	CDFW
	Action Total:	*$1,867,287*						*$1,867,287*	
SONCC-MadR.1.1.4									
	SONCC-MadR.1.1.4.1	$34,015						$34,015	CDFW
	SONCC-MadR.1.1.4.2	$593,022						$593,022	CDFW
	Action Total:	*$627,037*						*$627,037*	
SONCC-MadR.7.1.6									
	SONCC-MadR.7.1.6.1	$17,077						$17,077	CDF
	Action Total:	*$17,077*						*$17,077*	
SONCC-MadR.7.1.8									
	SONCC-MadR.7.1.8.1	$5,669						$5,669	CDF
	SONCC-MadR.7.1.8.2	$34,015	$34,015	$34,015	$34,015	$34,015	$34,015	$204,090	CDF
	Action Total:	*$39,684*	*$34,015*	*$34,015*	*$34,015*	*$34,015*	*$34,015*	*$209,759*	
SONCC-MadR.26.1.48									
	SONCC-MadR.26.1.48.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MadR.5.1.9									
	SONCC-MadR.5.1.9.1	$17,008						$17,008	BIA/Tribe
	SONCC-MadR.5.1.9.2	$145,350						$145,350	BIA/Tribe
	Action Total:	*$162,358*						*$162,358*	
SONCC-MadR.5.1.55									
	SONCC-MadR.5.1.55.1	$17,008						$17,008	BIA/Tribe
	SONCC-MadR.5.1.55.2	$145,350						$145,350	BIA/Tribe
	Action Total:	*$162,358*						*$162,358*	
SONCC-MadR.1.2.36									
	SONCC-MadR.1.2.36.1	$34,015						$34,015	CDFW
	SONCC-MadR.1.2.36.2	$34,015						$34,015	CDFW
	SONCC-MadR.1.2.36.3	$341,075						$341,075	CDFW
	Action Total:	*$409,105*						*$409,105*	
SONCC-MadR.3.1.18									
	SONCC-MadR.3.1.18.1	$34,015						$34,015	NMFS
	SONCC-MadR.3.1.18.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.3.1.19									
	SONCC-MadR.3.1.19.1	$17,008						$17,008	CDFW
	SONCC-MadR.3.1.19.2	$17,008						$17,008	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-MadR.3.1.41									
	SONCC-MadR.3.1.41.1	$73,540						$73,540	CDFW
	SONCC-MadR.3.1.41.2	$36,770						$36,770	CDFW
	SONCC-MadR.3.1.41.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-MadR.3.1.52									
	SONCC-MadR.3.1.52.1	$17,008						$17,008	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MadR.3.1.52.2	$17,008						$17,008	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-MadR.7.1.5									
	SONCC-MadR.7.1.5.1	$34,015						$34,015	Private
	SONCC-MadR.7.1.5.2	$485,792						$485,792	Private
	SONCC-MadR.7.1.5.3	$3,530,261						$3,530,261	Private
	SONCC-MadR.7.1.5.4	$158,614						$158,614	Private
	SONCC-MadR.7.1.5.5	$0						$0	USFS
	Action Total:	*$4,208,682*						*$4,208,682*	
SONCC-MadR.7.1.7									
	SONCC-MadR.7.1.7.1	$17,008						$17,008	NRCS/RCD
	SONCC-MadR.7.1.7.2	$17,008						$17,008	NRCS/RCD
	SONCC-MadR.7.1.7.3	$374,880						$374,880	NRCS/RCD
	SONCC-MadR.7.1.7.4	$20,638						$20,638	NRCS/RCD
	SONCC-MadR.7.1.7.5	$911						$911	NRCS/RCD
	Action Total:	*$430,444*						*$430,444*	
SONCC-MadR.7.1.56									
	SONCC-MadR.7.1.56.1	$17,008						$17,008	NRCS/RCD
	SONCC-MadR.7.1.56.2	$17,008						$17,008	NRCS/RCD
	SONCC-MadR.7.1.56.3	$374,880						$374,880	NRCS/RCD
	SONCC-MadR.7.1.56.4	$20,638						$20,638	NRCS/RCD
	SONCC-MadR.7.1.56.5	$911						$911	NRCS/RCD
	Action Total:	*$430,444*						*$430,444*	
SONCC-MadR.16.1.21									
	SONCC-MadR.16.1.21.1	$34,015						$34,015	NMFS
	SONCC-MadR.16.1.21.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.16.1.22									
	SONCC-MadR.16.1.22.1	$34,015						$34,015	NMFS
	SONCC-MadR.16.1.22.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.16.2.23									
	SONCC-MadR.16.2.23.1	$34,015						$34,015	NMFS
	SONCC-MadR.16.2.23.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.16.2.24									
	SONCC-MadR.16.2.24.1	$34,015						$34,015	NMFS
	SONCC-MadR.16.2.24.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.17.2.12									
	SONCC-MadR.17.2.12.1	$34,015						$34,015	CDFW
	SONCC-MadR.17.2.12.2	$68,030						$68,030	CDFW
	Action Total:	*$102,045*						*$102,045*	
SONCC-MadR.10.2.20									
	SONCC-MadR.10.2.20.1	$0						$0	EPA
	SONCC-MadR.10.2.20.2	$0						$0	RWQCB
	Action Total:	*$0*						*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MadR.10.7.47									
	SONCC-MadR.10.7.47.1	$8,504						$8,504	CDFW
	SONCC-MadR.10.7.47.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MadR.10.7.49									
	SONCC-MadR.10.7.49.1	$8,504						$8,504	CDFW
	SONCC-MadR.10.7.49.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MadR.27.2.30									
	SONCC-MadR.27.2.30.1	$136,060						$136,060	CDFW
	SONCC-MadR.27.2.30.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-MadR.27.2.31									
	SONCC-MadR.27.2.31.1	$778,975		$778,975		$778,975		$2,336,925	CDFW
	Action Total:	*$778,975*		*$778,975*		*$778,975*		*$2,336,925*	
SONCC-MadR.27.2.32									
	SONCC-MadR.27.2.32.1	$778,975		$778,975		$778,975		$2,336,925	CDFW
	Action Total:	*$778,975*		*$778,975*		*$778,975*		*$2,336,925*	
SONCC-MadR.27.2.33									
	SONCC-MadR.27.2.33.1	$778,975		$778,975		$778,975		$2,336,925	CDFW
	Action Total:	*$778,975*		*$778,975*		*$778,975*		*$2,336,925*	
SONCC-MadR.27.2.34									
	SONCC-MadR.27.2.34.1	$778,975		$778,975		$778,975		$2,336,925	CDFW
	Action Total:	*$778,975*		*$778,975*		*$778,975*		*$2,336,925*	
SONCC-MadR.27.2.35									
	SONCC-MadR.27.2.35.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MadR.27.2.40									
	SONCC-MadR.27.2.40.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-MadR.27.2.45									
	SONCC-MadR.27.2.45.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MadR.27.2.46									
	SONCC-MadR.27.2.46.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MadR.27.1.25									
	SONCC-MadR.27.1.25.1	$229,305	$229,305	$229,305	$229,305	$229,305	$229,305	$1,375,830	CDFW
	Action Total:	*$229,305*	*$229,305*	*$229,305*	*$229,305*	*$229,305*	*$229,305*	*$1,375,830*	
SONCC-MadR.27.1.26									
	SONCC-MadR.27.1.26.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-MadR.27.1.27									
	SONCC-MadR.27.1.27.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MadR.27.1.28									
	SONCC-MadR.27.1.28.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MadR.27.1.29									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MadR.27.1.29.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MadR.27.1.38									
	SONCC-MadR.27.1.38.1	$76,435	$76,435	$76,435	$76,435	$76,435	$76,435	$458,610	CDFW
	Action Total:	*$76,435*	*$76,435*	*$76,435*	*$76,435*	*$76,435*	*$76,435*	*$458,610*	
SONCC-MadR.27.1.39									
	SONCC-MadR.27.1.39.1	$34,015						$34,015	NMFS
	SONCC-MadR.27.1.39.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-MadR.27.4.42									
	SONCC-MadR.27.4.42.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MadR.27.4.43									
	SONCC-MadR.27.4.43.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MadR.27.4.44									
	SONCC-MadR.27.4.44.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
	Population Total:	***$101,777,080***	***$1,119,478***	***$4,255,623***	***$1,119,478***	***$4,255,623***	***$3,477,421***	***$116,004,701***	

Population: Mainstem Eel River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MER.2.1.37									
	SONCC-MER.2.1.37.1	$17,008						$17,008	CDFW
	SONCC-MER.2.1.37.2	$227,084						$227,084	CDFW
	Action Total:	*$244,092*						*$244,092*	
SONCC-MER.2.1.9									
	SONCC-MER.2.1.9.1	$17,008						$17,008	CDFW
	SONCC-MER.2.1.9.2	$575,243						$575,243	CDFW
	Action Total:	*$592,250*						*$592,250*	
SONCC-MER.2.1.62									
	SONCC-MER.2.1.62.1	$17,008						$17,008	CDFW
	SONCC-MER.2.1.62.2	$227,084						$227,084	CDFW
	Action Total:	*$244,092*						*$244,092*	
SONCC-MER.2.1.63									
	SONCC-MER.2.1.63.1	$17,008						$17,008	CDFW
	SONCC-MER.2.1.63.2	$575,243						$575,243	CDFW
	Action Total:	*$592,250*						*$592,250*	
SONCC-MER.10.3.36									
	SONCC-MER.10.3.36.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-MER.10.3.60									
	SONCC-MER.10.3.60.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-MER.2.2.8									
	SONCC-MER.2.2.8.1	$17,008						$17,008	CDFW
	SONCC-MER.2.2.8.2	$107,371						$107,371	CDFW
	Action Total:	*$124,378*						*$124,378*	
SONCC-MER.2.2.64									
	SONCC-MER.2.2.64.1	$17,008						$17,008	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MER.2.2.64.2	$107,371						$107,371	CDFW
	Action Total:	*$124,378*						*$124,378*	
SONCC-MER.14.2.2									
	SONCC-MER.14.2.2.1	$68,030						$68,030	CDFW
	SONCC-MER.14.2.2.2	$2,959,250						$2,959,250	CDFW
	Action Total:	*$3,027,280*						*$3,027,280*	
SONCC-MER.10.1.35									
	SONCC-MER.10.1.35.1	$17,008						$17,008	CDFW
	SONCC-MER.10.1.35.2	$567,025						$567,025	CDFW
	SONCC-MER.10.1.35.3	$18,053						$18,053	CDFW
	Action Total:	*$602,085*						*$602,085*	
SONCC-MER.10.1.59									
	SONCC-MER.10.1.59.1	$17,008						$17,008	CDFW
	SONCC-MER.10.1.59.2	$567,025						$567,025	CDFW
	SONCC-MER.10.1.59.3	$18,053						$18,053	CDFW
	Action Total:	*$602,085*						*$602,085*	
SONCC-MER.1.2.31									
	SONCC-MER.1.2.31.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-MER.3.1.53									
	SONCC-MER.3.1.53.1	$0						$0	SWRCB
	SONCC-MER.3.1.53.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-MER.3.1.58									
	SONCC-MER.3.1.58.1	$18,385						$18,385	SWRCB
	SONCC-MER.3.1.58.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-MER.3.1.67									
	SONCC-MER.3.1.67.1	$18,385						$18,385	SWRCB
	SONCC-MER.3.1.67.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-MER.5.1.33									
	SONCC-MER.5.1.33.1	$159,090						$159,090	CDFW
	Action Total:	*$159,090*						*$159,090*	
SONCC-MER.5.1.13									
	SONCC-MER.5.1.13.1	$22,270						$22,270	CDFW
	SONCC-MER.5.1.13.2	$610,463						$610,463	CDFW
	Action Total:	*$632,733*						*$632,733*	
SONCC-MER.5.1.68									
	SONCC-MER.5.1.68.1	$22,270						$22,270	CDFW
	SONCC-MER.5.1.68.2	$610,463						$610,463	CDFW
	Action Total:	*$632,733*						*$632,733*	
SONCC-MER.3.1.39									
	SONCC-MER.3.1.39.1	$73,540						$73,540	CDFW
	SONCC-MER.3.1.39.2	$73,540						$73,540	CDFW
	SONCC-MER.3.1.39.3	$36,770						$36,770	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-MER.3.1.4									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MER.3.1.4.1	$36,077						$36,077	CDFW
	SONCC-MER.3.1.4.2	$36,077						$36,077	CDFW
	SONCC-MER.3.1.4.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-MER.3.1.5									
	SONCC-MER.3.1.5.1	$38,068						$38,068	SWRCB
	Action Total:	*$38,068*						*$38,068*	
SONCC-MER.3.1.6									
	SONCC-MER.3.1.6.1	$350,000						$350,000	NGO
	SONCC-MER.3.1.6.2	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$15,000	NGO
	Action Total:	*$352,500*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$365,000*	
SONCC-MER.3.1.56									
	SONCC-MER.3.1.56.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	SWRCB
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-MER.3.1.65									
	SONCC-MER.3.1.65.1	$38,068						$38,068	SWRCB
	Action Total:	*$38,068*						*$38,068*	
SONCC-MER.3.1.66									
	SONCC-MER.3.1.66.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	SWRCB
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-MER.26.1.1									
	SONCC-MER.26.1.1.1	$68,030						$68,030	CDFW
	SONCC-MER.26.1.1.2	$500,000						$500,000	CDFW
	SONCC-MER.26.1.1.3	$600,000	$600,000	$600,000				$1,800,000	CDFW
	SONCC-MER.26.1.1.4	$1,250,000	$1,250,000	$1,250,000				$3,750,000	CDFW
	Action Total:	*$2,418,030*	*$1,850,000*	*$1,850,000*				*$6,118,030*	
SONCC-MER.26.1.57									
	SONCC-MER.26.1.57.1	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$306,750*	
SONCC-MER.3.1.34									
	SONCC-MER.3.1.34.1	$34,015						$34,015	CDFW
	SONCC-MER.3.1.34.2	$34,015						$34,015	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-MER.3.1.55									
	SONCC-MER.3.1.55.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-MER.7.1.12									
	SONCC-MER.7.1.12.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-MER.8.1.14									
	SONCC-MER.8.1.14.1	$466,177						$466,177	CDFW
	SONCC-MER.8.1.14.2	$32,227,895						$32,227,895	CDFW
	SONCC-MER.8.1.14.3	$4,245,540						$4,245,540	CDFW
	SONCC-MER.8.1.14.4	$1,243,475	$1,243,475	$1,243,475	$1,243,475	$1,243,475	$1,243,475	$7,460,847	CDFW
	Action Total:	*$38,183,086*	*$1,243,475*	*$1,243,475*	*$1,243,475*	*$1,243,475*	*$1,243,475*	*$44,400,459*	
SONCC-MER.8.1.16									
	SONCC-MER.8.1.16.1	$395,765						$395,765	CDF
	SONCC-MER.8.1.16.2	$1,078,916						$1,078,916	CDF

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$1,474,681*						*$1,474,681*	
SONCC-MER.8.1.17									
	SONCC-MER.8.1.17.1	$34,015						$34,015	CDF
	SONCC-MER.8.1.17.2	$34,015						$34,015	CDF
	Action Total:	*$68,030*						*$68,030*	
SONCC-MER.8.1.69									
	SONCC-MER.8.1.69.1	$466,177						$466,177	CDFW
	SONCC-MER.8.1.69.2	$32,227,895						$32,227,895	CDFW
	SONCC-MER.8.1.69.3	$4,245,540						$4,245,540	CDFW
	SONCC-MER.8.1.69.4	$1,243,475	$1,243,475	$1,243,475	$1,243,475	$1,243,475	$1,243,475	$7,460,847	CDFW
	Action Total:	*$38,183,086*	*$1,243,475*	*$1,243,475*	*$1,243,475*	*$1,243,475*	*$1,243,475*	*$44,400,459*	
SONCC-MER.8.1.70									
	SONCC-MER.8.1.70.1	$395,765						$395,765	CDF
	SONCC-MER.8.1.70.2	$1,078,916						$1,078,916	CDF
	Action Total:	*$1,474,681*						*$1,474,681*	
SONCC-MER.10.7.52									
	SONCC-MER.10.7.52.1	$8,504						$8,504	CDFW
	SONCC-MER.10.7.52.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MER.10.7.61									
	SONCC-MER.10.7.61.1	$8,504						$8,504	CDFW
	SONCC-MER.10.7.61.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MER.3.1.3									
	SONCC-MER.3.1.3.1	$8,503						$8,503	County
	Action Total:	*$8,503*						*$8,503*	
SONCC-MER.3.1.7									
	SONCC-MER.3.1.7.1	$76,136						$76,136	SWRCB
	Action Total:	*$76,136*						*$76,136*	
SONCC-MER.7.1.10									
	SONCC-MER.7.1.10.1	$34,015						$34,015	CDF
	SONCC-MER.7.1.10.2	$79,261						$79,261	CDF
	SONCC-MER.7.1.10.3	$572,098						$572,098	CDF
	Action Total:	*$685,373*						*$685,373*	
SONCC-MER.16.1.19									
	SONCC-MER.16.1.19.1	$34,015						$34,015	NMFS
	SONCC-MER.16.1.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MER.16.1.20									
	SONCC-MER.16.1.20.1	$34,015						$34,015	NMFS
	SONCC-MER.16.1.20.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MER.16.2.21									
	SONCC-MER.16.2.21.1	$34,015						$34,015	NMFS
	SONCC-MER.16.2.21.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MER.16.2.22									
	SONCC-MER.16.2.22.1	$34,015						$34,015	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MER.16.2.22.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MER.8.1.15									
	SONCC-MER.8.1.15.1	$2,267						$2,267	County
	Action Total:	*$2,267*						*$2,267*	
SONCC-MER.27.2.47									
	SONCC-MER.27.2.47.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-MER.27.2.48									
	SONCC-MER.27.2.48.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MER.27.2.40									
	SONCC-MER.27.2.40.1	$690,280		$690,280		$690,280		$2,070,840	CDFW
	Action Total:	*$690,280*		*$690,280*		*$690,280*		*$2,070,840*	
SONCC-MER.27.2.41									
	SONCC-MER.27.2.41.1	$690,280		$690,280		$690,280		$2,070,840	CDFW
	Action Total:	*$690,280*		*$690,280*		*$690,280*		*$2,070,840*	
SONCC-MER.27.2.42									
	SONCC-MER.27.2.42.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-MER.27.2.42.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-MER.27.2.43									
	SONCC-MER.27.2.43.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MER.27.2.27									
	SONCC-MER.27.2.27.1	$136,060						$136,060	CDFW
	SONCC-MER.27.2.27.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-MER.27.2.28									
	SONCC-MER.27.2.28.1	$690,280		$690,280		$690,280		$2,070,840	CDFW
	Action Total:	*$690,280*		*$690,280*		*$690,280*		*$2,070,840*	
SONCC-MER.27.2.29									
	SONCC-MER.27.2.29.1	$690,280		$690,280		$690,280		$2,070,840	CDFW
	Action Total:	*$690,280*		*$690,280*		*$690,280*		*$2,070,840*	
SONCC-MER.27.2.51									
	SONCC-MER.27.2.51.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MER.27.1.30									
	SONCC-MER.27.1.30.1	$71,952	$71,952	$71,952	$71,952	$71,952	$71,952	$431,712	CDFW
	Action Total:	*$71,952*	*$71,952*	*$71,952*	*$71,952*	*$71,952*	*$71,952*	*$431,712*	
SONCC-MER.27.1.32									
	SONCC-MER.27.1.32.1	$34,015						$34,015	NMFS
	SONCC-MER.27.1.32.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-MER.27.1.23									
	SONCC-MER.27.1.23.1	$116,550	$116,550	$116,550	$116,550	$116,550	$116,550	$699,300	CDFW
	Action Total:	*$116,550*	*$116,550*	*$116,550*	*$116,550*	*$116,550*	*$116,550*	*$699,300*	
SONCC-MER.27.1.24									
	SONCC-MER.27.1.24.1	$68,030		$68,030		$68,030		$204,090	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-MER.27.1.25									
	SONCC-MER.27.1.25.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MER.27.1.26									
	SONCC-MER.27.1.26.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-MER.27.1.26.2	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	CDFW
	Action Total:	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$612,270*	
SONCC-MER.27.1.50									
	SONCC-MER.27.1.50.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-MER.27.4.44									
	SONCC-MER.27.4.44.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MER.27.4.45									
	SONCC-MER.27.4.45.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MER.27.4.46									
	SONCC-MER.27.4.46.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MER.27.4.49									
	SONCC-MER.27.4.49.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MER.7.1.11									
	SONCC-MER.7.1.11.1							$0	CDF
	SONCC-MER.7.1.11.2							$0	CDF
	Action Total:							*$0*	
	Population Total:	***$96,787,689***	***$6,665,574***	***$9,446,939***	***$4,815,574***	***$7,596,939***	***$4,815,574***	***$130,128,286***	

Population: Maple Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MapC.8.1.4									
	SONCC-MapC.8.1.4.1	$188,183						$188,183	NGO
	SONCC-MapC.8.1.4.2	$7,178,040						$7,178,040	NGO
	SONCC-MapC.8.1.4.3	$85,089						$85,089	NGO
	SONCC-MapC.8.1.4.4	$112,283					$112,283	$224,566	NGO
	Action Total:	*$7,563,595*					*$112,283*	*$7,675,878*	
SONCC-MapC.8.1.34									
	SONCC-MapC.8.1.34.1	$188,183						$188,183	NGO
	SONCC-MapC.8.1.34.2	$7,178,040						$7,178,040	NGO
	SONCC-MapC.8.1.34.3	$85,089						$85,089	NGO
	SONCC-MapC.8.1.34.4	$112,283					$112,283	$224,566	NGO
	Action Total:	*$7,563,595*					*$112,283*	*$7,675,878*	
SONCC-MapC.1.2.21									
	SONCC-MapC.1.2.21.1	$34,015						$34,015	CDFW
	SONCC-MapC.1.2.21.2	$34,015						$34,015	CDFW
	SONCC-MapC.1.2.21.3	$341,075						$341,075	CDFW
	Action Total:	*$409,105*						*$409,105*	
SONCC-MapC.1.3.6									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MapC.1.3.6.1	$44,540						$44,540	Caltrans
	SONCC-MapC.1.3.6.2	$1,556,400						$1,556,400	Caltrans
	Action Total:	*$1,600,940*						*$1,600,940*	
SONCC-MapC.2.1.1									
	SONCC-MapC.2.1.1.1	$17,008						$17,008	NGO
	SONCC-MapC.2.1.1.2	$1,040,915						$1,040,915	NGO
	Action Total:	*$1,057,923*						*$1,057,923*	
SONCC-MapC.2.1.31									
	SONCC-MapC.2.1.31.1	$17,008						$17,008	NGO
	SONCC-MapC.2.1.31.2	$1,040,915						$1,040,915	NGO
	Action Total:	*$1,057,923*						*$1,057,923*	
SONCC-MapC.2.2.2									
	SONCC-MapC.2.2.2.1	$17,008						$17,008	NGO
	SONCC-MapC.2.2.2.2	$194,290						$194,290	NGO
	Action Total:	*$211,298*						*$211,298*	
SONCC-MapC.2.2.32									
	SONCC-MapC.2.2.32.1	$17,008						$17,008	NGO
	SONCC-MapC.2.2.32.2	$194,290						$194,290	NGO
	Action Total:	*$211,298*						*$211,298*	
SONCC-MapC.2.2.29									
	SONCC-MapC.2.2.29.1	$17,008						$17,008	CDFW
	SONCC-MapC.2.2.29.2	$204,516						$204,516	CDFW
	Action Total:	*$221,524*						*$221,524*	
SONCC-MapC.2.2.33									
	SONCC-MapC.2.2.33.1	$17,008						$17,008	CDFW
	SONCC-MapC.2.2.33.2	$204,516						$204,516	CDFW
	Action Total:	*$221,524*						*$221,524*	
SONCC-MapC.1.3.7									
	SONCC-MapC.1.3.7.1	$44,540						$44,540	Private
	SONCC-MapC.1.3.7.2	$568,181						$568,181	Private
	Action Total:	*$612,721*						*$612,721*	
SONCC-MapC.14.3.9									
	SONCC-MapC.14.3.9.1	$34,015						$34,015	CDFW
	SONCC-MapC.14.3.9.2	$15,736	$15,736	$15,736	$15,736	$15,736	$15,736	$94,416	CDFW
	Action Total:	*$49,751*	*$15,736*	*$15,736*	*$15,736*	*$15,736*	*$15,736*	*$128,431*	
SONCC-MapC.14.2.8									
	SONCC-MapC.14.2.8.1	$34,015						$34,015	CDFW
	SONCC-MapC.14.2.8.2	$19,950						$19,950	CDFW
	Action Total:	*$53,965*						*$53,965*	
SONCC-MapC.7.1.3									
	SONCC-MapC.7.1.3.1	$34,015						$34,015	NGO
	SONCC-MapC.7.1.3.2	$145,738						$145,738	NGO
	SONCC-MapC.7.1.3.3	$1,060,474						$1,060,474	NGO
	Action Total:	*$1,240,226*						*$1,240,226*	
SONCC-MapC.26.1.28									
	SONCC-MapC.26.1.28.1	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$306,750*	
SONCC-MapC.10.7.27									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MapC.10.7.27.1	$8,504						$8,504	CDFW
	SONCC-MapC.10.7.27.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MapC.10.7.30									
	SONCC-MapC.10.7.30.1	$8,504						$8,504	CDFW
	SONCC-MapC.10.7.30.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MapC.16.1.11									
	SONCC-MapC.16.1.11.1	$34,015						$34,015	NMFS
	SONCC-MapC.16.1.11.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MapC.16.2.12									
	SONCC-MapC.16.2.12.1	$34,015						$34,015	NMFS
	SONCC-MapC.16.2.12.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MapC.16.2.13									
	SONCC-MapC.16.2.13.1	$34,015						$34,015	NMFS
	SONCC-MapC.16.2.13.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MapC.27.2.17									
	SONCC-MapC.27.2.17.1	$136,060						$136,060	CDFW
	SONCC-MapC.27.2.17.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-MapC.27.2.18									
	SONCC-MapC.27.2.18.1	$56,859		$56,859		$56,859		$170,577	CDFW
	Action Total:	*$56,859*		*$56,859*		*$56,859*		*$170,577*	
SONCC-MapC.27.2.19									
	SONCC-MapC.27.2.19.1	$56,859		$56,859		$56,859		$170,577	CDFW
	Action Total:	*$56,859*		*$56,859*		*$56,859*		*$170,577*	
SONCC-MapC.27.2.20									
	SONCC-MapC.27.2.20.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MapC.27.2.23									
	SONCC-MapC.27.2.23.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-MapC.27.2.24									
	SONCC-MapC.27.2.24.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-MapC.27.2.24.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-MapC.27.2.26									
	SONCC-MapC.27.2.26.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MapC.27.1.15									
	SONCC-MapC.27.1.15.1	$20,650	$20,650	$20,650	$20,650	$20,650	$20,650	$123,900	CDFW
	Action Total:	*$20,650*	*$20,650*	*$20,650*	*$20,650*	*$20,650*	*$20,650*	*$123,900*	
SONCC-MapC.27.1.16									
	SONCC-MapC.27.1.16.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MapC.27.1.22									
	SONCC-MapC.27.1.22.1	$34,015						$34,015	NMFS
	SONCC-MapC.27.1.22.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-MapC.27.4.25									
	SONCC-MapC.27.4.25.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MapC.8.1.5									
	SONCC-MapC.8.1.5.1							$0	County
	Action Total:							*$0*	
SONCC-MapC.16.1.10									
	SONCC-MapC.16.1.10.1							$0	NMFS
	SONCC-MapC.16.1.10.2							$0	NMFS
	Action Total:							*$0*	
	Population Total:	***$23,143,354***	***$498,419***	***$564,352***	***$498,419***	***$564,352***	***$722,985***	***$25,991,878***	

Population: Mattole River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MatR.3.1.3									
	SONCC-MatR.3.1.3.1	$36,077						$36,077	CDFW
	SONCC-MatR.3.1.3.2	$36,077						$36,077	CDFW
	SONCC-MatR.3.1.3.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-MatR.3.1.6									
	SONCC-MatR.3.1.6.1	$247,000	$247,000	$247,000	$247,000	$247,000	$247,000	$1,482,000	SWRCB
	Action Total:	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$1,482,000*	
SONCC-MatR.26.1.47									
	SONCC-MatR.26.1.47.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MatR.26.1.1									
	SONCC-MatR.26.1.1.1	$68,030						$68,030	NGO
	SONCC-MatR.26.1.1.2	$17,000						$17,000	NGO
	SONCC-MatR.26.1.1.3	$500,000						$500,000	NGO
	SONCC-MatR.26.1.1.4	$600,000	$600,000	$600,000				$1,800,000	NGO
	SONCC-MatR.26.1.1.5	$1,250,000	$1,250,000	$1,250,000	$1,250,000			$5,000,000	NGO
	Action Total:	*$2,435,030*	*$1,850,000*	*$1,850,000*	*$1,250,000*			*$7,385,030*	
SONCC-MatR.3.1.5									
	SONCC-MatR.3.1.5.1	$175,000	$175,000					$350,000	CDFW
	SONCC-MatR.3.1.5.2	$1,250	$1,250	$1,250	$1,250	$1,250	$1,250	$7,500	CDFW
	Action Total:	*$176,250*	*$176,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$357,500*	
SONCC-MatR.3.1.7									
	SONCC-MatR.3.1.7.1	$0						$0	SWRCB
	SONCC-MatR.3.1.7.2							$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-MatR.3.1.61									
	SONCC-MatR.3.1.61.1	$175,000	$175,000					$350,000	CDFW
	SONCC-MatR.3.1.61.2	$1,250	$1,250	$1,250	$1,250	$1,250	$1,250	$7,500	CDFW
	Action Total:	*$176,250*	*$176,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$357,500*	
SONCC-MatR.2.1.68									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MatR.2.1.68.1	$36,077						$36,077	NGO
	SONCC-MatR.2.1.68.2	$36,077						$36,077	NGO
	SONCC-MatR.2.1.68.3	$350,000						$350,000	NGO
	Action Total:	*$422,154*						*$422,154*	
SONCC-MatR.2.1.12									
	SONCC-MatR.2.1.12.1	$17,008						$17,008	NGO
	SONCC-MatR.2.1.12.2	$2,520,110						$2,520,110	NGO
	Action Total:	*$2,537,118*						*$2,537,118*	
SONCC-MatR.2.1.58									
	SONCC-MatR.2.1.58.1	$17,008						$17,008	NGO
	SONCC-MatR.2.1.58.2	$2,520,110						$2,520,110	NGO
	Action Total:	*$2,537,118*						*$2,537,118*	
SONCC-MatR.3.2.10									
	SONCC-MatR.3.2.10.1	$17,008						$17,008	NGO
	SONCC-MatR.3.2.10.2	$3,000,000						$3,000,000	NGO
	SONCC-MatR.3.2.10.3	$62,500	$62,500					$125,000	NGO
	Action Total:	*$3,079,508*	*$62,500*					*$3,142,008*	
SONCC-MatR.3.2.62									
	SONCC-MatR.3.2.62.1	$17,008						$17,008	NGO
	SONCC-MatR.3.2.62.2	$3,000,000						$3,000,000	NGO
	SONCC-MatR.3.2.62.3	$62,500	$62,500					$125,000	NGO
	Action Total:	*$3,079,508*	*$62,500*					*$3,142,008*	
SONCC-MatR.2.2.13									
	SONCC-MatR.2.2.13.1	$17,008						$17,008	NGO
	SONCC-MatR.2.2.13.2	$470,387						$470,387	NGO
	Action Total:	*$487,394*						*$487,394*	
SONCC-MatR.2.2.59									
	SONCC-MatR.2.2.59.1	$17,008						$17,008	NGO
	SONCC-MatR.2.2.59.2	$470,387						$470,387	NGO
	Action Total:	*$487,394*						*$487,394*	
SONCC-MatR.3.1.48									
	SONCC-MatR.3.1.48.1	$73,540						$73,540	CDFW
	SONCC-MatR.3.1.48.2	$36,770						$36,770	CDFW
	SONCC-MatR.3.1.48.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-MatR.22.2.49									
	SONCC-MatR.22.2.49.1	$36,770						$36,770	County
	Action Total:	*$36,770*						*$36,770*	
SONCC-MatR.22.2.60									
	SONCC-MatR.22.2.60.1	$36,770						$36,770	County
	Action Total:	*$36,770*						*$36,770*	
SONCC-MatR.22.3.45									
	SONCC-MatR.22.3.45.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MatR.5.2.43									
	SONCC-MatR.5.2.43.1	$22,270						$22,270	NGO
	SONCC-MatR.5.2.43.2	$85,230						$85,230	NGO
	Action Total:	*$107,500*						*$107,500*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MatR.5.2.64									
	SONCC-MatR.5.2.64.1	$22,270						$22,270	NGO
	SONCC-MatR.5.2.64.2	$85,230						$85,230	NGO
	Action Total:	*$107,500*						*$107,500*	
SONCC-MatR.1.2.35									
	SONCC-MatR.1.2.35.1	$34,015						$34,015	BLM
	SONCC-MatR.1.2.35.2	$34,015						$34,015	BLM
	SONCC-MatR.1.2.35.3	$341,075						$341,075	BLM
	Action Total:	*$409,105*						*$409,105*	
SONCC-MatR.1.2.56									
	SONCC-MatR.1.2.56.1	$17,008						$17,008	BLM
	SONCC-MatR.1.2.56.2	$17,008						$17,008	BLM
	SONCC-MatR.1.2.56.3	$74,000						$74,000	BLM
	Action Total:	*$108,015*						*$108,015*	
SONCC-MatR.10.7.55									
	SONCC-MatR.10.7.55.1	$8,504						$8,504	CDFW
	SONCC-MatR.10.7.55.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MatR.10.7.57									
	SONCC-MatR.10.7.57.1	$8,504						$8,504	CDFW
	SONCC-MatR.10.7.57.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MatR.3.1.9									
	SONCC-MatR.3.1.9.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-MatR.3.1.4									
	SONCC-MatR.3.1.4.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-MatR.5.1.19									
	SONCC-MatR.5.1.19.1	$8,504						$8,504	CDFW
	SONCC-MatR.5.1.19.2	$159,090						$159,090	CDFW
	Action Total:	*$167,594*						*$167,594*	
SONCC-MatR.5.1.63									
	SONCC-MatR.5.1.63.1	$8,504						$8,504	CDFW
	SONCC-MatR.5.1.63.2	$159,090						$159,090	CDFW
	Action Total:	*$167,594*						*$167,594*	
SONCC-MatR.7.1.14									
	SONCC-MatR.7.1.14.1	$17,008						$17,008	NRCS/RCD
	SONCC-MatR.7.1.14.2	$85,038						$85,038	NRCS/RCD
	SONCC-MatR.7.1.14.3	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NRCS/RCD
	Action Total:	*$187,083*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$612,270*	
SONCC-MatR.7.1.65									
	SONCC-MatR.7.1.65.1	$17,008						$17,008	NRCS/RCD
	SONCC-MatR.7.1.65.2	$85,038						$85,038	NRCS/RCD
	SONCC-MatR.7.1.65.3	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NRCS/RCD
	Action Total:	*$187,083*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$612,270*	
SONCC-MatR.8.1.17									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MatR.8.1.17.1	$364,760						$364,760	NGO
	SONCC-MatR.8.1.17.2	$5,702,554						$5,702,554	NGO
	SONCC-MatR.8.1.17.3	$975,853						$975,853	NGO
	SONCC-MatR.8.1.17.4	$709,533				$709,533		$1,419,066	NGO
	Action Total:	*$7,752,700*				*$709,533*		*$8,462,233*	
SONCC-MatR.8.1.18									
	SONCC-MatR.8.1.18.1	$225,364						$225,364	NRCS/RCD
	SONCC-MatR.8.1.18.2	$598,672						$598,672	NRCS/RCD
	Action Total:	*$824,036*						*$824,036*	
SONCC-MatR.8.1.66									
	SONCC-MatR.8.1.66.1	$364,760						$364,760	NGO
	SONCC-MatR.8.1.66.2	$5,702,554						$5,702,554	NGO
	SONCC-MatR.8.1.66.3	$975,853						$975,853	NGO
	SONCC-MatR.8.1.66.4	$709,533				$709,533		$1,419,066	NGO
	Action Total:	*$7,752,700*				*$709,533*		*$8,462,233*	
SONCC-MatR.8.1.67									
	SONCC-MatR.8.1.67.1	$225,364						$225,364	NRCS/RCD
	SONCC-MatR.8.1.67.2	$598,672						$598,672	NRCS/RCD
	Action Total:	*$824,036*						*$824,036*	
SONCC-MatR.3.1.46									
	SONCC-MatR.3.1.46.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MatR.3.1.2									
	SONCC-MatR.3.1.2.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MatR.7.1.40									
	SONCC-MatR.7.1.40.1	$182,000						$182,000	NGO
	SONCC-MatR.7.1.40.2	$3,674,112						$3,674,112	NGO
	Action Total:	*$3,856,112*						*$3,856,112*	
SONCC-MatR.7.1.15									
	SONCC-MatR.7.1.15.1	$34,015						$34,015	NGO
	SONCC-MatR.7.1.15.2	$352,838						$352,838	NGO
	SONCC-MatR.7.1.15.3	$2,567,462						$2,567,462	NGO
	Action Total:	*$2,954,316*						*$2,954,316*	
SONCC-MatR.7.1.16									
	SONCC-MatR.7.1.16.1	$0						$0	CDF
	Action Total:	*$0*						*$0*	
SONCC-MatR.16.1.21									
	SONCC-MatR.16.1.21.1	$34,015						$34,015	NMFS
	SONCC-MatR.16.1.21.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MatR.16.1.22									
	SONCC-MatR.16.1.22.1	$34,015						$34,015	NMFS
	SONCC-MatR.16.1.22.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MatR.16.2.23									
	SONCC-MatR.16.2.23.1	$34,015						$34,015	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MatR.16.2.23.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MatR.16.2.24									
	SONCC-MatR.16.2.24.1	$34,015						$34,015	NMFS
	SONCC-MatR.16.2.24.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MatR.8.1.42									
	SONCC-MatR.8.1.42.1	$34,015						$34,015	County
	Action Total:	*$34,015*						*$34,015*	
SONCC-MatR.10.2.41									
	SONCC-MatR.10.2.41.1	$45,925						$45,925	RWQCB
	SONCC-MatR.10.2.41.2	$114,813						$114,813	RWQCB
	Action Total:	*$160,738*						*$160,738*	
SONCC-MatR.27.2.38									
	SONCC-MatR.27.2.38.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-MatR.27.2.53									
	SONCC-MatR.27.2.53.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MatR.27.2.28									
	SONCC-MatR.27.2.28.1	$136,060						$136,060	CDFW
	SONCC-MatR.27.2.28.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-MatR.27.2.29									
	SONCC-MatR.27.2.29.1	$2,079,779		$2,079,779		$2,079,779		$6,239,337	CDFW
	Action Total:	*$2,079,779*		*$2,079,779*		*$2,079,779*		*$6,239,337*	
SONCC-MatR.27.2.30									
	SONCC-MatR.27.2.30.1	$2,079,779		$2,079,779		$2,079,779		$6,239,337	CDFW
	Action Total:	*$2,079,779*		*$2,079,779*		*$2,079,779*		*$6,239,337*	
SONCC-MatR.27.2.31									
	SONCC-MatR.27.2.31.1	$2,079,779		$2,079,779		$2,079,779		$6,239,337	CDFW
	Action Total:	*$2,079,779*		*$2,079,779*		*$2,079,779*		*$6,239,337*	
SONCC-MatR.27.2.32									
	SONCC-MatR.27.2.32.1	$2,079,779		$2,079,779		$2,079,779		$6,239,337	CDFW
	Action Total:	*$2,079,779*		*$2,079,779*		*$2,079,779*		*$6,239,337*	
SONCC-MatR.27.2.33									
	SONCC-MatR.27.2.33.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-MatR.27.2.33.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-MatR.27.2.34									
	SONCC-MatR.27.2.34.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MatR.27.2.54									
	SONCC-MatR.27.2.54.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MatR.27.1.36									
	SONCC-MatR.27.1.36.1	$124,893	$124,893	$124,893	$124,893	$124,893	$124,893	$749,358	CDFW
	Action Total:	*$124,893*	*$124,893*	*$124,893*	*$124,893*	*$124,893*	*$124,893*	*$749,358*	
SONCC-MatR.27.1.37									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MatR.27.1.37.1	$34,015						$34,015	NMFS
	SONCC-MatR.27.1.37.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-MatR.27.1.25									
	SONCC-MatR.27.1.25.1	$374,680	$374,680	$374,680	$374,680	$374,680	$374,680	$2,248,080	CDFW
	Action Total:	*$374,680*	*$374,680*	*$374,680*	*$374,680*	*$374,680*	*$374,680*	*$2,248,080*	
SONCC-MatR.27.1.26									
	SONCC-MatR.27.1.26.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-MatR.27.1.27									
	SONCC-MatR.27.1.27.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MatR.27.4.50									
	SONCC-MatR.27.4.50.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MatR.27.4.51									
	SONCC-MatR.27.4.51.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MatR.27.4.52									
	SONCC-MatR.27.4.52.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
	Population Total:	***$51,819,114***	***$3,893,571***	***$11,757,932***	***$2,818,571***	***$11,326,998***	***$1,568,571***	***$83,184,755***	

Population: Mid Klamath River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MKR.10.3.1									
	SONCC-MKR.10.3.1.1	$34,015						$34,015	BIA/Tribe
	SONCC-MKR.10.3.1.2	$102,258						$102,258	BIA/Tribe
	Action Total:	*$136,273*						*$136,273*	
SONCC-MKR.2.2.4									
	SONCC-MKR.2.2.4.1	$36,770						$36,770	BIA/Tribe
	SONCC-MKR.2.2.4.2	$232,560						$232,560	BIA/Tribe
	Action Total:	*$269,330*						*$269,330*	
SONCC-MKR.1.2.43									
	SONCC-MKR.1.2.43.1	$0						$0	BIA/Tribe
	Action Total:	*$0*						*$0*	
SONCC-MKR.2.1.6									
	SONCC-MKR.2.1.6.1	$17,008						$17,008	BIA/Tribe
	SONCC-MKR.2.1.6.2	$201,951						$201,951	BIA/Tribe
	Action Total:	*$218,959*						*$218,959*	
SONCC-MKR.2.1.64									
	SONCC-MKR.2.1.64.1	$17,008						$17,008	BIA/Tribe
	SONCC-MKR.2.1.64.2	$201,951						$201,951	BIA/Tribe
	Action Total:	*$218,959*						*$218,959*	
SONCC-MKR.10.3.10									
	SONCC-MKR.10.3.10.1	$17,008						$17,008	CDFW
	SONCC-MKR.10.3.10.2	$17,008						$17,008	CDFW
	SONCC-MKR.10.3.10.3	$0						$0	CDFW
	SONCC-MKR.10.3.10.4	$0						$0	CDFW
	Action Total:	*$34,015*						*$34,015*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MKR.10.3.61									
	SONCC-MKR.10.3.61.1	$17,008						$17,008	CDFW
	SONCC-MKR.10.3.61.2	$17,008						$17,008	CDFW
	SONCC-MKR.10.3.61.3	$0						$0	CDFW
	SONCC-MKR.10.3.61.4	$0						$0	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-MKR.2.2.5									
	SONCC-MKR.2.2.5.1	$89,080						$89,080	USFS
	SONCC-MKR.2.2.5.2	$1,800,000						$1,800,000	USFS
	Action Total:	*$1,889,080*						*$1,889,080*	
SONCC-MKR.10.2.13									
	SONCC-MKR.10.2.13.1	$17,008						$17,008	BIA/Tribe
	SONCC-MKR.10.2.13.2	$2,108,812						$2,108,812	BIA/Tribe
	Action Total:	*$2,125,819*						*$2,125,819*	
SONCC-MKR.10.2.60									
	SONCC-MKR.10.2.60.1	$17,008						$17,008	BIA/Tribe
	SONCC-MKR.10.2.60.2	$2,108,812						$2,108,812	BIA/Tribe
	Action Total:	*$2,125,819*						*$2,125,819*	
SONCC-MKR.5.1.22									
	SONCC-MKR.5.1.22.1	$18,385						$18,385	BIA/Tribe
	SONCC-MKR.5.1.22.2	$130,815						$130,815	BIA/Tribe
	Action Total:	*$149,200*						*$149,200*	
SONCC-MKR.5.1.69									
	SONCC-MKR.5.1.69.1	$18,385						$18,385	BIA/Tribe
	SONCC-MKR.5.1.69.2	$130,815						$130,815	BIA/Tribe
	Action Total:	*$149,200*						*$149,200*	
SONCC-MKR.3.1.15									
	SONCC-MKR.3.1.15.1	$34,015						$34,015	CDFW
	SONCC-MKR.3.1.15.2	$48,346						$48,346	CDFW
	Action Total:	*$82,361*						*$82,361*	
SONCC-MKR.3.1.56									
	SONCC-MKR.3.1.56.1	$247,000	$247,000	$247,000	$247,000	$247,000	$247,000	$1,482,000	SWRCB
	Action Total:	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$1,482,000*	
SONCC-MKR.3.1.58									
	SONCC-MKR.3.1.58.1	$18,385						$18,385	SWRCB
	SONCC-MKR.3.1.58.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-MKR.3.1.66									
	SONCC-MKR.3.1.66.1	$34,015						$34,015	CDFW
	SONCC-MKR.3.1.66.2	$48,346						$48,346	CDFW
	Action Total:	*$82,361*						*$82,361*	
SONCC-MKR.3.1.68									
	SONCC-MKR.3.1.68.1	$18,385						$18,385	DWR
	SONCC-MKR.3.1.68.2	$36,770						$36,770	DWR
	Action Total:	*$55,155*						*$55,155*	
SONCC-MKR.10.3.24									
	SONCC-MKR.10.3.24.1	$17,008						$17,008	Caltrans

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MKR.10.3.24.2	$159,090						$159,090	Caltrans
	Action Total:	*$176,098*						*$176,098*	
SONCC-MKR.10.3.62									
	SONCC-MKR.10.3.62.1	$17,008						$17,008	Caltrans
	SONCC-MKR.10.3.62.2	$159,090						$159,090	Caltrans
	Action Total:	*$176,098*						*$176,098*	
SONCC-MKR.7.1.8									
	SONCC-MKR.7.1.8.1	$34,015						$34,015	USFS
	SONCC-MKR.7.1.8.2	$28,764						$28,764	USFS
	SONCC-MKR.7.1.8.3	$15,192						$15,192	USFS
	Action Total:	*$77,971*						*$77,971*	
SONCC-MKR.7.1.9									
	SONCC-MKR.7.1.9.1	$76,136						$76,136	USFS
	SONCC-MKR.7.1.9.2	$36,400						$36,400	USFS
	SONCC-MKR.7.1.9.3	$36,400						$36,400	USFS
	SONCC-MKR.7.1.9.4	$83,920						$83,920	USFS
	Action Total:	*$232,856*						*$232,856*	
SONCC-MKR.26.1.57									
	SONCC-MKR.26.1.57.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MKR.10.3.12									
	SONCC-MKR.10.3.12.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-MKR.2.2.2									
	SONCC-MKR.2.2.2.1	$17,008						$17,008	BIA/Tribe
	SONCC-MKR.2.2.2.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	BIA/Tribe
	SONCC-MKR.2.2.2.3	$10,000						$10,000	BIA/Tribe
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-MKR.2.2.65									
	SONCC-MKR.2.2.65.1	$17,008						$17,008	BIA/Tribe
	SONCC-MKR.2.2.65.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	BIA/Tribe
	SONCC-MKR.2.2.65.3	$10,000						$10,000	BIA/Tribe
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-MKR.5.2.27									
	SONCC-MKR.5.2.27.1	$22,270						$22,270	CDFW
	SONCC-MKR.5.2.27.2	$85,230						$85,230	CDFW
	Action Total:	*$107,500*						*$107,500*	
SONCC-MKR.5.2.72									
	SONCC-MKR.5.2.72.1	$22,270						$22,270	CDFW
	SONCC-MKR.5.2.72.2	$85,230						$85,230	CDFW
	Action Total:	*$107,500*						*$107,500*	
SONCC-MKR.5.1.23									
	SONCC-MKR.5.1.23.1	$17,008						$17,008	BIA/Tribe
	SONCC-MKR.5.1.23.2	$20,450						$20,450	BIA/Tribe
	Action Total:	*$37,458*						*$37,458*	
SONCC-MKR.5.1.26									
	SONCC-MKR.5.1.26.1	$17,008						$17,008	BIA/Tribe

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MKR.5.1.26.2	$145,350						$145,350	BIA/Tribe
	Action Total:	*$162,358*						*$162,358*	
SONCC-MKR.5.1.70									
	SONCC-MKR.5.1.70.1	$17,008						$17,008	BIA/Tribe
	SONCC-MKR.5.1.70.2	$20,450						$20,450	BIA/Tribe
	Action Total:	*$37,458*						*$37,458*	
SONCC-MKR.5.1.71									
	SONCC-MKR.5.1.71.1	$17,008						$17,008	BIA/Tribe
	SONCC-MKR.5.1.71.2	$145,350						$145,350	BIA/Tribe
	Action Total:	*$162,358*						*$162,358*	
SONCC-MKR.3.1.45									
	SONCC-MKR.3.1.45.1	$73,540						$73,540	CDFW
	SONCC-MKR.3.1.45.2	$36,770						$36,770	CDFW
	SONCC-MKR.3.1.45.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-MKR.3.1.17									
	SONCC-MKR.3.1.17.1	$0						$0	SWRCB
	SONCC-MKR.3.1.17.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-MKR.3.1.59									
	SONCC-MKR.3.1.59.1	$36,077						$36,077	CDFW
	SONCC-MKR.3.1.59.2	$36,077						$36,077	CDFW
	SONCC-MKR.3.1.59.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-MKR.8.1.20									
	SONCC-MKR.8.1.20.1	$789,189						$789,189	USFS
	SONCC-MKR.8.1.20.2	$22,152						$22,152	USFS
	Action Total:	*$811,341*						*$811,341*	
SONCC-MKR.8.1.21									
	SONCC-MKR.8.1.21.1	$939,257						$939,257	USFS
	SONCC-MKR.8.1.21.2	$3,788,410						$3,788,410	USFS
	SONCC-MKR.8.1.21.3	$3,035,344						$3,035,344	USFS
	SONCC-MKR.8.1.21.4	$2,480,977					$2,480,977	$4,961,953	USFS
	Action Total:	*$10,243,988*					*$2,480,977*	*$12,724,964*	
SONCC-MKR.8.1.73									
	SONCC-MKR.8.1.73.1	$789,189						$789,189	USFS
	SONCC-MKR.8.1.73.2	$22,152						$22,152	USFS
	Action Total:	*$811,341*						*$811,341*	
SONCC-MKR.8.1.74									
	SONCC-MKR.8.1.74.1	$939,257						$939,257	USFS
	SONCC-MKR.8.1.74.2	$3,788,410						$3,788,410	USFS
	SONCC-MKR.8.1.74.3	$3,035,344						$3,035,344	USFS
	SONCC-MKR.8.1.74.4	$2,480,977					$2,480,977	$4,961,953	USFS
	Action Total:	*$10,243,988*					*$2,480,977*	*$12,724,964*	
SONCC-MKR.10.7.55									
	SONCC-MKR.10.7.55.1	$8,504						$8,504	CDFW
	SONCC-MKR.10.7.55.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MKR.10.7.63									
	SONCC-MKR.10.7.63.1	$8,504						$8,504	CDFW
	SONCC-MKR.10.7.63.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MKR.3.1.42									
	SONCC-MKR.3.1.42.1	$52,277						$52,277	BIA/Tribe
	SONCC-MKR.3.1.42.2	$19,979	$19,979	$19,979	$19,979	$19,979	$19,979	$119,871	BIA/Tribe
	Action Total:	*$72,256*	*$19,979*	*$19,979*	*$19,979*	*$19,979*	*$19,979*	*$172,148*	
SONCC-MKR.3.1.19									
	SONCC-MKR.3.1.19.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-MKR.3.1.67									
	SONCC-MKR.3.1.67.1	$52,277						$52,277	BIA/Tribe
	SONCC-MKR.3.1.67.2	$19,979	$19,979	$19,979	$19,979	$19,979	$19,979	$119,871	BIA/Tribe
	Action Total:	*$72,256*	*$19,979*	*$19,979*	*$19,979*	*$19,979*	*$19,979*	*$172,148*	
SONCC-MKR.16.1.28									
	SONCC-MKR.16.1.28.1	$34,015						$34,015	NMFS
	SONCC-MKR.16.1.28.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MKR.16.1.29									
	SONCC-MKR.16.1.29.1	$34,015						$34,015	NMFS
	SONCC-MKR.16.1.29.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MKR.16.1.53									
	SONCC-MKR.16.1.53.1	$34,015						$34,015	NMFS
	SONCC-MKR.16.1.53.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MKR.16.1.54									
	SONCC-MKR.16.1.54.1	$34,015						$34,015	BIA/Tribe
	SONCC-MKR.16.1.54.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-MKR.16.2.30									
	SONCC-MKR.16.2.30.1	$34,015						$34,015	NMFS
	SONCC-MKR.16.2.30.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MKR.16.2.31									
	SONCC-MKR.16.2.31.1	$34,015						$34,015	NMFS
	SONCC-MKR.16.2.31.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MKR.27.2.47									
	SONCC-MKR.27.2.47.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MKR.27.2.48									
	SONCC-MKR.27.2.48.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MKR.27.2.49									
	SONCC-MKR.27.2.49.1	$68,030						$68,030	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$68,030*						*$68,030*	
SONCC-MKR.27.2.50									
	SONCC-MKR.27.2.50.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MKR.27.2.37									
	SONCC-MKR.27.2.37.1	$136,060						$136,060	CDFW
	SONCC-MKR.27.2.37.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-MKR.27.2.38									
	SONCC-MKR.27.2.38.1	$429,333		$429,333		$429,333		$1,287,999	CDFW
	Action Total:	*$429,333*		*$429,333*		*$429,333*		*$1,287,999*	
SONCC-MKR.27.2.39									
	SONCC-MKR.27.2.39.1	$429,333		$429,333		$429,333		$1,287,999	CDFW
	Action Total:	*$429,333*		*$429,333*		*$429,333*		*$1,287,999*	
SONCC-MKR.27.2.40									
	SONCC-MKR.27.2.40.1	$429,333		$429,333		$429,333		$1,287,999	CDFW
	Action Total:	*$429,333*		*$429,333*		*$429,333*		*$1,287,999*	
SONCC-MKR.27.2.41									
	SONCC-MKR.27.2.41.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-MKR.27.2.41.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-MKR.27.2.52									
	SONCC-MKR.27.2.52.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MKR.27.1.44									
	SONCC-MKR.27.1.44.1	$34,015						$34,015	NMFS
	SONCC-MKR.27.1.44.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-MKR.27.1.32									
	SONCC-MKR.27.1.32.1	$34,015						$34,015	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-MKR.27.1.33									
	SONCC-MKR.27.1.33.1	$170,235	$170,235	$170,235	$170,235	$170,235	$170,235	$1,021,410	CDFW
	Action Total:	*$170,235*	*$170,235*	*$170,235*	*$170,235*	*$170,235*	*$170,235*	*$1,021,410*	
SONCC-MKR.27.1.34									
	SONCC-MKR.27.1.34.1	$56,745	$56,745	$56,745	$56,745	$56,745	$56,745	$340,470	CDFW
	Action Total:	*$56,745*	*$56,745*	*$56,745*	*$56,745*	*$56,745*	*$56,745*	*$340,470*	
SONCC-MKR.27.1.35									
	SONCC-MKR.27.1.35.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MKR.27.1.36									
	SONCC-MKR.27.1.36.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MKR.27.4.46									
	SONCC-MKR.27.4.46.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MKR.27.4.51									
	SONCC-MKR.27.4.51.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MKR.10.3.11									
	SONCC-MKR.10.3.11.1							$0	CDFW
	Action Total:							*$0*	
SONCC-MKR.2.2.3									
	SONCC-MKR.2.2.3.1							$0	CDFW
	Action Total:							*$0*	
SONCC-MKR.5.1.25									
	SONCC-MKR.5.1.25.1							$0	BIA/Tribe
	SONCC-MKR.5.1.25.2							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-MKR.3.1.16									
	SONCC-MKR.3.1.16.1							$0	NGO
	Action Total:							*$0*	
SONCC-MKR.7.1.7									
	SONCC-MKR.7.1.7.1							$0	NRCS/RCD
	SONCC-MKR.7.1.7.2							$0	NRCS/RCD
	SONCC-MKR.7.1.7.3							$0	NRCS/RCD
	SONCC-MKR.7.1.7.4							$0	NRCS/RCD
	SONCC-MKR.7.1.7.5							$0	NRCS/RCD
	Action Total:							*$0*	
	Population Total:	***$35,019,824***	***$1,486,707***	***$2,760,936***	***$1,486,707***	***$2,760,936***	***$6,448,660***	***$49,963,770***	

Population: Middle Fork Eel River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MFER.2.1.2									
	SONCC-MFER.2.1.2.1	$17,008						$17,008	CDFW
	SONCC-MFER.2.1.2.2	$443,759						$443,759	CDFW
	Action Total:	*$460,766*						*$460,766*	
SONCC-MFER.2.2.22									
	SONCC-MFER.2.2.22.1	$17,008						$17,008	CDFW
	SONCC-MFER.2.2.22.2	$331,316						$331,316	CDFW
	Action Total:	*$348,323*						*$348,323*	
SONCC-MFER.2.2.3									
	SONCC-MFER.2.2.3.1	$17,008						$17,008	CDFW
	SONCC-MFER.2.2.3.2	$12,807						$12,807	CDFW
	Action Total:	*$29,815*						*$29,815*	
SONCC-MFER.10.1.29									
	SONCC-MFER.10.1.29.1	$34,015						$34,015	USFS
	SONCC-MFER.10.1.29.2	$62,130						$62,130	USFS
	SONCC-MFER.10.1.29.3	$452,097						$452,097	USFS
	Action Total:	*$548,242*						*$548,242*	
SONCC-MFER.2.1.43									
	SONCC-MFER.2.1.43.1	$17,008						$17,008	CDFW
	SONCC-MFER.2.1.43.2	$443,759						$443,759	CDFW
	Action Total:	*$460,766*						*$460,766*	
SONCC-MFER.2.2.44									
	SONCC-MFER.2.2.44.1	$17,008						$17,008	CDFW
	SONCC-MFER.2.2.44.2	$331,316						$331,316	CDFW
	Action Total:	*$348,323*						*$348,323*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MFER.2.2.45									
	SONCC-MFER.2.2.45.1	$17,008						$17,008	CDFW
	SONCC-MFER.2.2.45.2	$12,807						$12,807	CDFW
	Action Total:	*$29,815*						*$29,815*	
SONCC-MFER.3.1.25									
	SONCC-MFER.3.1.25.1	$73,540						$73,540	CDFW
	SONCC-MFER.3.1.25.2	$36,770						$36,770	CDFW
	SONCC-MFER.3.1.25.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-MFER.10.7.41									
	SONCC-MFER.10.7.41.1	$8,504						$8,504	CDFW
	SONCC-MFER.10.7.41.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MFER.10.7.42									
	SONCC-MFER.10.7.42.1	$8,504						$8,504	CDFW
	SONCC-MFER.10.7.42.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MFER.7.1.5									
	SONCC-MFER.7.1.5.1	$17,008						$17,008	NRCS/RCD
	SONCC-MFER.7.1.5.2	$34,015						$34,015	NRCS/RCD
	SONCC-MFER.7.1.5.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$136,060*						*$136,060*	
SONCC-MFER.7.1.46									
	SONCC-MFER.7.1.46.1	$17,008						$17,008	NRCS/RCD
	SONCC-MFER.7.1.46.2	$34,015						$34,015	NRCS/RCD
	SONCC-MFER.7.1.46.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$136,060*						*$136,060*	
SONCC-MFER.8.1.8									
	SONCC-MFER.8.1.8.1	$575,914						$575,914	USFS
	SONCC-MFER.8.1.8.2	$487,344						$487,344	USFS
	Action Total:	*$1,063,258*						*$1,063,258*	
SONCC-MFER.8.1.9									
	SONCC-MFER.8.1.9.1	$775,931						$775,931	USFS
	SONCC-MFER.8.1.9.2	$62,133						$62,133	USFS
	SONCC-MFER.8.1.9.3	$2,465,679						$2,465,679	USFS
	SONCC-MFER.8.1.9.4	$34,862,677					$34,862,677	$69,725,354	USFS
	Action Total:	*$38,166,420*					*$34,862,677*	*$73,029,097*	
SONCC-MFER.8.1.47									
	SONCC-MFER.8.1.47.1	$575,914						$575,914	USFS
	SONCC-MFER.8.1.47.2	$487,344						$487,344	USFS
	Action Total:	*$1,063,258*						*$1,063,258*	
SONCC-MFER.8.1.48									
	SONCC-MFER.8.1.48.1	$775,931						$775,931	USFS
	SONCC-MFER.8.1.48.2	$62,133						$62,133	USFS
	SONCC-MFER.8.1.48.3	$2,465,679						$2,465,679	USFS
	SONCC-MFER.8.1.48.4	$34,862,677					$34,862,677	$69,725,354	USFS
	Action Total:	*$38,166,420*					*$34,862,677*	*$73,029,097*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MFER.1.2.23									
	SONCC-MFER.1.2.23.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-MFER.7.1.4									
	SONCC-MFER.7.1.4.1	$0						$0	County
	SONCC-MFER.7.1.4.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MFER.16.1.11									
	SONCC-MFER.16.1.11.1	$34,015						$34,015	NMFS
	SONCC-MFER.16.1.11.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MFER.16.1.12									
	SONCC-MFER.16.1.12.1	$34,015						$34,015	NMFS
	SONCC-MFER.16.1.12.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MFER.16.1.39									
	SONCC-MFER.16.1.39.1	$34,015						$34,015	NMFS
	SONCC-MFER.16.1.39.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MFER.16.1.40									
	SONCC-MFER.16.1.40.1	$34,015						$34,015	BIA/Tribe
	SONCC-MFER.16.1.40.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-MFER.16.2.13									
	SONCC-MFER.16.2.13.1	$34,015						$34,015	NMFS
	SONCC-MFER.16.2.13.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MFER.16.2.14									
	SONCC-MFER.16.2.14.1	$34,015						$34,015	NMFS
	SONCC-MFER.16.2.14.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MFER.8.1.7									
	SONCC-MFER.8.1.7.1	$18,200						$18,200	USFS
	SONCC-MFER.8.1.7.2	$647,088						$647,088	USFS
	Action Total:	*$665,288*						*$665,288*	
SONCC-MFER.14.2.1									
	SONCC-MFER.14.2.1.1	$34,015						$34,015	CDFW
	SONCC-MFER.14.2.1.2	$2,583,525						$2,583,525	CDFW
	Action Total:	*$2,617,540*						*$2,617,540*	
SONCC-MFER.27.2.26									
	SONCC-MFER.27.2.26.1	$201,243		$201,243		$201,243		$603,729	CDFW
	Action Total:	*$201,243*		*$201,243*		*$201,243*		*$603,729*	
SONCC-MFER.27.2.27									
	SONCC-MFER.27.2.27.1	$201,243		$201,243		$201,243		$603,729	CDFW
	Action Total:	*$201,243*		*$201,243*		*$201,243*		*$603,729*	
SONCC-MFER.27.2.30									
	SONCC-MFER.27.2.30.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MFER.27.2.36									
	SONCC-MFER.27.2.36.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MFER.27.2.37									
	SONCC-MFER.27.2.37.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-MFER.27.2.28									
	SONCC-MFER.27.2.28.1	$201,243		$201,243		$201,243		$603,729	CDFW
	Action Total:	*$201,243*		*$201,243*		*$201,243*		*$603,729*	
SONCC-MFER.27.2.18									
	SONCC-MFER.27.2.18.1	$136,060						$136,060	CDFW
	SONCC-MFER.27.2.18.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-MFER.27.2.19									
	SONCC-MFER.27.2.19.1	$201,243		$201,243		$201,243		$603,729	CDFW
	Action Total:	*$201,243*		*$201,243*		*$201,243*		*$603,729*	
SONCC-MFER.27.2.20									
	SONCC-MFER.27.2.20.1	$201,243		$201,243		$201,243		$603,729	CDFW
	Action Total:	*$201,243*		*$201,243*		*$201,243*		*$603,729*	
SONCC-MFER.27.2.38									
	SONCC-MFER.27.2.38.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MFER.27.1.21									
	SONCC-MFER.27.1.21.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-MFER.27.1.21.2	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	CDFW
	Action Total:	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$612,270*	
SONCC-MFER.27.1.24									
	SONCC-MFER.27.1.24.1	$34,015						$34,015	NMFS
	SONCC-MFER.27.1.24.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-MFER.27.1.16									
	SONCC-MFER.27.1.16.1	$38,850	$38,850	$38,850	$38,850	$38,850	$38,850	$233,100	CDFW
	Action Total:	*$38,850*	*$38,850*	*$38,850*	*$38,850*	*$38,850*	*$38,850*	*$233,100*	
SONCC-MFER.27.1.17									
	SONCC-MFER.27.1.17.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-MFER.27.1.17.2	$13,084	$13,084	$13,084	$13,084	$13,084	$13,084	$78,504	CDFW
	Action Total:	*$98,122*	*$98,122*	*$98,122*	*$98,122*	*$98,122*	*$98,122*	*$588,729*	
SONCC-MFER.27.4.31									
	SONCC-MFER.27.4.31.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MFER.27.4.32									
	SONCC-MFER.27.4.32.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	CDFW
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MFER.27.4.33									
	SONCC-MFER.27.4.33.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MFER.27.4.34									
	SONCC-MFER.27.4.34.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MFER.27.4.35									
	SONCC-MFER.27.4.35.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
	Population Total:	***$86,894,589***	***$848,664***	***$1,807,094***	***$848,664***	***$1,807,094***	***$70,574,018***	***$162,780,123***	

Population: Middle Mainstem Eel River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MMER.3.1.38									
	SONCC-MMER.3.1.38.1	$36,077						$36,077	CDFW
	SONCC-MMER.3.1.38.2	$36,077						$36,077	CDFW
	SONCC-MMER.3.1.38.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-MMER.3.1.39									
	SONCC-MMER.3.1.39.1	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-MMER.3.1.10									
	SONCC-MMER.3.1.10.1	$34,015						$34,015	NGO
	SONCC-MMER.3.1.10.2	$350,000						$350,000	NGO
	SONCC-MMER.3.1.10.3	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$15,000	NGO
	Action Total:	*$386,515*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$2,500*	*$399,015*	
SONCC-MMER.26.1.1									
	SONCC-MMER.26.1.1.1	$68,030						$68,030	CDFW
	SONCC-MMER.26.1.1.2	$500,000						$500,000	CDFW
	SONCC-MMER.26.1.1.3	$600,000	$600,000	$600,000				$1,800,000	CDFW
	SONCC-MMER.26.1.1.4	$1,250,000	$1,250,000	$1,250,000	$1,250,000			$5,000,000	CDFW
	Action Total:	*$2,418,030*	*$1,850,000*	*$1,850,000*	*$1,250,000*			*$7,368,030*	
SONCC-MMER.8.1.17									
	SONCC-MMER.8.1.17.1	$264,043						$264,043	NRCS/RCD
	SONCC-MMER.8.1.17.2	$1,915,580						$1,915,580	NRCS/RCD
	Action Total:	*$2,179,623*						*$2,179,623*	
SONCC-MMER.8.1.60									
	SONCC-MMER.8.1.60.1	$264,043						$264,043	NRCS/RCD
	SONCC-MMER.8.1.60.2	$1,915,580						$1,915,580	NRCS/RCD
	Action Total:	*$2,179,623*						*$2,179,623*	
SONCC-MMER.3.1.40									
	SONCC-MMER.3.1.40.1	$73,540						$73,540	CDFW
	SONCC-MMER.3.1.40.2	$36,770						$36,770	CDFW
	SONCC-MMER.3.1.40.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-MMER.3.1.12									
	SONCC-MMER.3.1.12.1	$0						$0	SWRCB
	SONCC-MMER.3.1.12.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-MMER.3.1.14									
	SONCC-MMER.3.1.14.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-MMER.5.1.7									
	SONCC-MMER.5.1.7.1	$22,270						$22,270	Caltrans
	SONCC-MMER.5.1.7.2	$741,277						$741,277	Caltrans

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$763,547*						*$763,547*	
SONCC-MMER.5.1.8									
	SONCC-MMER.5.1.8.1	$348,836						$348,836	Caltrans
	Action Total:	*$348,836*						*$348,836*	
SONCC-MMER.5.1.58									
	SONCC-MMER.5.1.58.1	$22,270						$22,270	Caltrans
	SONCC-MMER.5.1.58.2	$741,277						$741,277	Caltrans
	Action Total:	*$763,547*						*$763,547*	
SONCC-MMER.1.2.34									
	SONCC-MMER.1.2.34.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-MMER.2.1.2									
	SONCC-MMER.2.1.2.1	$17,008						$17,008	CDFW
	SONCC-MMER.2.1.2.2	$5,752,425						$5,752,425	CDFW
	Action Total:	*$5,769,433*						*$5,769,433*	
SONCC-MMER.2.1.55									
	SONCC-MMER.2.1.55.1	$17,008						$17,008	CDFW
	SONCC-MMER.2.1.55.2	$5,752,425						$5,752,425	CDFW
	Action Total:	*$5,769,433*						*$5,769,433*	
SONCC-MMER.26.1.52									
	SONCC-MMER.26.1.52.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MMER.2.2.37									
	SONCC-MMER.2.2.37.1	$17,008						$17,008	CDFW
	SONCC-MMER.2.2.37.2	$166,010						$166,010	CDFW
	Action Total:	*$183,018*						*$183,018*	
SONCC-MMER.2.2.53									
	SONCC-MMER.2.2.53.1	$17,008						$17,008	CDFW
	SONCC-MMER.2.2.53.2	$1,073,709						$1,073,709	CDFW
	Action Total:	*$1,090,717*						*$1,090,717*	
SONCC-MMER.2.2.56									
	SONCC-MMER.2.2.56.1	$17,008						$17,008	CDFW
	SONCC-MMER.2.2.56.2	$166,010						$166,010	CDFW
	Action Total:	*$183,018*						*$183,018*	
SONCC-MMER.2.2.57									
	SONCC-MMER.2.2.57.1	$17,008						$17,008	CDFW
	SONCC-MMER.2.2.57.2	$1,073,709						$1,073,709	CDFW
	Action Total:	*$1,090,717*						*$1,090,717*	
SONCC-MMER.14.2.9									
	SONCC-MMER.14.2.9.1	$68,030						$68,030	CDFW
	SONCC-MMER.14.2.9.2	$8,495,375						$8,495,375	CDFW
	Action Total:	*$8,563,405*						*$8,563,405*	
SONCC-MMER.3.1.11									
	SONCC-MMER.3.1.11.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-MMER.8.1.15									
	SONCC-MMER.8.1.15.1	$415,605						$415,605	CDFW
	SONCC-MMER.8.1.15.2	$16,948,150						$16,948,150	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MMER.8.1.15.3	$1,134,866						$1,134,866	CDFW
	SONCC-MMER.8.1.15.4	$830,178					$830,178	$1,660,355	CDFW
	Action Total:	*$19,328,798*					*$830,178*	*$20,158,976*	
SONCC-MMER.8.1.16									
	SONCC-MMER.8.1.16.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MMER.8.1.59									
	SONCC-MMER.8.1.59.1	$415,605						$415,605	CDFW
	SONCC-MMER.8.1.59.2	$16,948,150						$16,948,150	CDFW
	SONCC-MMER.8.1.59.3	$1,134,866						$1,134,866	CDFW
	SONCC-MMER.8.1.59.4	$830,178					$830,178	$1,660,355	CDFW
	Action Total:	*$19,328,798*					*$830,178*	*$20,158,976*	
SONCC-MMER.7.1.3									
	SONCC-MMER.7.1.3.1	$34,015						$34,015	NRCS/RCD
	SONCC-MMER.7.1.3.2	$5,860,512						$5,860,512	NRCS/RCD
	Action Total:	*$5,894,527*						*$5,894,527*	
SONCC-MMER.7.1.4									
	SONCC-MMER.7.1.4.1	$17,077						$17,077	CDFW
	Action Total:	*$17,077*						*$17,077*	
SONCC-MMER.10.7.51									
	SONCC-MMER.10.7.51.1	$8,504						$8,504	CDFW
	SONCC-MMER.10.7.51.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MMER.10.7.54									
	SONCC-MMER.10.7.54.1	$8,504						$8,504	CDFW
	SONCC-MMER.10.7.54.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MMER.7.1.5									
	SONCC-MMER.7.1.5.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-MMER.7.1.6									
	SONCC-MMER.7.1.6.1	$18,200						$18,200	CDF
	SONCC-MMER.7.1.6.2	$838,656						$838,656	CDF
	Action Total:	*$856,856*						*$856,856*	
SONCC-MMER.16.1.19									
	SONCC-MMER.16.1.19.1	$34,015						$34,015	NMFS
	SONCC-MMER.16.1.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MMER.16.1.20									
	SONCC-MMER.16.1.20.1	$34,015						$34,015	NMFS
	SONCC-MMER.16.1.20.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MMER.16.2.21									
	SONCC-MMER.16.2.21.1	$34,015						$34,015	NMFS
	SONCC-MMER.16.2.21.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MMER.16.2.22									
	SONCC-MMER.16.2.22.1	$34,015						$34,015	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MMER.16.2.22.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MMER.10.2.36									
	SONCC-MMER.10.2.36.1	$91,850						$91,850	NRCS/RCD
	SONCC-MMER.10.2.36.2	$229,625						$229,625	NRCS/RCD
	Action Total:	*$321,475*						*$321,475*	
SONCC-MMER.27.2.45									
	SONCC-MMER.27.2.45.1	$34,015		$34,015		$34,015		$102,045	NMFS
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MMER.27.2.46									
	SONCC-MMER.27.2.46.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-MMER.27.2.47									
	SONCC-MMER.27.2.47.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MMER.27.2.27									
	SONCC-MMER.27.2.27.1	$136,060						$136,060	CDFW
	SONCC-MMER.27.2.27.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-MMER.27.2.28									
	SONCC-MMER.27.2.28.1	$2,176,008		$2,176,008		$2,176,008		$6,528,024	CDFW
	Action Total:	*$2,176,008*		*$2,176,008*		*$2,176,008*		*$6,528,024*	
SONCC-MMER.27.2.29									
	SONCC-MMER.27.2.29.1	$2,176,008		$2,176,008		$2,176,008		$6,528,024	CDFW
	Action Total:	*$2,176,008*		*$2,176,008*		*$2,176,008*		*$6,528,024*	
SONCC-MMER.27.2.30									
	SONCC-MMER.27.2.30.1	$2,176,008		$2,176,008		$2,176,008		$6,528,024	CDFW
	Action Total:	*$2,176,008*		*$2,176,008*		*$2,176,008*		*$6,528,024*	
SONCC-MMER.27.2.31									
	SONCC-MMER.27.2.31.1	$2,176,008		$2,176,008		$2,176,008		$6,528,024	CDFW
	Action Total:	*$2,176,008*		*$2,176,008*		*$2,176,008*		*$6,528,024*	
SONCC-MMER.27.2.32									
	SONCC-MMER.27.2.32.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-MMER.27.2.32.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-MMER.27.2.50									
	SONCC-MMER.27.2.50.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MMER.27.1.33									
	SONCC-MMER.27.1.33.1	$127,750	$127,750	$127,750	$127,750	$127,750	$127,750	$766,500	CDFW
	Action Total:	*$127,750*	*$127,750*	*$127,750*	*$127,750*	*$127,750*	*$127,750*	*$766,500*	
SONCC-MMER.27.1.35									
	SONCC-MMER.27.1.35.1	$34,015						$34,015	NMFS
	SONCC-MMER.27.1.35.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-MMER.27.1.23									
	SONCC-MMER.27.1.23.1	$383,250	$383,250	$383,250	$383,250	$383,250	$383,250	$2,299,500	CDFW
	Action Total:	*$383,250*	*$383,250*	*$383,250*	*$383,250*	*$383,250*	*$383,250*	*$2,299,500*	
SONCC-MMER.27.1.24									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MMER.27.1.24.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-MMER.27.1.25									
	SONCC-MMER.27.1.25.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MMER.27.1.26									
	SONCC-MMER.27.1.26.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-MMER.27.1.26.2	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	CDFW
	Action Total:	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$612,270*	
SONCC-MMER.27.1.49									
	SONCC-MMER.27.1.49.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-MMER.27.4.44									
	SONCC-MMER.27.4.44.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MMER.27.4.48									
	SONCC-MMER.27.4.48.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MMER.27.4.41									
	SONCC-MMER.27.4.41.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MMER.27.4.42									
	SONCC-MMER.27.4.42.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MMER.27.4.43									
	SONCC-MMER.27.4.43.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
	Population Total:	***$89,629,061***	***$4,322,255***	***$13,046,532***	***$3,722,255***	***$11,196,532***	***$4,132,610***	***$126,049,245***	

Population: Middle Rogue and Applegate Rivers

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MRAR.7.3.49									
	SONCC-MRAR.7.3.49.1	$0						$0	ODA
	SONCC-MRAR.7.3.49.2	$0						$0	ODA
	SONCC-MRAR.7.3.49.3	$0						$0	ODA
	SONCC-MRAR.7.3.49.4	$0						$0	ODA
	SONCC-MRAR.7.3.49.5	$0						$0	ODA
	SONCC-MRAR.7.3.49.6	$0						$0	ODA
	Action Total:	*$0*						*$0*	
SONCC-MRAR.7.2.50									
	SONCC-MRAR.7.2.50.1	$68,030						$68,030	ODF
	SONCC-MRAR.7.2.50.2	$0						$0	ODF
	SONCC-MRAR.7.2.50.3	$0						$0	ODF
	SONCC-MRAR.7.2.50.4	$0						$0	ODF
	SONCC-MRAR.7.2.50.5	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	
SONCC-MRAR.3.1.5									
	SONCC-MRAR.3.1.5.1	$73,540						$73,540	OWRD
	SONCC-MRAR.3.1.5.2	$36,770						$36,770	OWRD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$110,310*						*$110,310*	
SONCC-MRAR.2.1.12									
	SONCC-MRAR.2.1.12.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-MRAR.2.1.13									
	SONCC-MRAR.2.1.13.1	$17,008						$17,008	NGO
	SONCC-MRAR.2.1.13.2	$13,077,180						$13,077,180	NGO
	Action Total:	*$13,094,187*						*$13,094,187*	
SONCC-MRAR.2.1.71									
	SONCC-MRAR.2.1.71.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-MRAR.2.1.72									
	SONCC-MRAR.2.1.72.1	$17,008						$17,008	NGO
	SONCC-MRAR.2.1.72.2	$13,077,180						$13,077,180	NGO
	Action Total:	*$13,094,187*						*$13,094,187*	
SONCC-MRAR.2.2.10									
	SONCC-MRAR.2.2.10.1	$17,008						$17,008	NRCS/RCD
	SONCC-MRAR.2.2.10.2	$2,440,899						$2,440,899	NRCS/RCD
	Action Total:	*$2,457,906*						*$2,457,906*	
SONCC-MRAR.2.2.11									
	SONCC-MRAR.2.2.11.1	$17,008						$17,008	ODFW
	SONCC-MRAR.2.2.11.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-MRAR.2.2.11.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-MRAR.2.2.47									
	SONCC-MRAR.2.2.47.1	$17,008						$17,008	NRCS/RCD
	SONCC-MRAR.2.2.47.2	$200,419						$200,419	NRCS/RCD
	SONCC-MRAR.2.2.47.3	$290,700						$290,700	NRCS/RCD
	Action Total:	*$508,127*						*$508,127*	
SONCC-MRAR.2.2.73									
	SONCC-MRAR.2.2.73.1	$17,008						$17,008	NRCS/RCD
	SONCC-MRAR.2.2.73.2	$2,440,899						$2,440,899	NRCS/RCD
	Action Total:	*$2,457,906*						*$2,457,906*	
SONCC-MRAR.2.2.74									
	SONCC-MRAR.2.2.74.1	$17,008						$17,008	ODFW
	SONCC-MRAR.2.2.74.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-MRAR.2.2.74.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-MRAR.2.2.75									
	SONCC-MRAR.2.2.75.1	$17,008						$17,008	NRCS/RCD
	SONCC-MRAR.2.2.75.2	$200,419						$200,419	NRCS/RCD
	SONCC-MRAR.2.2.75.3	$290,700						$290,700	NRCS/RCD
	Action Total:	*$508,127*						*$508,127*	
SONCC-MRAR.3.1.42									
	SONCC-MRAR.3.1.42.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-MRAR.3.1.66									
	SONCC-MRAR.3.1.66.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	OWRD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-MRAR.3.1.78									
	SONCC-MRAR.3.1.78.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	OWRD
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-MRAR.3.1.4									
	SONCC-MRAR.3.1.4.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-MRAR.22.3.45									
	SONCC-MRAR.22.3.45.1	$0						$0	County
	SONCC-MRAR.22.3.45.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MRAR.22.1.46									
	SONCC-MRAR.22.1.46.1	$0						$0	County
	SONCC-MRAR.22.1.46.2	$0						$0	County
	SONCC-MRAR.22.1.46.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MRAR.2.3.39									
	SONCC-MRAR.2.3.39.1	$17,008						$17,008	ODFW
	SONCC-MRAR.2.3.39.2							$0	ODFW
	SONCC-MRAR.2.3.39.3	$38,068						$38,068	ODFW
	SONCC-MRAR.2.3.39.4							$0	ODFW
	Action Total:	*$55,076*						*$55,076*	
SONCC-MRAR.2.3.77									
	SONCC-MRAR.2.3.77.1	$17,008						$17,008	ODFW
	SONCC-MRAR.2.3.77.2	$0						$0	ODFW
	SONCC-MRAR.2.3.77.3	$38,068						$38,068	ODFW
	SONCC-MRAR.2.3.77.4							$0	ODFW
	Action Total:	*$55,076*						*$55,076*	
SONCC-MRAR.3.1.68									
	SONCC-MRAR.3.1.68.1	$18,385						$18,385	OWRD
	SONCC-MRAR.3.1.68.2	$36,770						$36,770	OWRD
	Action Total:	*$55,155*						*$55,155*	
SONCC-MRAR.3.1.79									
	SONCC-MRAR.3.1.79.1	$18,385						$18,385	OWRD
	SONCC-MRAR.3.1.79.2	$36,770						$36,770	OWRD
	Action Total:	*$55,155*						*$55,155*	
SONCC-MRAR.7.1.43									
	SONCC-MRAR.7.1.43.1	$17,008						$17,008	NRCS/RCD
	SONCC-MRAR.7.1.43.2	$85,038						$85,038	NRCS/RCD
	SONCC-MRAR.7.1.43.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-MRAR.7.1.81									
	SONCC-MRAR.7.1.81.1	$17,008						$17,008	NRCS/RCD
	SONCC-MRAR.7.1.81.2	$85,038						$85,038	NRCS/RCD
	SONCC-MRAR.7.1.81.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-MRAR.26.1.67									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MRAR.26.1.67.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MRAR.10.2.29									
	SONCC-MRAR.10.2.29.1	$0						$0	ODEQ
	Action Total:	*$0*						*$0*	
SONCC-MRAR.10.2.41									
	SONCC-MRAR.10.2.41.1	$0						$0	ODEQ
	SONCC-MRAR.10.2.41.2	$0						$0	ODEQ
	Action Total:	*$0*						*$0*	
SONCC-MRAR.2.1.2									
	SONCC-MRAR.2.1.2.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-MRAR.2.2.63									
	SONCC-MRAR.2.2.63.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-MRAR.7.1.8									
	SONCC-MRAR.7.1.8.1	$34,015						$34,015	USFS
	SONCC-MRAR.7.1.8.3	$27,907,200						$27,907,200	USFS
	Action Total:	*$27,941,215*						*$27,941,215*	
SONCC-MRAR.7.1.9									
	SONCC-MRAR.7.1.9.1	$0						$0	County
	SONCC-MRAR.7.1.9.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MRAR.7.1.44									
	SONCC-MRAR.7.1.44.1	$170,075						$170,075	USFS
	Action Total:	*$170,075*						*$170,075*	
SONCC-MRAR.8.2.51									
	SONCC-MRAR.8.2.51.1	$68,030						$68,030	USACE
	SONCC-MRAR.8.2.51.2	$140,000						$140,000	USACE
	Action Total:	*$208,030*						*$208,030*	
SONCC-MRAR.5.1.15									
	SONCC-MRAR.5.1.15.1	$22,270						$22,270	NGO
	SONCC-MRAR.5.1.15.2	$655,508						$655,508	NGO
	Action Total:	*$677,778*						*$677,778*	
SONCC-MRAR.5.1.35									
	SONCC-MRAR.5.1.35.1	$44,540						$44,540	USFS
	SONCC-MRAR.5.1.35.2	$1,311,016						$1,311,016	USFS
	Action Total:	*$1,355,556*						*$1,355,556*	
SONCC-MRAR.5.1.80									
	SONCC-MRAR.5.1.80.1	$22,270						$22,270	NGO
	SONCC-MRAR.5.1.80.2	$655,508						$655,508	NGO
	Action Total:	*$677,778*						*$677,778*	
SONCC-MRAR.8.1.6									
	SONCC-MRAR.8.1.6.1	$2,372,984						$2,372,984	USFS
	SONCC-MRAR.8.1.6.2	$55,031,640						$55,031,640	USFS
	SONCC-MRAR.8.1.6.3	$2,267,460						$2,267,460	USFS
	SONCC-MRAR.8.1.6.4	$3,728,035					$3,728,035	$7,456,069	USFS
	Action Total:	*$63,400,118*					*$3,728,035*	*$67,128,153*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MRAR.8.1.82									
	SONCC-MRAR.8.1.82.1	$2,372,984						$2,372,984	USFS
	SONCC-MRAR.8.1.82.2	$55,031,640						$55,031,640	USFS
	SONCC-MRAR.8.1.82.3	$2,267,460						$2,267,460	USFS
	SONCC-MRAR.8.1.82.4	$3,728,035					$3,728,035	$7,456,069	USFS
	Action Total:	*$63,400,118*					*$3,728,035*	*$67,128,153*	
SONCC-MRAR.10.2.37									
	SONCC-MRAR.10.2.37.1	$45,925						$45,925	ODFW
	SONCC-MRAR.10.2.37.2	$114,813						$114,813	ODFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-MRAR.10.2.69									
	SONCC-MRAR.10.2.69.1	$45,925						$45,925	ODFW
	SONCC-MRAR.10.2.69.2	$114,813						$114,813	ODFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-MRAR.10.7.65									
	SONCC-MRAR.10.7.65.1	$8,504						$8,504	ODFW
	SONCC-MRAR.10.7.65.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MRAR.10.7.70									
	SONCC-MRAR.10.7.70.1	$8,504						$8,504	ODFW
	SONCC-MRAR.10.7.70.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MRAR.3.1.31									
	SONCC-MRAR.3.1.31.1	$68,030						$68,030	USACE
	SONCC-MRAR.3.1.31.2	$0						$0	USACE
	Action Total:	*$68,030*						*$68,030*	
SONCC-MRAR.1.2.34									
	SONCC-MRAR.1.2.34.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-MRAR.7.1.32									
	SONCC-MRAR.7.1.32.1	$0						$0	BLM
	Action Total:	*$0*						*$0*	
SONCC-MRAR.16.1.16									
	SONCC-MRAR.16.1.16.1	$34,015						$34,015	NMFS
	SONCC-MRAR.16.1.16.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MRAR.16.1.17									
	SONCC-MRAR.16.1.17.1	$34,015						$34,015	NMFS
	SONCC-MRAR.16.1.17.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MRAR.16.2.18									
	SONCC-MRAR.16.2.18.1	$34,015						$34,015	NMFS
	SONCC-MRAR.16.2.18.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-MRAR.16.2.19									
	SONCC-MRAR.16.2.19.1	$34,015						$34,015	NMFS
	SONCC-MRAR.16.2.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MRAR.14.2.14									
	SONCC-MRAR.14.2.14.1	$34,015						$34,015	ODFW
	SONCC-MRAR.14.2.14.2	$1,356,600	$1,356,600	$1,356,600	$1,356,600	$1,356,600	$1,356,600	$8,139,600	ODFW
	Action Total:	*$1,390,615*	*$1,356,600*	*$1,356,600*	*$1,356,600*	*$1,356,600*	*$1,356,600*	*$8,173,615*	
SONCC-MRAR.27.2.23									
	SONCC-MRAR.27.2.23.1	$136,060						$136,060	ODFW
	SONCC-MRAR.27.2.23.2		$81,800		$81,800		$81,800	$245,400	ODFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-MRAR.27.2.24									
	SONCC-MRAR.27.2.24.1	$19,181,454		$19,181,454		$19,181,454		$57,544,362	ODFW
	Action Total:	*$19,181,454*		*$19,181,454*		*$19,181,454*		*$57,544,362*	
SONCC-MRAR.27.2.25									
	SONCC-MRAR.27.2.25.1	$19,181,454		$19,181,454		$19,181,454		$57,544,362	ODFW
	Action Total:	*$19,181,454*		*$19,181,454*		*$19,181,454*		*$57,544,362*	
SONCC-MRAR.27.2.26									
	SONCC-MRAR.27.2.26.1	$19,181,454		$19,181,454		$19,181,454		$57,544,362	ODFW
	Action Total:	*$19,181,454*		*$19,181,454*		*$19,181,454*		*$57,544,362*	
SONCC-MRAR.27.2.27									
	SONCC-MRAR.27.2.27.1	$19,181,454		$19,181,454		$19,181,454		$57,544,362	ODFW
	Action Total:	*$19,181,454*		*$19,181,454*		*$19,181,454*		*$57,544,362*	
SONCC-MRAR.27.2.28									
	SONCC-MRAR.27.2.28.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	ODFW
	SONCC-MRAR.27.2.28.2	$34,015						$34,015	ODFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-MRAR.27.2.58									
	SONCC-MRAR.27.2.58.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MRAR.27.2.59									
	SONCC-MRAR.27.2.59.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-MRAR.27.2.61									
	SONCC-MRAR.27.2.61.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-MRAR.27.2.64									
	SONCC-MRAR.27.2.64.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MRAR.27.1.20									
	SONCC-MRAR.27.1.20.1	$1,137,870	$1,137,870	$1,137,870	$1,137,870	$1,137,870	$1,137,870	$6,827,220	ODFW
	Action Total:	*$1,137,870*	*$1,137,870*	*$1,137,870*	*$1,137,870*	*$1,137,870*	*$1,137,870*	*$6,827,220*	
SONCC-MRAR.27.1.21									
	SONCC-MRAR.27.1.21.1	$379,290	$379,290	$379,290	$379,290	$379,290	$379,290	$2,275,740	ODFW
	Action Total:	*$379,290*	*$379,290*	*$379,290*	*$379,290*	*$379,290*	*$379,290*	*$2,275,740*	
SONCC-MRAR.27.1.22									
	SONCC-MRAR.27.1.22.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MRAR.27.1.33									
	SONCC-MRAR.27.1.33.1	$68,030		$68,030		$68,030		$204,090	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-MRAR.27.1.36									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MRAR.27.1.36.1	$34,015						$34,015	NMFS
	SONCC-MRAR.27.1.36.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-MRAR.27.4.52									
	SONCC-MRAR.27.4.52.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MRAR.27.4.53									
	SONCC-MRAR.27.4.53.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MRAR.27.4.54									
	SONCC-MRAR.27.4.54.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MRAR.27.4.55									
	SONCC-MRAR.27.4.55.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MRAR.27.4.56									
	SONCC-MRAR.27.4.56.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MRAR.27.4.60									
	SONCC-MRAR.27.4.60.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MRAR.27.4.62									
	SONCC-MRAR.27.4.62.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$272,848,886***	***$4,161,560***	***$80,907,621***	***$4,161,560***	***$80,907,621***	***$11,617,629***	***$454,604,877***	

Population: Mussel Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MusC.19.3.3									
	SONCC-MusC.19.3.3.2	$68,030						$68,030	ODF
	SONCC-MusC.19.3.3.3	$0						$0	ODF
	SONCC-MusC.19.3.3.4	$0						$0	ODF
	SONCC-MusC.19.3.3.5	$0						$0	ODF
	SONCC-MusC.19.3.3.6	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	
SONCC-MusC.2.1.6									
	SONCC-MusC.2.1.6.1	$17,008						$17,008	NGO
	SONCC-MusC.2.1.6.2	$129,430						$129,430	NGO
	Action Total:	*$146,437*						*$146,437*	
SONCC-MusC.2.1.35									
	SONCC-MusC.2.1.35.1	$17,008						$17,008	NGO
	SONCC-MusC.2.1.35.2	$129,430						$129,430	NGO
	Action Total:	*$146,437*						*$146,437*	
SONCC-MusC.2.2.4									
	SONCC-MusC.2.2.4.1	$17,008						$17,008	NGO
	SONCC-MusC.2.2.4.2	$51,129						$51,129	NGO
	Action Total:	*$68,137*						*$68,137*	
SONCC-MusC.2.2.5									
	SONCC-MusC.2.2.5.1	$17,008						$17,008	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MusC.2.2.5.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-MusC.2.2.5.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-MusC.2.2.36									
	SONCC-MusC.2.2.36.1	$17,008						$17,008	NGO
	SONCC-MusC.2.2.36.2	$51,129						$51,129	NGO
	Action Total:	*$68,137*						*$68,137*	
SONCC-MusC.2.2.37									
	SONCC-MusC.2.2.37.1	$17,008						$17,008	ODFW
	SONCC-MusC.2.2.37.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-MusC.2.2.37.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-MusC.7.1.1									
	SONCC-MusC.7.1.1.1	$8,503						$8,503	County
	SONCC-MusC.7.1.1.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-MusC.2.2.31									
	SONCC-MusC.2.2.31.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-MusC.7.1.19									
	SONCC-MusC.7.1.19.1	$17,008						$17,008	NRCS/RCD
	SONCC-MusC.7.1.19.2	$17,008						$17,008	NRCS/RCD
	SONCC-MusC.7.1.19.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$119,053*						*$119,053*	
SONCC-MusC.7.1.20									
	SONCC-MusC.7.1.20.1	$0						$0	County
	SONCC-MusC.7.1.20.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MusC.7.1.40									
	SONCC-MusC.7.1.40.1	$17,008						$17,008	NRCS/RCD
	SONCC-MusC.7.1.40.2	$17,008						$17,008	NRCS/RCD
	SONCC-MusC.7.1.40.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$119,053*						*$119,053*	
SONCC-MusC.22.1.21									
	SONCC-MusC.22.1.21.1	$0						$0	County
	SONCC-MusC.22.1.21.2	$0						$0	County
	SONCC-MusC.22.1.21.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-MusC.5.1.8									
	SONCC-MusC.5.1.8.1	$17,008						$17,008	ODFW
	Action Total:	*$17,008*						*$17,008*	
SONCC-MusC.5.1.39									
	SONCC-MusC.5.1.39.1	$17,008						$17,008	ODFW
	Action Total:	*$17,008*						*$17,008*	
SONCC-MusC.3.1.18									
	SONCC-MusC.3.1.18.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-MusC.3.1.38									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-MusC.3.1.38.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-MusC.8.1.11									
	SONCC-MusC.8.1.11.1	$21,386						$21,386	NGO
	SONCC-MusC.8.1.11.2	$498,475						$498,475	NGO
	SONCC-MusC.8.1.11.3	$20,349						$20,349	NGO
	SONCC-MusC.8.1.11.4	$28,668						$28,668	NGO
	Action Total:	*$568,878*						*$568,878*	
SONCC-MusC.8.1.41									
	SONCC-MusC.8.1.41.1	$21,386						$21,386	NGO
	SONCC-MusC.8.1.41.2	$498,475						$498,475	NGO
	SONCC-MusC.8.1.41.3	$20,349						$20,349	NGO
	SONCC-MusC.8.1.41.4	$28,668						$28,668	NGO
	Action Total:	*$568,878*						*$568,878*	
SONCC-MusC.10.7.33									
	SONCC-MusC.10.7.33.1	$8,504						$8,504	ODFW
	SONCC-MusC.10.7.33.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MusC.10.7.34									
	SONCC-MusC.10.7.34.1	$8,504						$8,504	ODFW
	SONCC-MusC.10.7.34.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-MusC.22.1.17									
	SONCC-MusC.22.1.17.1	$0						$0	ODEQ
	SONCC-MusC.22.1.17.2	$0						$0	ODEQ
	Action Total:	*$0*						*$0*	
SONCC-MusC.22.1.7									
	SONCC-MusC.22.1.7.1	$76,136						$76,136	OWRD
	Action Total:	*$76,136*						*$76,136*	
SONCC-MusC.27.2.27									
	SONCC-MusC.27.2.27.1	$1,224		$1,224		$1,224		$3,672	ODFW
	Action Total:	*$1,224*		*$1,224*		*$1,224*		*$3,672*	
SONCC-MusC.27.2.28									
	SONCC-MusC.27.2.28.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-MusC.27.2.29									
	SONCC-MusC.27.2.29.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	ODFW
	SONCC-MusC.27.2.29.2	$34,015						$34,015	ODFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-MusC.27.2.13									
	SONCC-MusC.27.2.13.1	$1,224		$1,224		$1,224		$3,672	ODFW
	Action Total:	*$1,224*		*$1,224*		*$1,224*		*$3,672*	
SONCC-MusC.27.2.14									
	SONCC-MusC.27.2.14.1	$1,224		$1,224		$1,224		$3,672	ODFW
	Action Total:	*$1,224*		*$1,224*		*$1,224*		*$3,672*	
SONCC-MusC.27.2.16									
	SONCC-MusC.27.2.16.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-MusC.27.2.32									
	SONCC-MusC.27.2.32.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MusC.27.2.10									
	SONCC-MusC.27.2.10.1	$136,060						$136,060	ODFW
	SONCC-MusC.27.2.10.2			$81,800			$81,800	$163,600	ODFW
	Action Total:	*$136,060*		*$81,800*			*$81,800*	*$299,660*	
SONCC-MusC.27.1.26									
	SONCC-MusC.27.1.26.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-MusC.27.1.12									
	SONCC-MusC.27.1.12.1	$3,030	$3,030	$3,030	$3,030	$3,030	$3,030	$18,180	ODFW
	Action Total:	*$3,030*	*$3,030*	*$3,030*	*$3,030*	*$3,030*	*$3,030*	*$18,180*	
SONCC-MusC.27.1.15									
	SONCC-MusC.27.1.15.1	$34,015						$34,015	NMFS
	SONCC-MusC.27.1.15.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-MusC.27.4.23									
	SONCC-MusC.27.4.23.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MusC.27.4.24									
	SONCC-MusC.27.4.24.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MusC.27.4.25									
	SONCC-MusC.27.4.25.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-MusC.27.4.30									
	SONCC-MusC.27.4.30.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$3,071,149***	***$638,478***	***$757,965***	***$638,478***	***$676,165***	***$720,278***	***$6,502,511***	

Population: North Fork Eel River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-NFER.8.1.1									
	SONCC-NFER.8.1.1.1	$450,306						$450,306	NGO
	SONCC-NFER.8.1.1.2	$10,846,816						$10,846,816	NGO
	SONCC-NFER.8.1.1.3	$1,845,177						$1,845,177	NGO
	SONCC-NFER.8.1.1.4	$1,349,785					$1,349,785	$2,699,570	NGO
	Action Total:	*$14,492,084*					*$1,349,785*	*$15,841,869*	
SONCC-NFER.8.1.9									
	SONCC-NFER.8.1.9.1	$9,100						$9,100	NRCS/RCD
	SONCC-NFER.8.1.9.2	$18,200						$18,200	NRCS/RCD
	SONCC-NFER.8.1.9.3	$45,500						$45,500	NRCS/RCD
	Action Total:	*$72,800*						*$72,800*	
SONCC-NFER.8.1.36									
	SONCC-NFER.8.1.36.1	$9,100						$9,100	NRCS/RCD
	SONCC-NFER.8.1.36.2	$18,200						$18,200	NRCS/RCD
	SONCC-NFER.8.1.36.3	$45,500						$45,500	NRCS/RCD
	Action Total:	*$72,800*						*$72,800*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-NFER.10.1.11									
	SONCC-NFER.10.1.11.1	$17,008						$17,008	USFS
	SONCC-NFER.10.1.11.2	$70,785						$70,785	USFS
	Action Total:	*$87,793*						*$87,793*	
SONCC-NFER.10.1.30									
	SONCC-NFER.10.1.30.1	$17,008						$17,008	USFS
	SONCC-NFER.10.1.30.2	$70,785						$70,785	USFS
	Action Total:	*$87,793*						*$87,793*	
SONCC-NFER.10.7.29									
	SONCC-NFER.10.7.29.1	$8,504						$8,504	CDFW
	SONCC-NFER.10.7.29.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-NFER.10.7.31									
	SONCC-NFER.10.7.31.1	$8,504						$8,504	CDFW
	SONCC-NFER.10.7.31.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-NFER.3.1.3									
	SONCC-NFER.3.1.3.1	$175,000						$175,000	NGO
	SONCC-NFER.3.1.3.2	$1,250	$1,250	$1,250	$1,250	$1,250	$1,250	$7,500	NGO
	Action Total:	*$176,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$182,500*	
SONCC-NFER.3.1.4									
	SONCC-NFER.3.1.4.1	$17,008						$17,008	USFS
	SONCC-NFER.3.1.4.2	$31,960						$31,960	USFS
	Action Total:	*$48,968*						*$48,968*	
SONCC-NFER.3.1.34									
	SONCC-NFER.3.1.34.1	$175,000						$175,000	NGO
	SONCC-NFER.3.1.34.2	$1,250	$1,250	$1,250	$1,250	$1,250	$1,250	$7,500	NGO
	Action Total:	*$176,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$182,500*	
SONCC-NFER.3.1.35									
	SONCC-NFER.3.1.35.1	$17,008						$17,008	USFS
	SONCC-NFER.3.1.35.2	$31,960						$31,960	USFS
	Action Total:	*$48,968*						*$48,968*	
SONCC-NFER.7.1.6									
	SONCC-NFER.7.1.6.1	$34,015						$34,015	USFS
	SONCC-NFER.7.1.6.2	$627,912						$627,912	USFS
	SONCC-NFER.7.1.6.3	$1,088,381						$1,088,381	USFS
	Action Total:	*$1,750,308*						*$1,750,308*	
SONCC-NFER.7.1.10									
	SONCC-NFER.7.1.10.1	$18,200						$18,200	USFS
	SONCC-NFER.7.1.10.2	$343,200						$343,200	USFS
	Action Total:	*$361,400*						*$361,400*	
SONCC-NFER.2.1.2									
	SONCC-NFER.2.1.2.1	$17,008						$17,008	CDFW
	SONCC-NFER.2.1.2.2	$43,971						$43,971	CDFW
	Action Total:	*$60,978*						*$60,978*	
SONCC-NFER.2.1.7									
	SONCC-NFER.2.1.7.1	$17,008						$17,008	NGO

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-NFER.2.1.7.2	$235,576						$235,576	NGO
	Action Total:	*$252,583*						*$252,583*	
SONCC-NFER.2.1.32									
	SONCC-NFER.2.1.32.1	$17,008						$17,008	CDFW
	SONCC-NFER.2.1.32.2	$43,971						$43,971	CDFW
	Action Total:	*$60,978*						*$60,978*	
SONCC-NFER.2.1.33									
	SONCC-NFER.2.1.33.1	$17,008						$17,008	NGO
	SONCC-NFER.2.1.33.2	$235,576						$235,576	NGO
	Action Total:	*$252,583*						*$252,583*	
SONCC-NFER.1.2.5									
	SONCC-NFER.1.2.5.1	$0						$0	NGO
	Action Total:	*$0*						*$0*	
SONCC-NFER.14.2.8									
	SONCC-NFER.14.2.8.1	$34,015						$34,015	CDFW
	SONCC-NFER.14.2.8.2	$1,795,500						$1,795,500	CDFW
	Action Total:	*$1,829,515*						*$1,829,515*	
SONCC-NFER.27.2.24									
	SONCC-NFER.27.2.24.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-NFER.27.2.26									
	SONCC-NFER.27.2.26.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-NFER.27.2.27									
	SONCC-NFER.27.2.27.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-NFER.27.2.12									
	SONCC-NFER.27.2.12.1	$97,110		$97,110		$97,110		$291,330	CDFW
	Action Total:	*$97,110*		*$97,110*		*$97,110*		*$291,330*	
SONCC-NFER.27.2.13									
	SONCC-NFER.27.2.13.1	$97,110		$97,110		$97,110		$291,330	CDFW
	Action Total:	*$97,110*		*$97,110*		*$97,110*		*$291,330*	
SONCC-NFER.27.2.16									
	SONCC-NFER.27.2.16.1	$97,110		$97,110		$97,110		$291,330	CDFW
	Action Total:	*$97,110*		*$97,110*		*$97,110*		*$291,330*	
SONCC-NFER.27.2.17									
	SONCC-NFER.27.2.17.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-NFER.27.2.18									
	SONCC-NFER.27.2.18.1	$97,110		$97,110		$97,110		$291,330	CDFW
	Action Total:	*$97,110*		*$97,110*		*$97,110*		*$291,330*	
SONCC-NFER.27.2.19									
	SONCC-NFER.27.2.19.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-NFER.27.2.19.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-NFER.27.2.28									
	SONCC-NFER.27.2.28.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-NFER.27.2.37									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-NFER.27.2.37.1	$136,060						$136,060	CDFW
	SONCC-NFER.27.2.37.2			$81,800				$81,800	CDFW
	Action Total:	*$136,060*		*$81,800*				*$217,860*	
SONCC-NFER.27.1.23									
	SONCC-NFER.27.1.23.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-NFER.27.1.25									
	SONCC-NFER.27.1.25.1	$26,987	$26,987	$26,987	$26,987	$26,987	$26,987	$161,922	CDFW
	Action Total:	*$26,987*	*$26,987*	*$26,987*	*$26,987*	*$26,987*	*$26,987*	*$161,922*	
SONCC-NFER.27.1.14									
	SONCC-NFER.27.1.14.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	CDFW
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-NFER.27.4.20									
	SONCC-NFER.27.4.20.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-NFER.27.4.21									
	SONCC-NFER.27.4.21.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-NFER.27.4.22									
	SONCC-NFER.27.4.22.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
	Population Total:	***$21,215,400***	***$682,147***	***$1,186,402***	***$682,147***	***$1,104,602***	***$2,031,932***	***$26,902,630***	

Population: Norton/Widow White Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-NWWC.7.1.1									
	SONCC-NWWC.7.1.1.1	$0						$0	County
	SONCC-NWWC.7.1.1.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-NWWC.7.1.2									
	SONCC-NWWC.7.1.2.1	$34,015						$34,015	County
	SONCC-NWWC.7.1.2.2	$35,156						$35,156	County
	SONCC-NWWC.7.1.2.3	$279,072						$279,072	County
	Action Total:	*$348,243*						*$348,243*	
SONCC-NWWC.2.1.7									
	SONCC-NWWC.2.1.7.1	$17,008						$17,008	CDFW
	SONCC-NWWC.2.1.7.2	$262,283						$262,283	CDFW
	Action Total:	*$279,291*						*$279,291*	
SONCC-NWWC.2.1.26									
	SONCC-NWWC.2.1.26.1	$17,008						$17,008	CDFW
	SONCC-NWWC.2.1.26.2	$262,283						$262,283	CDFW
	Action Total:	*$279,291*						*$279,291*	
SONCC-NWWC.2.2.8									
	SONCC-NWWC.2.2.8.1	$17,008						$17,008	NGO
	SONCC-NWWC.2.2.8.2	$51,129						$51,129	NGO
	Action Total:	*$68,137*						*$68,137*	
SONCC-NWWC.2.2.27									
	SONCC-NWWC.2.2.27.1	$17,008						$17,008	NGO
	SONCC-NWWC.2.2.27.2	$51,129						$51,129	NGO
	Action Total:	*$68,137*						*$68,137*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-NWWC.5.1.3									
	SONCC-NWWC.5.1.3.1	$17,008						$17,008	County
	SONCC-NWWC.5.1.3.2	$406,977						$406,977	Caltrans
	SONCC-NWWC.5.1.3.3	$441,860						$441,860	County
	Action Total:	*$865,844*						*$865,844*	
SONCC-NWWC.5.1.29									
	SONCC-NWWC.5.1.29.1	$17,008						$17,008	County
	SONCC-NWWC.5.1.29.2	$406,977						$406,977	Caltrans
	SONCC-NWWC.5.1.29.3	$441,860						$441,860	County
	Action Total:	*$865,844*						*$865,844*	
SONCC-NWWC.10.2.16									
	SONCC-NWWC.10.2.16.1	$45,925						$45,925	CDFW
	SONCC-NWWC.10.2.16.2	$114,813						$114,813	CDFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-NWWC.10.2.24									
	SONCC-NWWC.10.2.24.1	$45,925						$45,925	CDFW
	SONCC-NWWC.10.2.24.2	$114,813						$114,813	CDFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-NWWC.2.2.9									
	SONCC-NWWC.2.2.9.1	$13,504						$13,504	CDFW
	SONCC-NWWC.2.2.9.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$98,541*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$523,729*	
SONCC-NWWC.2.2.28									
	SONCC-NWWC.2.2.28.1	$27,008						$27,008	CDFW
	SONCC-NWWC.2.2.28.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-NWWC.10.7.23									
	SONCC-NWWC.10.7.23.1	$8,504						$8,504	CDFW
	SONCC-NWWC.10.7.23.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-NWWC.10.7.25									
	SONCC-NWWC.10.7.25.1	$8,504						$8,504	CDFW
	SONCC-NWWC.10.7.25.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-NWWC.27.2.6									
	SONCC-NWWC.27.2.6.1	$136,060						$136,060	CDFW
	SONCC-NWWC.27.2.6.2			$81,800			$81,800	$163,600	CDFW
	Action Total:	*$136,060*		*$81,800*			*$81,800*	*$299,660*	
SONCC-NWWC.27.2.11									
	SONCC-NWWC.27.2.11.1	$97,110		$97,110		$97,110		$291,330	CDFW
	Action Total:	*$97,110*		*$97,110*		*$97,110*		*$291,330*	
SONCC-NWWC.27.2.12									
	SONCC-NWWC.27.2.12.1	$2,432		$2,432		$2,432		$7,296	CDFW
	Action Total:	*$2,432*		*$2,432*		*$2,432*		*$7,296*	
SONCC-NWWC.27.2.22									
	SONCC-NWWC.27.2.22.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-NWWC.27.1.21									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-NWWC.27.1.21.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-NWWC.27.1.10									
	SONCC-NWWC.27.1.10.1	$4,270	$4,270	$4,270	$4,270	$4,270	$4,270	$25,620	CDFW
	Action Total:	*$4,270*	*$4,270*	*$4,270*	*$4,270*	*$4,270*	*$4,270*	*$25,620*	
SONCC-NWWC.27.1.13									
	SONCC-NWWC.27.1.13.1	$34,015						$34,015	NMFS
	SONCC-NWWC.27.1.13.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-NWWC.27.4.17									
	SONCC-NWWC.27.4.17.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-NWWC.27.4.18									
	SONCC-NWWC.27.4.18.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-NWWC.27.4.19									
	SONCC-NWWC.27.4.19.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-NWWC.27.4.20									
	SONCC-NWWC.27.4.20.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-NWWC.2.2.15									
	SONCC-NWWC.2.2.15.1							$0	CDFW
	Action Total:							*$0*	
SONCC-NWWC.10.2.4									
	SONCC-NWWC.10.2.4.1							$0	NGO
	Action Total:							*$0*	
SONCC-NWWC.10.2.5									
	SONCC-NWWC.10.2.5.1							$0	NGO
	Action Total:							*$0*	
	Population Total:	***$3,938,095***	***$514,700***	***$696,042***	***$514,700***	***$614,242***	***$596,500***	***$6,874,280***	

Population: Pistol River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-PisR.19.3.3									
	SONCC-PisR.19.3.3.1	$34,015						$34,015	ODF
	SONCC-PisR.19.3.3.2	$0						$0	ODF
	SONCC-PisR.19.3.3.3	$0						$0	ODF
	SONCC-PisR.19.3.3.4	$0						$0	ODF
	SONCC-PisR.19.3.3.5	$0						$0	ODF
	Action Total:	*$34,015*						*$34,015*	
SONCC-PisR.19.3.40									
	SONCC-PisR.19.3.40.1	$34,015						$34,015	ODF
	SONCC-PisR.19.3.40.2	$0						$0	ODF
	SONCC-PisR.19.3.40.3	$0						$0	ODF
	SONCC-PisR.19.3.40.4	$0						$0	ODF
	SONCC-PisR.19.3.40.5	$0						$0	ODF
	Action Total:	*$34,015*						*$34,015*	
SONCC-PisR.2.2.6									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-PisR.2.2.6.1	$17,008						$17,008	USFS
	SONCC-PisR.2.2.6.2	$55,858						$55,858	USFS
	Action Total:	*$72,866*						*$72,866*	
SONCC-PisR.2.2.7									
	SONCC-PisR.2.2.7.1	$17,008						$17,008	ODFW
	SONCC-PisR.2.2.7.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-PisR.2.2.7.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-PisR.2.2.41									
	SONCC-PisR.2.2.41.1	$17,008						$17,008	USFS
	SONCC-PisR.2.2.41.2	$55,858						$55,858	USFS
	Action Total:	*$72,866*						*$72,866*	
SONCC-PisR.2.2.42									
	SONCC-PisR.2.2.42.1	$17,008						$17,008	ODFW
	SONCC-PisR.2.2.42.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-PisR.2.2.42.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-PisR.28.1.4									
	SONCC-PisR.28.1.4.1	$232,416						$232,416	NGO
	SONCC-PisR.28.1.4.2	$3,150,362						$3,150,362	NGO
	SONCC-PisR.28.1.4.3	$303,782						$303,782	NGO
	SONCC-PisR.28.1.4.4	$499,301				$499,301		$998,602	NGO
	Action Total:	*$4,185,861*				*$499,301*		*$4,685,162*	
SONCC-PisR.12.1.26									
	SONCC-PisR.12.1.26.1	$0						$0	ODA
	SONCC-PisR.12.1.26.2	$0						$0	ODA
	SONCC-PisR.12.1.26.3	$0						$0	ODA
	SONCC-PisR.12.1.26.4	$0						$0	ODA
	SONCC-PisR.12.1.26.5	$0						$0	ODA
	SONCC-PisR.12.1.26.6	$0						$0	ODA
	Action Total:	*$0*						*$0*	
SONCC-PisR.7.1.22									
	SONCC-PisR.7.1.22.1	$17,008						$17,008	NRCS/RCD
	SONCC-PisR.7.1.22.2	$17,008						$17,008	NRCS/RCD
	SONCC-PisR.7.1.22.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$119,053*						*$119,053*	
SONCC-PisR.7.1.45									
	SONCC-PisR.7.1.45.1	$17,008						$17,008	NRCS/RCD
	SONCC-PisR.7.1.45.2	$17,008						$17,008	NRCS/RCD
	SONCC-PisR.7.1.45.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$119,053*						*$119,053*	
SONCC-PisR.28.2.25									
	SONCC-PisR.28.2.25.1	$0						$0	County
	SONCC-PisR.28.2.25.2	$0						$0	County
	SONCC-PisR.28.2.25.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-PisR.7.1.2									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-PisR.7.1.2.1	$0						$0	County
	SONCC-PisR.7.1.2.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-PisR.2.2.35									
	SONCC-PisR.2.2.35.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-PisR.10.2.9									
	SONCC-PisR.10.2.9.1	$136,060						$136,060	EPA
	Action Total:	*$136,060*						*$136,060*	
SONCC-PisR.7.1.23									
	SONCC-PisR.7.1.23.1	$170,075						$170,075	USFS
	Action Total:	*$170,075*						*$170,075*	
SONCC-PisR.7.1.24									
	SONCC-PisR.7.1.24.1	$0						$0	County
	SONCC-PisR.7.1.24.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-PisR.7.1.1									
	SONCC-PisR.7.1.1.1	$34,015						$34,015	ODF
	SONCC-PisR.7.1.1.3	$914,648						$914,648	ODF
	Action Total:	*$948,663*						*$948,663*	
SONCC-PisR.5.1.10									
	SONCC-PisR.5.1.10.1	$22,270						$22,270	USFS
	Action Total:	*$22,270*						*$22,270*	
SONCC-PisR.5.1.44									
	SONCC-PisR.5.1.44.1	$22,270						$22,270	USFS
	Action Total:	*$22,270*						*$22,270*	
SONCC-PisR.3.1.21									
	SONCC-PisR.3.1.21.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-PisR.3.1.43									
	SONCC-PisR.3.1.43.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-PisR.10.2.19									
	SONCC-PisR.10.2.19.1	$45,925						$45,925	ODFW
	SONCC-PisR.10.2.19.2	$114,813						$114,813	ODFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-PisR.10.2.38									
	SONCC-PisR.10.2.38.1	$45,925						$45,925	ODFW
	SONCC-PisR.10.2.38.2	$114,813						$114,813	ODFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-PisR.10.7.37									
	SONCC-PisR.10.7.37.1	$8,504						$8,504	ODFW
	SONCC-PisR.10.7.37.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-PisR.10.7.39									
	SONCC-PisR.10.7.39.1	$8,504						$8,504	ODFW
	SONCC-PisR.10.7.39.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-PisR.3.1.12									
	SONCC-PisR.3.1.12.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-PisR.10.2.20									
	SONCC-PisR.10.2.20.1	$0						$0	ODEQ
	SONCC-PisR.10.2.20.2	$0						$0	ODEQ
	Action Total:	*$0*						*$0*	
SONCC-PisR.10.2.8									
	SONCC-PisR.10.2.8.1	$76,136						$76,136	OWRD
	Action Total:	*$76,136*						*$76,136*	
SONCC-PisR.27.2.30									
	SONCC-PisR.27.2.30.1	$30,462		$30,462		$30,462		$91,386	ODFW
	Action Total:	*$30,462*		*$30,462*		*$30,462*		*$91,386*	
SONCC-PisR.27.2.31									
	SONCC-PisR.27.2.31.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-PisR.27.2.32									
	SONCC-PisR.27.2.32.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	ODFW
	SONCC-PisR.27.2.32.2	$34,015						$34,015	ODFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-PisR.27.2.33									
	SONCC-PisR.27.2.33.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-PisR.27.2.15									
	SONCC-PisR.27.2.15.1	$30,462		$30,462		$30,462		$91,386	ODFW
	Action Total:	*$30,462*		*$30,462*		*$30,462*		*$91,386*	
SONCC-PisR.27.2.16									
	SONCC-PisR.27.2.16.1	$30,462		$30,462		$30,462		$91,386	ODFW
	Action Total:	*$30,462*		*$30,462*		*$30,462*		*$91,386*	
SONCC-PisR.27.2.18									
	SONCC-PisR.27.2.18.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-PisR.27.2.36									
	SONCC-PisR.27.2.36.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-PisR.27.2.13									
	SONCC-PisR.27.2.13.1	$136,060						$136,060	ODFW
	SONCC-PisR.27.2.13.2			$81,800			$81,800	$163,600	ODFW
	Action Total:	*$136,060*		*$81,800*			*$81,800*	*$299,660*	
SONCC-PisR.27.1.29									
	SONCC-PisR.27.1.29.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-PisR.27.1.14									
	SONCC-PisR.27.1.14.1	$15,115	$15,115	$15,115	$15,115	$15,115	$15,115	$90,690	ODFW
	Action Total:	*$15,115*	*$15,115*	*$15,115*	*$15,115*	*$15,115*	*$15,115*	*$90,690*	
SONCC-PisR.27.1.17									
	SONCC-PisR.27.1.17.1	$34,015						$34,015	NMFS
	SONCC-PisR.27.1.17.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-PisR.27.4.27									
	SONCC-PisR.27.4.27.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-PisR.27.4.28									
	SONCC-PisR.27.4.28.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-PisR.27.4.34									
	SONCC-PisR.27.4.34.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$7,641,296***	***$735,805***	***$943,006***	***$735,805***	***$1,360,507***	***$817,605***	***$12,234,024***	

Population: Redwood Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-RedC.1.2.5									
	SONCC-RedC.1.2.5.1	$89,080						$89,080	USACE
	SONCC-RedC.1.2.5.2	$0						$0	USACE
	SONCC-RedC.1.2.5.3	$1,000,000						$1,000,000	USACE
	SONCC-RedC.1.2.5.4	$468,653						$468,653	USACE
	SONCC-RedC.1.2.5.5	$766,990						$766,990	USACE
	Action Total:	*$2,324,723*						*$2,324,723*	
SONCC-RedC.7.1.38									
	SONCC-RedC.7.1.38.1	$45,925						$45,925	USACE
	SONCC-RedC.7.1.38.2	$0						$0	USACE
	SONCC-RedC.7.1.38.3	$18,976,896						$18,976,896	USACE
	Action Total:	*$19,022,821*						*$19,022,821*	
SONCC-RedC.1.2.32									
	SONCC-RedC.1.2.32.1	$34,015						$34,015	CDFW
	SONCC-RedC.1.2.32.2	$34,015						$34,015	CDFW
	SONCC-RedC.1.2.32.3	$682,150						$682,150	CDFW
	Action Total:	*$750,180*						*$750,180*	
SONCC-RedC.2.1.4									
	SONCC-RedC.2.1.4.1	$17,008						$17,008	NPS
	SONCC-RedC.2.1.4.2	$2,410,540						$2,410,540	NPS
	Action Total:	*$2,427,548*						*$2,427,548*	
SONCC-RedC.2.1.58									
	SONCC-RedC.2.1.58.1	$17,008						$17,008	NPS
	SONCC-RedC.2.1.58.2	$2,410,540						$2,410,540	NPS
	Action Total:	*$2,427,548*						*$2,427,548*	
SONCC-RedC.2.2.36									
	SONCC-RedC.2.2.36.1	$17,008						$17,008	CDFW
	SONCC-RedC.2.2.36.2	$460,161						$460,161	CDFW
	Action Total:	*$477,169*						*$477,169*	
SONCC-RedC.2.2.40									
	SONCC-RedC.2.2.40.1	$0						$0	NPS
	SONCC-RedC.2.2.40.2	$0						$0	NPS
	Action Total:	*$0*						*$0*	
SONCC-RedC.2.2.59									
	SONCC-RedC.2.2.59.1	$17,008						$17,008	CDFW
	SONCC-RedC.2.2.59.2	$460,161						$460,161	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$477,169*						*$477,169*	
SONCC-RedC.5.1.10									
	SONCC-RedC.5.1.10.1	$44,540						$44,540	NPS
	SONCC-RedC.5.1.10.2	$436,045						$436,045	NPS
	Action Total:	*$480,585*						*$480,585*	
SONCC-RedC.8.1.13									
	SONCC-RedC.8.1.13.1	$68,030						$68,030	NPS
	SONCC-RedC.8.1.13.2	$68,030						$68,030	NGO
	SONCC-RedC.8.1.13.3	$528,240						$528,240	NGO
	Action Total:	*$664,300*						*$664,300*	
SONCC-RedC.10.1.41									
	SONCC-RedC.10.1.41.1	$17,008						$17,008	NPS
	SONCC-RedC.10.1.41.2	$109,570						$109,570	NPS
	SONCC-RedC.10.1.41.3	$87,210						$87,210	NPS
	Action Total:	*$213,788*						*$213,788*	
SONCC-RedC.10.1.56									
	SONCC-RedC.10.1.56.1	$17,008						$17,008	NPS
	SONCC-RedC.10.1.56.2	$109,570						$109,570	NPS
	SONCC-RedC.10.1.56.3	$87,210						$87,210	NPS
	Action Total:	*$213,788*						*$213,788*	
SONCC-RedC.27.2.35									
	SONCC-RedC.27.2.35.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-RedC.2.1.6									
	SONCC-RedC.2.1.6.1	$34,015						$34,015	NPS
	SONCC-RedC.2.1.6.2	$34,015						$34,015	NPS
	SONCC-RedC.2.1.6.3	$338,776						$338,776	NPS
	SONCC-RedC.2.1.6.4	$470,000						$470,000	NGO
	SONCC-RedC.2.1.6.5	$0						$0	CDFW
	Action Total:	*$876,806*						*$876,806*	
SONCC-RedC.5.1.11									
	SONCC-RedC.5.1.11.1	$94,040						$94,040	NPS
	SONCC-RedC.5.1.11.2	$26,163						$26,163	NPS
	SONCC-RedC.5.1.11.3	$25,563						$25,563	NPS
	Action Total:	*$145,766*						*$145,766*	
SONCC-RedC.5.1.61									
	SONCC-RedC.5.1.61.1	$94,040						$94,040	NPS
	SONCC-RedC.5.1.61.2	$26,163						$26,163	NPS
	SONCC-RedC.5.1.61.3	$25,563						$25,563	NPS
	Action Total:	*$145,766*						*$145,766*	
SONCC-RedC.7.1.14									
	SONCC-RedC.7.1.14.1	$0						$0	CDF
	SONCC-RedC.7.1.14.2	$34,015						$34,015	CDF
	SONCC-RedC.7.1.14.3	$34,015						$34,015	CDF
	Action Total:	*$68,030*						*$68,030*	
SONCC-RedC.26.1.55									
	SONCC-RedC.26.1.55.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-RedC.8.1.12									
	SONCC-RedC.8.1.12.1	$18,200						$18,200	NPS
	SONCC-RedC.8.1.12.2	$3,518,112						$3,518,112	NPS
	Action Total:	*$3,536,312*						*$3,536,312*	
SONCC-RedC.8.1.15									
	SONCC-RedC.8.1.15.1	$980,707						$980,707	NPS
	SONCC-RedC.8.1.15.2	$35,491,420						$35,491,420	NPS
	SONCC-RedC.8.1.15.3	$531,353						$531,353	NPS
	SONCC-RedC.8.1.15.4	$701,172					$701,172	$1,402,343	NPS
	Action Total:	*$37,704,651*					*$701,172*	*$38,405,823*	
SONCC-RedC.8.1.16									
	SONCC-RedC.8.1.16.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-RedC.8.1.64									
	SONCC-RedC.8.1.64.1	$980,707						$980,707	NPS
	SONCC-RedC.8.1.64.2	$35,491,420						$35,491,420	NPS
	SONCC-RedC.8.1.64.3	$531,353						$531,353	NPS
	SONCC-RedC.8.1.64.4	$701,172					$701,172	$1,402,343	NPS
	Action Total:	*$37,704,651*					*$701,172*	*$38,405,823*	
SONCC-RedC.7.1.54									
	SONCC-RedC.7.1.54.1	$110,947						$110,947	Private
	Action Total:	*$110,947*						*$110,947*	
SONCC-RedC.7.1.7									
	SONCC-RedC.7.1.7.1	$8,503						$8,503	County
	SONCC-RedC.7.1.7.2	$34,015						$34,015	County
	Action Total:	*$42,518*						*$42,518*	
SONCC-RedC.7.1.9									
	SONCC-RedC.7.1.9.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-RedC.10.2.42									
	SONCC-RedC.10.2.42.1	$45,925						$45,925	RWQCB
	SONCC-RedC.10.2.42.2	$0						$0	RWQCB
	Action Total:	*$45,925*						*$45,925*	
SONCC-RedC.10.1.45									
	SONCC-RedC.10.1.45.1	$0						$0	RWQCB
	SONCC-RedC.10.1.45.2	$0						$0	RWQCB
	SONCC-RedC.10.1.45.3	$0						$0	RWQCB
	Action Total:	*$0*						*$0*	
SONCC-RedC.5.1.37									
	SONCC-RedC.5.1.37.1	$22,270						$22,270	CDFW
	SONCC-RedC.5.1.37.2	$218,023						$218,023	CDFW
	Action Total:	*$240,293*						*$240,293*	
SONCC-RedC.5.1.62									
	SONCC-RedC.5.1.62.1	$22,270						$22,270	CDFW
	SONCC-RedC.5.1.62.2	$218,023						$218,023	CDFW
	Action Total:	*$240,293*						*$240,293*	
SONCC-RedC.3.1.39									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-RedC.3.1.39.1	$18,385						$18,385	SWRCB
	SONCC-RedC.3.1.39.2	$0						$0	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-RedC.3.1.46									
	SONCC-RedC.3.1.46.1	$73,540						$73,540	CDFW
	SONCC-RedC.3.1.46.2	$36,770						$36,770	CDFW
	SONCC-RedC.3.1.46.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-RedC.3.1.60									
	SONCC-RedC.3.1.60.1	$18,385						$18,385	SWRCB
	SONCC-RedC.3.1.60.2	$0						$0	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-RedC.7.1.8									
	SONCC-RedC.7.1.8.1	$17,008						$17,008	NRCS/RCD
	SONCC-RedC.7.1.8.2	$17,008						$17,008	NRCS/RCD
	SONCC-RedC.7.1.8.3	$425,148						$425,148	NRCS/RCD
	SONCC-RedC.7.1.8.4	$14,358						$14,358	NRCS/RCD
	SONCC-RedC.7.1.8.5	$607						$607	NRCS/RCD
	Action Total:	*$474,128*						*$474,128*	
SONCC-RedC.7.1.63									
	SONCC-RedC.7.1.63.1	$17,008						$17,008	NRCS/RCD
	SONCC-RedC.7.1.63.2	$17,008						$17,008	NRCS/RCD
	SONCC-RedC.7.1.63.3	$425,148						$425,148	NRCS/RCD
	SONCC-RedC.7.1.63.4	$14,358						$14,358	NRCS/RCD
	SONCC-RedC.7.1.63.5	$607						$607	NRCS/RCD
	Action Total:	*$474,128*						*$474,128*	
SONCC-RedC.16.1.19									
	SONCC-RedC.16.1.19.1	$34,015						$34,015	NMFS
	SONCC-RedC.16.1.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-RedC.16.1.20									
	SONCC-RedC.16.1.20.1	$34,015						$34,015	NMFS
	SONCC-RedC.16.1.20.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-RedC.16.2.21									
	SONCC-RedC.16.2.21.1	$34,015						$34,015	NMFS
	SONCC-RedC.16.2.21.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-RedC.16.2.22									
	SONCC-RedC.16.2.22.1	$34,015						$34,015	NMFS
	SONCC-RedC.16.2.22.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-RedC.27.2.44									
	SONCC-RedC.27.2.44.1	$340,150	$340,150	$340,150	$340,150	$340,150	$340,150	$2,040,900	NPS
	SONCC-RedC.27.2.44.2	$170,075	$170,075	$170,075	$170,075	$170,075	$170,075	$1,020,450	NPS
	SONCC-RedC.27.2.44.3	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NPS
	Action Total:	*$595,263*	*$595,263*	*$595,263*	*$595,263*	*$595,263*	*$595,263*	*$3,571,575*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-RedC.27.1.23									
	SONCC-RedC.27.1.23.1	$226,532	$226,532	$226,532	$226,532	$226,532	$226,532	$1,359,192	CDFW
	Action Total:	*$226,532*	*$226,532*	*$226,532*	*$226,532*	*$226,532*	*$226,532*	*$1,359,192*	
SONCC-RedC.27.1.43									
	SONCC-RedC.27.1.43.1	$203,455	$203,455	$203,455	$203,455	$203,455	$203,455	$1,220,730	NPS
	Action Total:	*$203,455*	*$203,455*	*$203,455*	*$203,455*	*$203,455*	*$203,455*	*$1,220,730*	
SONCC-RedC.10.7.53									
	SONCC-RedC.10.7.53.1	$8,504						$8,504	CDFW
	SONCC-RedC.10.7.53.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-RedC.10.7.57									
	SONCC-RedC.10.7.57.1	$8,504						$8,504	CDFW
	SONCC-RedC.10.7.57.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-RedC.27.2.50									
	SONCC-RedC.27.2.50.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-RedC.27.2.26									
	SONCC-RedC.27.2.26.1	$136,060						$136,060	CDFW
	SONCC-RedC.27.2.26.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-RedC.27.2.27									
	SONCC-RedC.27.2.27.1	$760,247		$760,247		$760,247		$2,280,741	CDFW
	Action Total:	*$760,247*		*$760,247*		*$760,247*		*$2,280,741*	
SONCC-RedC.27.2.28									
	SONCC-RedC.27.2.28.1	$760,247		$760,247		$760,247		$2,280,741	CDFW
	Action Total:	*$760,247*		*$760,247*		*$760,247*		*$2,280,741*	
SONCC-RedC.27.2.29									
	SONCC-RedC.27.2.29.1	$760,247		$760,247		$760,247		$2,280,741	CDFW
	Action Total:	*$760,247*		*$760,247*		*$760,247*		*$2,280,741*	
SONCC-RedC.27.2.30									
	SONCC-RedC.27.2.30.1	$760,247		$760,247		$760,247		$2,280,741	CDFW
	Action Total:	*$760,247*		*$760,247*		*$760,247*		*$2,280,741*	
SONCC-RedC.27.2.31									
	SONCC-RedC.27.2.31.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-RedC.27.2.52									
	SONCC-RedC.27.2.52.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-RedC.27.1.24									
	SONCC-RedC.27.1.24.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-RedC.27.1.25									
	SONCC-RedC.27.1.25.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-RedC.27.1.33									
	SONCC-RedC.27.1.33.1	$75,511	$75,511	$75,511	$75,511	$75,511	$75,511	$453,066	CDFW
	Action Total:	*$75,511*	*$75,511*	*$75,511*	*$75,511*	*$75,511*	*$75,511*	*$453,066*	
SONCC-RedC.27.1.34									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-RedC.27.1.34.1	$34,015						$34,015	NMFS
	SONCC-RedC.27.1.34.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-RedC.27.1.51									
	SONCC-RedC.27.1.51.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-RedC.27.4.47									
	SONCC-RedC.27.4.47.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-RedC.27.4.48									
	SONCC-RedC.27.4.48.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-RedC.27.4.49									
	SONCC-RedC.27.4.49.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
	Population Total:	***$117,834,989***	***$2,730,408***	***$5,791,641***	***$2,730,408***	***$5,791,641***	***$4,132,751***	***$139,011,838***	

Population: Salmon River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SalR.2.1.7									
	SONCC-SalR.2.1.7.1	$17,008						$17,008	USFS
	SONCC-SalR.2.1.7.2	$95,874						$95,874	USFS
	Action Total:	*$112,881*						*$112,881*	
SONCC-SalR.2.1.8									
	SONCC-SalR.2.1.8.1	$17,008						$17,008	USFS
	SONCC-SalR.2.1.8.2	$51,129						$51,129	USFS
	Action Total:	*$68,137*						*$68,137*	
SONCC-SalR.2.1.37									
	SONCC-SalR.2.1.37.1	$17,008						$17,008	USFS
	SONCC-SalR.2.1.37.2	$95,874						$95,874	USFS
	Action Total:	*$112,881*						*$112,881*	
SONCC-SalR.2.1.38									
	SONCC-SalR.2.1.38.1	$17,008						$17,008	USFS
	SONCC-SalR.2.1.38.2	$51,129						$51,129	USFS
	Action Total:	*$68,137*						*$68,137*	
SONCC-SalR.2.2.25									
	SONCC-SalR.2.2.25.1	$34,015						$34,015	USFS
	SONCC-SalR.2.2.25.2	$288,023						$288,023	USFS
	Action Total:	*$322,038*						*$322,038*	
SONCC-SalR.7.1.2									
	SONCC-SalR.7.1.2.1	$36,400						$36,400	USFS
	SONCC-SalR.7.1.2.2	$29,372						$29,372	USFS
	Action Total:	*$65,772*						*$65,772*	
SONCC-SalR.26.1.33									
	SONCC-SalR.26.1.33.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SalR.3.1.4									
	SONCC-SalR.3.1.4.1	$17,008						$17,008	CDFW
	SONCC-SalR.3.1.4.2	$17,008						$17,008	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SalR.3.1.4.3	$17,008						$17,008	CDFW
	Action Total:	*$51,023*						*$51,023*	
SONCC-SalR.3.1.39									
	SONCC-SalR.3.1.39.1	$17,008						$17,008	CDFW
	SONCC-SalR.3.1.39.2	$17,008						$17,008	CDFW
	SONCC-SalR.3.1.39.3	$17,008						$17,008	CDFW
	Action Total:	*$51,023*						*$51,023*	
SONCC-SalR.10.3.5									
	SONCC-SalR.10.3.5.1	$17,008						$17,008	USFS
	SONCC-SalR.10.3.5.2	$38,068						$38,068	USFS
	SONCC-SalR.10.3.5.3	$17,008						$17,008	USFS
	Action Total:	*$72,083*						*$72,083*	
SONCC-SalR.10.3.35									
	SONCC-SalR.10.3.35.1	$17,008						$17,008	USFS
	SONCC-SalR.10.3.35.2	$38,068						$38,068	USFS
	SONCC-SalR.10.3.35.3	$17,008						$17,008	USFS
	Action Total:	*$72,083*						*$72,083*	
SONCC-SalR.10.2.6									
	SONCC-SalR.10.2.6.1	$24,173						$24,173	RWQCB
	SONCC-SalR.10.2.6.2	$17,008						$17,008	RWQCB
	SONCC-SalR.10.2.6.3	$0						$0	RWQCB
	Action Total:	*$41,181*						*$41,181*	
SONCC-SalR.10.2.34									
	SONCC-SalR.10.2.34.1	$24,173						$24,173	RWQCB
	SONCC-SalR.10.2.34.2	$17,008						$17,008	RWQCB
	SONCC-SalR.10.2.34.3	$0						$0	RWQCB
	Action Total:	*$41,181*						*$41,181*	
SONCC-SalR.5.1.43									
	SONCC-SalR.5.1.43.1	$8,504						$8,504	USFS
	Action Total:	*$8,504*						*$8,504*	
SONCC-SalR.5.1.9									
	SONCC-SalR.5.1.9.1	$22,270						$22,270	USFS
	SONCC-SalR.5.1.9.2	$697,672						$697,672	USFS
	Action Total:	*$719,942*						*$719,942*	
SONCC-SalR.5.1.10									
	SONCC-SalR.5.1.10.1	$14,535						$14,535	USFS
	Action Total:	*$14,535*						*$14,535*	
SONCC-SalR.5.1.40									
	SONCC-SalR.5.1.40.1	$14,535						$14,535	USFS
	Action Total:	*$14,535*						*$14,535*	
SONCC-SalR.5.1.41									
	SONCC-SalR.5.1.41.1	$22,270						$22,270	USFS
	SONCC-SalR.5.1.41.2	$697,672						$697,672	USFS
	Action Total:	*$719,942*						*$719,942*	
SONCC-SalR.7.1.1									
	SONCC-SalR.7.1.1.1	$34,015						$34,015	USFS
	SONCC-SalR.7.1.1.2	$13,423						$13,423	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SalR.7.1.1.3	$97,675						$97,675	USFS
	SONCC-SalR.7.1.1.4	$4,389						$4,389	USFS
	Action Total:	*$149,502*						*$149,502*	
SONCC-SalR.8.1.26									
	SONCC-SalR.8.1.26.1	$514,092						$514,092	USFS
	SONCC-SalR.8.1.26.2	$4,186,080						$4,186,080	USFS
	Action Total:	*$4,700,172*						*$4,700,172*	
SONCC-SalR.8.1.3									
	SONCC-SalR.8.1.3.1	$487,025						$487,025	USFS
	SONCC-SalR.8.1.3.2	$2,412,619						$2,412,619	USFS
	SONCC-SalR.8.1.3.3	$1,765,753						$1,765,753	USFS
	SONCC-SalR.8.1.3.4	$144,535						$144,535	USFS
	Action Total:	*$4,809,931*						*$4,809,931*	
SONCC-SalR.8.1.42									
	SONCC-SalR.8.1.42.1	$487,025						$487,025	USFS
	SONCC-SalR.8.1.42.2	$2,412,619						$2,412,619	USFS
	SONCC-SalR.8.1.42.3	$1,765,753						$1,765,753	USFS
	SONCC-SalR.8.1.42.4	$144,535						$144,535	USFS
	Action Total:	*$4,809,931*						*$4,809,931*	
SONCC-SalR.10.7.32									
	SONCC-SalR.10.7.32.1	$8,504						$8,504	CDFW
	SONCC-SalR.10.7.32.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-SalR.10.7.36									
	SONCC-SalR.10.7.36.1	$8,504						$8,504	CDFW
	SONCC-SalR.10.7.36.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-SalR.1.2.20									
	SONCC-SalR.1.2.20.1	$0						$0	BIA/Tribe
	Action Total:	*$0*						*$0*	
SONCC-SalR.16.1.11									
	SONCC-SalR.16.1.11.1	$34,015						$34,015	NMFS
	SONCC-SalR.16.1.11.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SalR.16.1.12									
	SONCC-SalR.16.1.12.1	$34,015						$34,015	NMFS
	SONCC-SalR.16.1.12.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SalR.16.1.30									
	SONCC-SalR.16.1.30.1	$34,015						$34,015	NMFS
	SONCC-SalR.16.1.30.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SalR.16.1.31									
	SONCC-SalR.16.1.31.1	$34,015						$34,015	BIA/Tribe
	SONCC-SalR.16.1.31.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-SalR.16.2.13									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SalR.16.2.13.1	$34,015						$34,015	NMFS
	SONCC-SalR.16.2.13.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SalR.16.2.14									
	SONCC-SalR.16.2.14.1	$34,015						$34,015	NMFS
	SONCC-SalR.16.2.14.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SalR.27.2.28									
	SONCC-SalR.27.2.28.5	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SalR.27.2.21									
	SONCC-SalR.27.2.21.1	$439,301		$439,301		$439,301		$1,317,903	CDFW
	Action Total:	*$439,301*		*$439,301*		*$439,301*		*$1,317,903*	
SONCC-SalR.27.2.22									
	SONCC-SalR.27.2.22.1	$439,301		$439,301		$439,301		$1,317,903	CDFW
	Action Total:	*$439,301*		*$439,301*		*$439,301*		*$1,317,903*	
SONCC-SalR.27.2.18									
	SONCC-SalR.27.2.18.1	$136,060						$136,060	CDFW
	SONCC-SalR.27.2.18.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-SalR.27.2.29									
	SONCC-SalR.27.2.29.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-SalR.27.1.19									
	SONCC-SalR.27.1.19.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-SalR.27.1.24									
	SONCC-SalR.27.1.24.1	$34,015						$34,015	NMFS
	SONCC-SalR.27.1.24.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-SalR.27.1.15									
	SONCC-SalR.27.1.15.1	$172,200	$172,200	$172,200	$172,200	$172,200	$172,200	$1,033,200	CDFW
	Action Total:	*$172,200*	*$172,200*	*$172,200*	*$172,200*	*$172,200*	*$172,200*	*$1,033,200*	
SONCC-SalR.27.1.16									
	SONCC-SalR.27.1.16.1	$57,400	$57,400	$57,400	$57,400	$57,400	$57,400	$344,400	CDFW
	Action Total:	*$57,400*	*$57,400*	*$57,400*	*$57,400*	*$57,400*	*$57,400*	*$344,400*	
SONCC-SalR.27.1.17									
	SONCC-SalR.27.1.17.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
	Population Total:	***$19,273,731***	***$788,225***	***$1,653,057***	***$788,225***	***$1,653,057***	***$788,225***	***$24,944,520***	

Population: Scott River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ScoR.3.1.7									
	SONCC-ScoR.3.1.7.1	$34,015						$34,015	CDFW
	SONCC-ScoR.3.1.7.2	$34,015						$34,015	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-ScoR.1.2.46									
	SONCC-ScoR.1.2.46.1	$0						$0	BIA/Tribe
	Action Total:	*$0*						*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ScoR.30.1.69									
	SONCC-ScoR.30.1.69.1	$68,030						$68,030	NMFS
	SONCC-ScoR.30.1.69.2	$68,030						$68,030	NMFS
	Action Total:	*$136,060*						*$136,060*	
SONCC-ScoR.10.1.14									
	SONCC-ScoR.10.1.14.1	$36,770						$36,770	NRCS/RCD
	SONCC-ScoR.10.1.14.2	$34,015	$34,015	$34,015	$34,015	$34,015	$34,015	$204,090	NRCS/RCD
	Action Total:	*$70,785*	*$34,015*	*$34,015*	*$34,015*	*$34,015*	*$34,015*	*$240,860*	
SONCC-ScoR.10.1.15									
	SONCC-ScoR.10.1.15.2	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	CDFW
	Action Total:	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$220,620*	
SONCC-ScoR.3.1.42									
	SONCC-ScoR.3.1.42.1	$36,770						$36,770	NGO
	SONCC-ScoR.3.1.42.2	$36,770						$36,770	NGO
	Action Total:	*$73,540*						*$73,540*	
SONCC-ScoR.3.1.1									
	SONCC-ScoR.3.1.1.1	$18,385						$18,385	SWRCB
	SONCC-ScoR.3.1.1.2	$18,385						$18,385	SWRCB
	SONCC-ScoR.3.1.1.3	$18,385						$18,385	Watermaster Dst
	Action Total:	*$55,155*						*$55,155*	
SONCC-ScoR.3.1.2									
	SONCC-ScoR.3.1.2.1	$130,680						$130,680	Watermaster Dst
	SONCC-ScoR.3.1.2.2	$198,875						$198,875	Watermaster Dst
	SONCC-ScoR.3.1.2.3	$25,780						$25,780	NGO
	Action Total:	*$355,335*						*$355,335*	
SONCC-ScoR.3.1.3									
	SONCC-ScoR.3.1.3.1	$367,700						$367,700	Watermaster Dst
	Action Total:	*$367,700*						*$367,700*	
SONCC-ScoR.3.1.5									
	SONCC-ScoR.3.1.5.1	$91,925						$91,925	NRCS/RCD
	SONCC-ScoR.3.1.5.2	$18,385						$18,385	NRCS/RCD
	SONCC-ScoR.3.1.5.3	$27,300						$27,300	NRCS/RCD
	Action Total:	*$137,610*						*$137,610*	
SONCC-ScoR.3.1.79									
	SONCC-ScoR.3.1.79.1	$18,385						$18,385	Watermaster Dst
	SONCC-ScoR.3.1.79.2	$18,385						$18,385	SWRCB
	SONCC-ScoR.3.1.79.3	$18,385						$18,385	Watermaster Dst
	Action Total:	*$55,155*						*$55,155*	
SONCC-ScoR.3.1.81									
	SONCC-ScoR.3.1.81.1	$91,925						$91,925	NRCS/RCD
	SONCC-ScoR.3.1.81.2	$18,385						$18,385	NRCS/RCD
	SONCC-ScoR.3.1.81.3	$27,300						$27,300	NRCS/RCD
	Action Total:	*$137,610*						*$137,610*	
SONCC-ScoR.3.2.10									
	SONCC-ScoR.3.2.10.1	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.3.2.10.2	$1,462,500						$1,462,500	NRCS/RCD
	SONCC-ScoR.3.2.10.3	$62,500	$62,500					$125,000	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$1,542,008*	*$62,500*					*$1,604,508*	
SONCC-ScoR.3.2.83									
	SONCC-ScoR.3.2.83.1	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.3.2.83.2	$1,462,500						$1,462,500	NRCS/RCD
	SONCC-ScoR.3.2.83.3	$62,500	$62,500					$125,000	NRCS/RCD
	Action Total:	*$1,542,008*	*$62,500*					*$1,604,508*	
SONCC-ScoR.3.1.65									
	SONCC-ScoR.3.1.65.1	$247,000	$247,000	$247,000	$247,000	$247,000	$247,000	$1,482,000	Watermaster Dst
	Action Total:	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$247,000*	*$1,482,000*	
SONCC-ScoR.3.1.67									
	SONCC-ScoR.3.1.67.1	$18,385						$18,385	SWRCB
	SONCC-ScoR.3.1.67.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-ScoR.3.1.82									
	SONCC-ScoR.3.1.82.1	$18,385						$18,385	SWRCB
	SONCC-ScoR.3.1.82.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-ScoR.3.1.68									
	SONCC-ScoR.3.1.68.1	$36,077						$36,077	CDFW
	SONCC-ScoR.3.1.68.2	$36,077						$36,077	CDFW
	SONCC-ScoR.3.1.68.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-ScoR.2.1.48									
	SONCC-ScoR.2.1.48.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-ScoR.2.1.25									
	SONCC-ScoR.2.1.25.1	$17,008						$17,008	NGO
	SONCC-ScoR.2.1.25.2	$13,367,540						$13,367,540	NGO
	Action Total:	*$13,384,548*						*$13,384,548*	
SONCC-ScoR.2.1.74									
	SONCC-ScoR.2.1.74.1	$17,008						$17,008	NGO
	SONCC-ScoR.2.1.74.2	$13,367,540						$13,367,540	NGO
	Action Total:	*$13,384,548*						*$13,384,548*	
SONCC-ScoR.2.2.20									
	SONCC-ScoR.2.2.20.1	$17,008						$17,008	CDFW
	SONCC-ScoR.2.2.20.2	$2,505,321						$2,505,321	CDFW
	Action Total:	*$2,522,329*						*$2,522,329*	
SONCC-ScoR.2.2.21									
	SONCC-ScoR.2.2.21.1	$17,008						$17,008	NGO
	SONCC-ScoR.2.2.21.2	$4,217,623						$4,217,623	NGO
	Action Total:	*$4,234,631*						*$4,234,631*	
SONCC-ScoR.2.2.22									
	SONCC-ScoR.2.2.22.1	$17,008						$17,008	CDFW
	SONCC-ScoR.2.2.22.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-ScoR.2.2.22.3	$50,000						$50,000	CDFW
	Action Total:	*$152,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$577,233*	
SONCC-ScoR.2.2.24									
	SONCC-ScoR.2.2.24.1	$44,540						$44,540	NGO

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ScoR.2.2.24.2	$163,429						$163,429	NGO
	Action Total:	*$207,969*						*$207,969*	
SONCC-ScoR.2.2.75									
	SONCC-ScoR.2.2.75.1	$17,008						$17,008	CDFW
	SONCC-ScoR.2.2.75.2	$2,505,321						$2,505,321	CDFW
	Action Total:	*$2,522,329*						*$2,522,329*	
SONCC-ScoR.2.2.76									
	SONCC-ScoR.2.2.76.1	$17,008						$17,008	NGO
	SONCC-ScoR.2.2.76.2	$4,217,623						$4,217,623	NGO
	Action Total:	*$4,234,631*						*$4,234,631*	
SONCC-ScoR.2.2.77									
	SONCC-ScoR.2.2.77.1	$17,008						$17,008	CDFW
	SONCC-ScoR.2.2.77.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-ScoR.2.2.77.3	$50,000						$50,000	CDFW
	Action Total:	*$152,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$577,233*	
SONCC-ScoR.2.2.78									
	SONCC-ScoR.2.2.78.1	$44,540						$44,540	NGO
	SONCC-ScoR.2.2.78.2	$163,429						$163,429	NGO
	Action Total:	*$207,969*						*$207,969*	
SONCC-ScoR.30.1.70									
	SONCC-ScoR.30.1.70.1	$68,030						$68,030	CDFW
	SONCC-ScoR.30.1.70.2	$68,030						$68,030	CDFW
	Action Total:	*$136,060*						*$136,060*	
SONCC-ScoR.26.1.66									
	SONCC-ScoR.26.1.66.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-ScoR.3.1.4									
	SONCC-ScoR.3.1.4.1	$36,770						$36,770	SWRCB
	SONCC-ScoR.3.1.4.2	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.3.1.4.3	$50,000						$50,000	NRCS/RCD
	SONCC-ScoR.3.1.4.4	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.3.1.4.5	$17,008						$17,008	SWRCB
	Action Total:	*$137,793*						*$137,793*	
SONCC-ScoR.3.1.80									
	SONCC-ScoR.3.1.80.1	$36,770						$36,770	SWRCB
	SONCC-ScoR.3.1.80.2	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.3.1.80.3	$50,000						$50,000	NRCS/RCD
	SONCC-ScoR.3.1.80.4	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.3.1.80.5	$17,008						$17,008	SWRCB
	Action Total:	*$137,793*						*$137,793*	
SONCC-ScoR.7.1.18									
	SONCC-ScoR.7.1.18.1	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.7.1.18.2	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.7.1.18.3	$1,464,162						$1,464,162	NRCS/RCD
	SONCC-ScoR.7.1.18.4	$79,656						$79,656	NRCS/RCD
	SONCC-ScoR.7.1.18.5	$3,035						$3,035	NRCS/RCD
	Action Total:	*$1,580,868*						*$1,580,868*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ScoR.7.1.87									
	SONCC-ScoR.7.1.87.1	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.7.1.87.2	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.7.1.87.3	$1,464,162						$1,464,162	NRCS/RCD
	SONCC-ScoR.7.1.87.4	$79,656						$79,656	NRCS/RCD
	SONCC-ScoR.7.1.87.5	$3,035						$3,035	NRCS/RCD
	Action Total:	*$1,580,868*						*$1,580,868*	
SONCC-ScoR.5.1.11									
	SONCC-ScoR.5.1.11.1	$22,270						$22,270	NGO
	SONCC-ScoR.5.1.11.2	$623,532						$623,532	NGO
	Action Total:	*$645,802*						*$645,802*	
SONCC-ScoR.5.1.12									
	SONCC-ScoR.5.1.12.1	$22,270						$22,270	NGO
	SONCC-ScoR.5.1.12.2	$119,318						$119,318	NGO
	Action Total:	*$141,588*						*$141,588*	
SONCC-ScoR.5.1.13									
	SONCC-ScoR.5.1.13.1	$18,385						$18,385	NGO
	SONCC-ScoR.5.1.13.2	$198,863						$198,863	NGO
	Action Total:	*$217,248*						*$217,248*	
SONCC-ScoR.5.1.84									
	SONCC-ScoR.5.1.84.1	$22,270						$22,270	NGO
	SONCC-ScoR.5.1.84.2	$623,532						$623,532	NGO
	Action Total:	*$645,802*						*$645,802*	
SONCC-ScoR.5.1.85									
	SONCC-ScoR.5.1.85.1	$22,270						$22,270	NGO
	SONCC-ScoR.5.1.85.2	$119,318						$119,318	NGO
	Action Total:	*$141,588*						*$141,588*	
SONCC-ScoR.5.1.86									
	SONCC-ScoR.5.1.86.1	$18,385						$18,385	NGO
	SONCC-ScoR.5.1.86.2	$198,863						$198,863	NGO
	Action Total:	*$217,248*						*$217,248*	
SONCC-ScoR.7.1.58									
	SONCC-ScoR.7.1.58.1	$17,008						$17,008	CDFW
	SONCC-ScoR.7.1.58.2	$17,008						$17,008	CDFW
	SONCC-ScoR.7.1.58.3	$85,038						$85,038	CDFW
	Action Total:	*$119,053*						*$119,053*	
SONCC-ScoR.7.1.88									
	SONCC-ScoR.7.1.88.1	$17,008						$17,008	CDFW
	SONCC-ScoR.7.1.88.2	$17,008						$17,008	CDFW
	SONCC-ScoR.7.1.88.3	$85,038						$85,038	CDFW
	Action Total:	*$119,053*						*$119,053*	
SONCC-ScoR.8.2.26									
	SONCC-ScoR.8.2.26.1	$18,385						$18,385	NGO
	SONCC-ScoR.8.2.26.2	$210,000	$210,000	$210,000	$210,000	$210,000	$210,000	$1,260,000	NGO
	Action Total:	*$228,385*	*$210,000*	*$210,000*	*$210,000*	*$210,000*	*$210,000*	*$1,278,385*	
SONCC-ScoR.8.2.90									
	SONCC-ScoR.8.2.90.1	$18,385						$18,385	NGO

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ScoR.8.2.90.2	$210,000	$210,000	$210,000	$210,000	$210,000	$210,000	$1,260,000	NGO
	Action Total:	*$228,385*	*$210,000*	*$210,000*	*$210,000*	*$210,000*	*$210,000*	*$1,278,385*	
SONCC-ScoR.8.1.44									
	SONCC-ScoR.8.1.44.1	$958,313						$958,313	NGO
	SONCC-ScoR.8.1.44.2	$14,914,372						$14,914,372	NGO
	SONCC-ScoR.8.1.44.3	$2,364,066						$2,364,066	NGO
	SONCC-ScoR.8.1.44.4	$26,461,528					$26,461,528	$52,923,056	NGO
	Action Total:	*$44,698,279*					*$26,461,528*	*$71,159,807*	
SONCC-ScoR.8.1.89									
	SONCC-ScoR.8.1.89.1	$958,313						$958,313	NGO
	SONCC-ScoR.8.1.89.2	$14,914,372						$14,914,372	NGO
	SONCC-ScoR.8.1.89.3	$2,364,066						$2,364,066	NGO
	SONCC-ScoR.8.1.89.4	$26,461,528					$26,461,528	$52,923,056	NGO
	Action Total:	*$44,698,279*					*$26,461,528*	*$71,159,807*	
SONCC-ScoR.10.2.49									
	SONCC-ScoR.10.2.49.1	$45,925						$45,925	CDFW
	SONCC-ScoR.10.2.49.2	$114,813						$114,813	CDFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-ScoR.10.2.72									
	SONCC-ScoR.10.2.72.1	$45,925						$45,925	CDFW
	SONCC-ScoR.10.2.72.2	$114,813						$114,813	CDFW
	Action Total:	*$160,738*						*$160,738*	
SONCC-ScoR.10.1.16									
	SONCC-ScoR.10.1.16.1	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.10.1.16.2	$123,711						$123,711	NRCS/RCD
	Action Total:	*$140,719*						*$140,719*	
SONCC-ScoR.10.1.71									
	SONCC-ScoR.10.1.71.1	$17,008						$17,008	NRCS/RCD
	SONCC-ScoR.10.1.71.2	$123,711						$123,711	NRCS/RCD
	Action Total:	*$140,719*						*$140,719*	
SONCC-ScoR.10.7.64									
	SONCC-ScoR.10.7.64.1	$8,504						$8,504	CDFW
	SONCC-ScoR.10.7.64.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-ScoR.10.7.73									
	SONCC-ScoR.10.7.73.1	$8,504						$8,504	CDFW
	SONCC-ScoR.10.7.73.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-ScoR.3.1.6									
	SONCC-ScoR.3.1.6.1	$76,136						$76,136	Water Trust
	SONCC-ScoR.3.1.6.2	$0						$0	Water Trust
	Action Total:	*$76,136*						*$76,136*	
SONCC-ScoR.3.1.9									
	SONCC-ScoR.3.1.9.1	$36,770						$36,770	NRCS/RCD
	SONCC-ScoR.3.1.9.2	$36,770						$36,770	SWRCB
	Action Total:	*$73,540*						*$73,540*	
SONCC-ScoR.7.1.43									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ScoR.7.1.43.1	$18,200						$18,200	USFS
	SONCC-ScoR.7.1.43.2	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$1,200,000	USFS
	Action Total:	*$218,200*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$1,218,200*	
SONCC-ScoR.7.1.59									
	SONCC-ScoR.7.1.59.1	$156,000						$156,000	CDF
	SONCC-ScoR.7.1.59.2	$156,000						$156,000	CDF
	Action Total:	*$312,000*						*$312,000*	
SONCC-ScoR.16.1.28									
	SONCC-ScoR.16.1.28.1	$34,015						$34,015	NMFS
	SONCC-ScoR.16.1.28.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ScoR.16.1.29									
	SONCC-ScoR.16.1.29.1	$34,015						$34,015	NMFS
	SONCC-ScoR.16.1.29.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ScoR.16.1.61									
	SONCC-ScoR.16.1.61.1	$34,015						$34,015	NMFS
	SONCC-ScoR.16.1.61.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ScoR.16.1.62									
	SONCC-ScoR.16.1.62.1	$34,015						$34,015	NMFS
	SONCC-ScoR.16.1.62.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ScoR.16.1.63									
	SONCC-ScoR.16.1.63.1	$34,015						$34,015	BIA/Tribe
	SONCC-ScoR.16.1.63.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-ScoR.16.2.30									
	SONCC-ScoR.16.2.30.1	$34,015						$34,015	NMFS
	SONCC-ScoR.16.2.30.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ScoR.16.2.31									
	SONCC-ScoR.16.2.31.1	$34,015						$34,015	NMFS
	SONCC-ScoR.16.2.31.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ScoR.10.2.17									
	SONCC-ScoR.10.2.17.1	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	RWQCB
	Action Total:	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$220,620*	
SONCC-ScoR.27.2.53									
	SONCC-ScoR.27.2.53.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-ScoR.27.2.55									
	SONCC-ScoR.27.2.55.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-ScoR.27.2.56									
	SONCC-ScoR.27.2.56.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-ScoR.27.2.36									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ScoR.27.2.36.1	$136,060						$136,060	CDFW
	SONCC-ScoR.27.2.36.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-ScoR.27.2.37									
	SONCC-ScoR.27.2.37.1	$6,478,842		$6,478,842		$6,478,842		$19,436,526	CDFW
	Action Total:	*$6,478,842*		*$6,478,842*		*$6,478,842*		*$19,436,526*	
SONCC-ScoR.27.2.38									
	SONCC-ScoR.27.2.38.1	$6,478,842		$6,478,842		$6,478,842		$19,436,526	CDFW
	Action Total:	*$6,478,842*		*$6,478,842*		*$6,478,842*		*$19,436,526*	
SONCC-ScoR.27.2.39									
	SONCC-ScoR.27.2.39.1	$6,478,842		$6,478,842		$6,478,842		$19,436,526	CDFW
	Action Total:	*$6,478,842*		*$6,478,842*		*$6,478,842*		*$19,436,526*	
SONCC-ScoR.27.2.40									
	SONCC-ScoR.27.2.40.1	$6,478,842		$6,478,842		$6,478,842		$19,436,526	CDFW
	Action Total:	*$6,478,842*		*$6,478,842*		*$6,478,842*		*$19,436,526*	
SONCC-ScoR.27.2.41									
	SONCC-ScoR.27.2.41.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-ScoR.27.2.41.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-ScoR.27.2.60									
	SONCC-ScoR.27.2.60.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-ScoR.27.1.45									
	SONCC-ScoR.27.1.45.1	$220,434	$220,434	$220,434	$220,434	$220,434	$220,434	$1,322,604	CDFW
	Action Total:	*$220,434*	*$220,434*	*$220,434*	*$220,434*	*$220,434*	*$220,434*	*$1,322,604*	
SONCC-ScoR.27.1.47									
	SONCC-ScoR.27.1.47.1	$34,015						$34,015	NMFS
	SONCC-ScoR.27.1.47.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-ScoR.27.1.32									
	SONCC-ScoR.27.1.32.1	$34,015						$34,015	CDFW
	SONCC-ScoR.27.1.32.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$119,053*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$544,240*	
SONCC-ScoR.27.1.33									
	SONCC-ScoR.27.1.33.1	$661,303	$661,303	$661,303	$661,303	$661,303	$661,303	$3,967,818	CDFW
	Action Total:	*$661,303*	*$661,303*	*$661,303*	*$661,303*	*$661,303*	*$661,303*	*$3,967,818*	
SONCC-ScoR.27.1.34									
	SONCC-ScoR.27.1.34.1	$68,030		$68,030		$68,030		$204,090	CDFW
	SONCC-ScoR.27.1.34.2	$34,015						$34,015	CDFW
	Action Total:	*$102,045*		*$68,030*		*$68,030*		*$238,105*	
SONCC-ScoR.27.1.35									
	SONCC-ScoR.27.1.35.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-ScoR.27.1.57									
	SONCC-ScoR.27.1.57.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-ScoR.27.4.51									
	SONCC-ScoR.27.4.51.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ScoR.27.4.52									
	SONCC-ScoR.27.4.52.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-ScoR.27.4.54									
	SONCC-ScoR.27.4.54.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
	Population Total:	***$172,471,306***	***$3,905,827***	***$29,716,440***	***$3,780,827***	***$29,716,440***	***$56,703,883***	***$296,294,723***	

Population: Shasta River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ShaR.3.1.1									
	SONCC-ShaR.3.1.1.1	$36,770						$36,770	Watermaster Dst
	SONCC-ShaR.3.1.1.2	$36,770						$36,770	SWRCB
	SONCC-ShaR.3.1.1.3	$36,770						$36,770	SWRCB
	SONCC-ShaR.3.1.1.4	$36,770						$36,770	Watermaster Dst
	SONCC-ShaR.3.1.1.5	$36,770						$36,770	Water Trust
	SONCC-ShaR.3.1.1.6	$36,770						$36,770	CDFW
	Action Total:	*$220,620*						*$220,620*	
SONCC-ShaR.10.1.16									
	SONCC-ShaR.10.1.16.1	$36,077						$36,077	NRCS/RCD
	SONCC-ShaR.10.1.16.2	$36,077						$36,077	NRCS/RCD
	Action Total:	*$72,154*						*$72,154*	
SONCC-ShaR.10.1.18									
	SONCC-ShaR.10.1.18.1	$34,015						$34,015	CDFW
	SONCC-ShaR.10.1.18.2	$36,770						$36,770	CDFW
	SONCC-ShaR.10.1.18.3	$34,015						$34,015	CDFW
	Action Total:	*$104,800*						*$104,800*	
SONCC-ShaR.10.1.19									
	SONCC-ShaR.10.1.19.1	$73,540						$73,540	Water District
	SONCC-ShaR.10.1.19.2	$73,540						$73,540	Water District
	Action Total:	*$147,080*						*$147,080*	
SONCC-ShaR.1.2.48									
	SONCC-ShaR.1.2.48.1	$0						$0	BIA/Tribe
	Action Total:	*$0*						*$0*	
SONCC-ShaR.30.1.70									
	SONCC-ShaR.30.1.70.1	$68,030						$68,030	NMFS
	SONCC-ShaR.30.1.70.2	$68,030						$68,030	NMFS
	Action Total:	*$136,060*						*$136,060*	
SONCC-ShaR.12.1.74									
	SONCC-ShaR.12.1.74.1	$17,008						$17,008	NRCS/RCD
	SONCC-ShaR.12.1.74.2	$17,008						$17,008	NRCS/RCD
	SONCC-ShaR.12.1.74.3	$1,741,346						$1,741,346	NRCS/RCD
	SONCC-ShaR.12.1.74.4	$94,735						$94,735	NRCS/RCD
	SONCC-ShaR.12.1.74.5	$3,642						$3,642	NRCS/RCD
	Action Total:	*$1,873,738*						*$1,873,738*	
SONCC-ShaR.12.1.22									
	SONCC-ShaR.12.1.22.1	$17,008						$17,008	NRCS/RCD
	SONCC-ShaR.12.1.22.2	$17,008						$17,008	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ShaR.12.1.22.3	$1,741,346						$1,741,346	NRCS/RCD
	SONCC-ShaR.12.1.22.4	$94,735						$94,735	NRCS/RCD
	SONCC-ShaR.12.1.22.5	$3,642						$3,642	NRCS/RCD
	Action Total:	*$1,873,738*						*$1,873,738*	
SONCC-ShaR.3.1.4									
	SONCC-ShaR.3.1.4.1	$45,454						$45,454	Water District
	SONCC-ShaR.3.1.4.2	$34,015						$34,015	Water District
	SONCC-ShaR.3.1.4.3	$190,909						$190,909	Water District
	SONCC-ShaR.3.1.4.4	$190,909						$190,909	Water District
	Action Total:	*$461,287*						*$461,287*	
SONCC-ShaR.10.1.20									
	SONCC-ShaR.10.1.20.1	$36,770						$36,770	NRCS/RCD
	SONCC-ShaR.10.1.20.2	$329,896						$329,896	NRCS/RCD
	Action Total:	*$366,666*						*$366,666*	
SONCC-ShaR.3.1.80									
	SONCC-ShaR.3.1.80.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	Watermaster Dst
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-ShaR.3.1.81									
	SONCC-ShaR.3.1.81.1	$18,385						$18,385	SWRCB
	SONCC-ShaR.3.1.81.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-ShaR.3.1.66									
	SONCC-ShaR.3.1.66.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	Watermaster Dst
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-ShaR.3.1.68									
	SONCC-ShaR.3.1.68.1	$18,385						$18,385	SWRCB
	SONCC-ShaR.3.1.68.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-ShaR.3.1.69									
	SONCC-ShaR.3.1.69.1	$36,077						$36,077	CDFW
	SONCC-ShaR.3.1.69.2	$36,077						$36,077	CDFW
	SONCC-ShaR.3.1.69.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-ShaR.3.1.78									
	SONCC-ShaR.3.1.78.1	$36,770						$36,770	SWRCB
	SONCC-ShaR.3.1.78.2	$22,963						$22,963	NRCS/RCD
	SONCC-ShaR.3.1.78.3	$98,000						$98,000	NRCS/RCD
	SONCC-ShaR.3.1.78.4	$18,385						$18,385	NRCS/RCD
	SONCC-ShaR.3.1.78.5	$18,385						$18,385	SWRCB
	Action Total:	*$194,503*						*$194,503*	
SONCC-ShaR.3.1.79									
	SONCC-ShaR.3.1.79.1	$18,385						$18,385	NGO
	SONCC-ShaR.3.1.79.2	$91,875						$91,875	NGO
	SONCC-ShaR.3.1.79.3	$18,385						$18,385	NGO
	Action Total:	*$128,645*						*$128,645*	
SONCC-ShaR.3.1.82									
	SONCC-ShaR.3.1.82.1	$36,770						$36,770	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ShaR.3.1.82.2	$24,173						$24,173	NRCS/RCD
	Action Total:	*$60,943*						*$60,943*	
SONCC-ShaR.3.1.5									
	SONCC-ShaR.3.1.5.1	$36,770						$36,770	SWRCB
	SONCC-ShaR.3.1.5.2	$22,963						$22,963	NRCS/RCD
	SONCC-ShaR.3.1.5.3	$98,000						$98,000	NRCS/RCD
	SONCC-ShaR.3.1.5.4	$18,385						$18,385	NRCS/RCD
	SONCC-ShaR.3.1.5.5	$18,385						$18,385	SWRCB
	Action Total:	*$194,503*						*$194,503*	
SONCC-ShaR.3.1.6									
	SONCC-ShaR.3.1.6.1	$18,385						$18,385	NGO
	SONCC-ShaR.3.1.6.2	$91,875						$91,875	NGO
	SONCC-ShaR.3.1.6.3	$18,385						$18,385	NGO
	Action Total:	*$128,645*						*$128,645*	
SONCC-ShaR.3.1.7									
	SONCC-ShaR.3.1.7.1	$36,770						$36,770	NRCS/RCD
	SONCC-ShaR.3.1.7.2	$24,173						$24,173	NRCS/RCD
	Action Total:	*$60,943*						*$60,943*	
SONCC-ShaR.10.1.12									
	SONCC-ShaR.10.1.12.1	$34,015						$34,015	RWQCB
	SONCC-ShaR.10.1.12.2	$0						$0	RWQCB
	Action Total:	*$34,015*						*$34,015*	
SONCC-ShaR.5.1.83									
	SONCC-ShaR.5.1.83.1	$18,385						$18,385	NGO
	SONCC-ShaR.5.1.83.2	$58,140						$58,140	NGO
	Action Total:	*$76,525*						*$76,525*	
SONCC-ShaR.5.1.85									
	SONCC-ShaR.5.1.85.1	$22,270						$22,270	County
	SONCC-ShaR.5.1.85.2	$2,863,635						$2,863,635	County
	Action Total:	*$2,885,905*						*$2,885,905*	
SONCC-ShaR.5.1.13									
	SONCC-ShaR.5.1.13.1	$18,385						$18,385	NGO
	SONCC-ShaR.5.1.13.2	$58,140						$58,140	NGO
	Action Total:	*$76,525*						*$76,525*	
SONCC-ShaR.5.1.15									
	SONCC-ShaR.5.1.15.1	$22,270						$22,270	County
	SONCC-ShaR.5.1.15.2	$2,863,635						$2,863,635	County
	Action Total:	*$2,885,905*						*$2,885,905*	
SONCC-ShaR.7.1.86									
	SONCC-ShaR.7.1.86.1	$17,008						$17,008	NGO
	Action Total:	*$17,008*						*$17,008*	
SONCC-ShaR.7.1.23									
	SONCC-ShaR.7.1.23.1	$17,008						$17,008	NGO
	Action Total:	*$17,008*						*$17,008*	
SONCC-ShaR.7.1.24									
	SONCC-ShaR.7.1.24.1	$2,224,416						$2,224,416	NGO
	SONCC-ShaR.7.1.24.2	$16,186,176						$16,186,176	NGO
	Action Total:	*$18,410,592*						*$18,410,592*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ShaR.26.1.25									
	SONCC-ShaR.26.1.25.1	$68,030						$68,030	CDFW
	SONCC-ShaR.26.1.25.2	$500,000						$500,000	CDFW
	SONCC-ShaR.26.1.25.3	$600,000	$600,000	$600,000				$1,800,000	CDFW
	SONCC-ShaR.26.1.25.4	$1,250,000	$1,250,000	$1,250,000	$1,250,000			$5,000,000	CDFW
	Action Total:	*$2,418,030*	*$1,850,000*	*$1,850,000*	*$1,250,000*			*$7,368,030*	
SONCC-ShaR.26.1.67									
	SONCC-ShaR.26.1.67.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-ShaR.8.2.89									
	SONCC-ShaR.8.2.89.1	$18,385						$18,385	Water District
	SONCC-ShaR.8.2.89.2	$16,800	$16,800	$16,800	$16,800	$16,800	$16,800	$100,800	Water District
	Action Total:	*$35,185*	*$16,800*	*$16,800*	*$16,800*	*$16,800*	*$16,800*	*$119,185*	
SONCC-ShaR.8.2.29									
	SONCC-ShaR.8.2.29.1	$18,385						$18,385	Water District
	SONCC-ShaR.8.2.29.2	$16,800	$16,800	$16,800	$16,800	$16,800	$16,800	$100,800	Water District
	Action Total:	*$35,185*	*$16,800*	*$16,800*	*$16,800*	*$16,800*	*$16,800*	*$119,185*	
SONCC-ShaR.2.2.75									
	SONCC-ShaR.2.2.75.1	$17,008						$17,008	NGO
	SONCC-ShaR.2.2.75.2	$2,965,482						$2,965,482	NGO
	Action Total:	*$2,982,490*						*$2,982,490*	
SONCC-ShaR.2.2.76									
	SONCC-ShaR.2.2.76.1	$17,008						$17,008	NGO
	SONCC-ShaR.2.2.76.2	$4,850,266						$4,850,266	NGO
	Action Total:	*$4,867,274*						*$4,867,274*	
SONCC-ShaR.2.2.77									
	SONCC-ShaR.2.2.77.1	$17,008						$17,008	CDFW
	SONCC-ShaR.2.2.77.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-ShaR.2.2.77.3	$10,000						$10,000	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-ShaR.2.2.46									
	SONCC-ShaR.2.2.46.1	$17,008						$17,008	CDFW
	SONCC-ShaR.2.2.46.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-ShaR.2.2.46.3	$10,000						$10,000	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-ShaR.2.2.27									
	SONCC-ShaR.2.2.27.1	$17,008						$17,008	NGO
	SONCC-ShaR.2.2.27.2	$2,965,482						$2,965,482	NGO
	Action Total:	*$2,982,490*						*$2,982,490*	
SONCC-ShaR.2.2.28									
	SONCC-ShaR.2.2.28.1	$17,008						$17,008	NGO
	SONCC-ShaR.2.2.28.2	$4,850,266						$4,850,266	NGO
	Action Total:	*$4,867,274*						*$4,867,274*	
SONCC-ShaR.30.1.71									
	SONCC-ShaR.30.1.71.1	$68,030						$68,030	CDFW
	SONCC-ShaR.30.1.71.2	$68,030						$68,030	CDFW
	Action Total:	*$136,060*						*$136,060*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-ShaR.3.1.2									
	SONCC-ShaR.3.1.2.1	$130,680						$130,680	Watermaster Dst
	SONCC-ShaR.3.1.2.2	$198,875						$198,875	Watermaster Dst
	SONCC-ShaR.3.1.2.3	$25,780						$25,780	NGO
	Action Total:	*$355,335*						*$355,335*	
SONCC-ShaR.3.1.3									
	SONCC-ShaR.3.1.3.1	$367,700	$367,700	$367,700	$367,700	$367,700	$367,700	$2,206,200	Watermaster Dst
	Action Total:	*$367,700*	*$367,700*	*$367,700*	*$367,700*	*$367,700*	*$367,700*	*$2,206,200*	
SONCC-ShaR.3.1.8									
	SONCC-ShaR.3.1.8.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-ShaR.26.1.26									
	SONCC-ShaR.26.1.26.1	$34,015						$34,015	NMFS
	SONCC-ShaR.26.1.26.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ShaR.10.2.21									
	SONCC-ShaR.10.2.21.1	$36,770	$36,770	$36,770	$36,770	$36,770	$36,770	$220,620	RWQCB
	Action Total:	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$220,620*	
SONCC-ShaR.8.1.88									
	SONCC-ShaR.8.1.88.1	$817,394						$817,394	USFS
	SONCC-ShaR.8.1.88.2	$7,696,454						$7,696,454	USFS
	SONCC-ShaR.8.1.88.3	$4,088,959						$4,088,959	USFS
	SONCC-ShaR.8.1.88.4	$1,894,477					$1,894,477	$3,788,954	USFS
	Action Total:	*$14,497,284*					*$1,894,477*	*$16,391,761*	
SONCC-ShaR.8.1.31									
	SONCC-ShaR.8.1.31.1	$817,394						$817,394	USFS
	SONCC-ShaR.8.1.31.2	$7,696,454						$7,696,454	USFS
	SONCC-ShaR.8.1.31.3	$4,088,959						$4,088,959	USFS
	SONCC-ShaR.8.1.31.4	$1,894,477					$1,894,477	$3,788,954	USFS
	Action Total:	*$14,497,284*					*$1,894,477*	*$16,391,761*	
SONCC-ShaR.10.2.72									
	SONCC-ShaR.10.2.72.1	$44,540						$44,540	CDFW
	SONCC-ShaR.10.2.72.2	$111,350						$111,350	CDFW
	Action Total:	*$155,890*						*$155,890*	
SONCC-ShaR.10.2.51									
	SONCC-ShaR.10.2.51.1	$44,540						$44,540	CDFW
	SONCC-ShaR.10.2.51.2	$111,350						$111,350	CDFW
	Action Total:	*$155,890*						*$155,890*	
SONCC-ShaR.8.1.87									
	SONCC-ShaR.8.1.87.1	$678,701						$678,701	NRCS/RCD
	SONCC-ShaR.8.1.87.2	$2,804,074						$2,804,074	NRCS/RCD
	Action Total:	*$3,482,775*						*$3,482,775*	
SONCC-ShaR.8.1.30									
	SONCC-ShaR.8.1.30.1	$678,701						$678,701	NRCS/RCD
	SONCC-ShaR.8.1.30.2	$2,804,074						$2,804,074	NRCS/RCD
	Action Total:	*$3,482,775*						*$3,482,775*	
SONCC-ShaR.10.7.73									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ShaR.10.7.73.1	$8,504						$8,504	CDFW
	SONCC-ShaR.10.7.73.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-ShaR.10.7.65									
	SONCC-ShaR.10.7.65.1	$8,504						$8,504	CDFW
	SONCC-ShaR.10.7.65.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-ShaR.3.1.9									
	SONCC-ShaR.3.1.9.1	$0						$0	SWRCB
	SONCC-ShaR.3.1.9.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-ShaR.3.1.11									
	SONCC-ShaR.3.1.11.1	$36,770						$36,770	SWRCB
	SONCC-ShaR.3.1.11.2	$36,770						$36,770	SWRCB
	Action Total:	*$73,540*						*$73,540*	
SONCC-ShaR.10.1.17									
	SONCC-ShaR.10.1.17.1	$34,015						$34,015	Private
	SONCC-ShaR.10.1.17.2	$36,770						$36,770	Private
	Action Total:	*$70,785*						*$70,785*	
SONCC-ShaR.7.1.45									
	SONCC-ShaR.7.1.45.1	$18,200						$18,200	NGO
	SONCC-ShaR.7.1.45.2	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$1,200,000	NGO
	Action Total:	*$218,200*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$1,218,200*	
SONCC-ShaR.2.1.50									
	SONCC-ShaR.2.1.50.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-ShaR.16.1.33									
	SONCC-ShaR.16.1.33.1	$34,015						$34,015	NMFS
	SONCC-ShaR.16.1.33.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ShaR.16.1.34									
	SONCC-ShaR.16.1.34.1	$34,015						$34,015	NMFS
	SONCC-ShaR.16.1.34.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ShaR.16.1.63									
	SONCC-ShaR.16.1.63.1	$34,015						$34,015	NMFS
	SONCC-ShaR.16.1.63.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ShaR.16.1.64									
	SONCC-ShaR.16.1.64.1	$34,015						$34,015	BIA/Tribe
	SONCC-ShaR.16.1.64.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-ShaR.16.2.35									
	SONCC-ShaR.16.2.35.1	$34,015						$34,015	NMFS
	SONCC-ShaR.16.2.35.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ShaR.16.2.36									
	SONCC-ShaR.16.2.36.1	$34,015						$34,015	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ShaR.16.2.36.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-ShaR.27.2.57									
	SONCC-ShaR.27.2.57.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-ShaR.27.2.58									
	SONCC-ShaR.27.2.58.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-ShaR.27.2.60									
	SONCC-ShaR.27.2.60.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NMFS
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-ShaR.27.2.52									
	SONCC-ShaR.27.2.52.1							$0	CDFW
	Action Total:							*$0*	
SONCC-ShaR.27.2.40									
	SONCC-ShaR.27.2.40.1	$136,060						$136,060	CDFW
	SONCC-ShaR.27.2.40.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-ShaR.27.2.41									
	SONCC-ShaR.27.2.41.1	$9,399,054		$9,399,054		$9,399,054		$28,197,162	CDFW
	Action Total:	*$9,399,054*		*$9,399,054*		*$9,399,054*		*$28,197,162*	
SONCC-ShaR.27.2.42									
	SONCC-ShaR.27.2.42.1	$9,399,054		$9,399,054		$9,399,054		$28,197,162	CDFW
	Action Total:	*$9,399,054*		*$9,399,054*		*$9,399,054*		*$28,197,162*	
SONCC-ShaR.27.2.43									
	SONCC-ShaR.27.2.43.1	$9,399,054		$9,399,054		$9,399,054		$28,197,162	CDFW
	Action Total:	*$9,399,054*		*$9,399,054*		*$9,399,054*		*$28,197,162*	
SONCC-ShaR.27.2.44									
	SONCC-ShaR.27.2.44.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-ShaR.27.2.44.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-ShaR.27.2.62									
	SONCC-ShaR.27.2.62.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-ShaR.27.1.47									
	SONCC-ShaR.27.1.47.1	$265,505	$265,505	$265,505	$265,505	$265,505	$265,505	$1,593,030	CDFW
	Action Total:	*$265,505*	*$265,505*	*$265,505*	*$265,505*	*$265,505*	*$265,505*	*$1,593,030*	
SONCC-ShaR.27.1.49									
	SONCC-ShaR.27.1.49.1	$34,015						$34,015	NMFS
	SONCC-ShaR.27.1.49.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-ShaR.27.1.37									
	SONCC-ShaR.27.1.37.1	$796,515	$796,515	$796,515	$796,515	$796,515	$796,515	$4,779,090	CDFW
	Action Total:	*$796,515*	*$796,515*	*$796,515*	*$796,515*	*$796,515*	*$796,515*	*$4,779,090*	
SONCC-ShaR.27.1.38									
	SONCC-ShaR.27.1.38.1	$68,030		$68,030		$68,030		$204,090	CDFW
	SONCC-ShaR.27.1.38.2	$34,015						$34,015	CDFW
	Action Total:	*$102,045*		*$68,030*		*$68,030*		*$238,105*	
SONCC-ShaR.27.1.39									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-ShaR.27.1.39.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-ShaR.27.1.61									
	SONCC-ShaR.27.1.61.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-ShaR.27.4.54									
	SONCC-ShaR.27.4.54.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-ShaR.27.4.55									
	SONCC-ShaR.27.4.55.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-ShaR.27.4.56									
	SONCC-ShaR.27.4.56.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-ShaR.27.4.59									
	SONCC-ShaR.27.4.59.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
	Population Total:	***$118,771,162***	***$5,721,625***	***$33,939,032***	***$5,121,625***	***$32,089,032***	***$7,660,579***	***$203,303,055***	

Population: Smith River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SmiR.2.1.1									
	SONCC-SmiR.2.1.1.1	$17,008						$17,008	CDFW
	SONCC-SmiR.2.1.1.2	$5,478,500						$5,478,500	CDFW
	Action Total:	*$5,495,508*						*$5,495,508*	
SONCC-SmiR.2.1.55									
	SONCC-SmiR.2.1.55.1	$17,008						$17,008	CDFW
	SONCC-SmiR.2.1.55.2	$5,478,500						$5,478,500	CDFW
	Action Total:	*$5,495,508*						*$5,495,508*	
SONCC-SmiR.2.2.2									
	SONCC-SmiR.2.2.2.1	$17,008						$17,008	CDFW
	SONCC-SmiR.2.2.2.2	$145,350						$145,350	CDFW
	Action Total:	*$162,358*						*$162,358*	
SONCC-SmiR.2.2.3									
	SONCC-SmiR.2.2.3.1	$17,008						$17,008	CDFW
	SONCC-SmiR.2.2.3.2	$1,022,580						$1,022,580	CDFW
	Action Total:	*$1,039,588*						*$1,039,588*	
SONCC-SmiR.2.2.4									
	SONCC-SmiR.2.2.4.1	$17,008						$17,008	CDFW
	SONCC-SmiR.2.2.4.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-SmiR.2.2.4.3	$40,000						$40,000	CDFW
	Action Total:	*$142,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$567,233*	
SONCC-SmiR.2.2.5									
	SONCC-SmiR.2.2.5.1	$44,540						$44,540	CDFW
	SONCC-SmiR.2.2.5.2	$66,824						$66,824	CDFW
	Action Total:	*$111,364*						*$111,364*	
SONCC-SmiR.2.2.56									
	SONCC-SmiR.2.2.56.1	$17,008						$17,008	CDFW
	SONCC-SmiR.2.2.56.2	$145,350						$145,350	CDFW
	Action Total:	*$162,358*						*$162,358*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SmiR.2.2.57									
	SONCC-SmiR.2.2.57.1	$17,008						$17,008	CDFW
	SONCC-SmiR.2.2.57.2	$1,022,580						$1,022,580	CDFW
	Action Total:	*$1,039,588*						*$1,039,588*	
SONCC-SmiR.2.2.58									
	SONCC-SmiR.2.2.58.1	$17,008						$17,008	CDFW
	SONCC-SmiR.2.2.58.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-SmiR.2.2.58.3	$40,000						$40,000	CDFW
	Action Total:	*$142,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$567,233*	
SONCC-SmiR.2.2.59									
	SONCC-SmiR.2.2.59.1	$44,540						$44,540	CDFW
	SONCC-SmiR.2.2.59.2	$66,824						$66,824	CDFW
	Action Total:	*$111,364*						*$111,364*	
SONCC-SmiR.2.2.46									
	SONCC-SmiR.2.2.46.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-SmiR.1.2.13									
	SONCC-SmiR.1.2.13.1	$34,015						$34,015	NRCS/RCD
	SONCC-SmiR.1.2.13.2	$76,136						$76,136	NRCS/RCD
	Action Total:	*$110,151*						*$110,151*	
SONCC-SmiR.1.3.12									
	SONCC-SmiR.1.3.12.1	$36,770						$36,770	CDFW
	SONCC-SmiR.1.3.12.2	$600,000						$600,000	CDFW
	Action Total:	*$636,770*						*$636,770*	
SONCC-SmiR.5.1.14									
	SONCC-SmiR.5.1.14.1	$22,270						$22,270	USFS
	SONCC-SmiR.5.1.14.2	$479,650						$479,650	USFS
	Action Total:	*$501,920*						*$501,920*	
SONCC-SmiR.5.1.62									
	SONCC-SmiR.5.1.62.1	$22,270						$22,270	USFS
	SONCC-SmiR.5.1.62.2	$479,650						$479,650	USFS
	Action Total:	*$501,920*						*$501,920*	
SONCC-SmiR.7.1.8									
	SONCC-SmiR.7.1.8.1	$50,000						$50,000	CDFW
	Action Total:	*$50,000*						*$50,000*	
SONCC-SmiR.7.1.66									
	SONCC-SmiR.7.1.66.1	$50,000						$50,000	CDFW
	Action Total:	*$50,000*						*$50,000*	
SONCC-SmiR.26.1.49									
	SONCC-SmiR.26.1.49.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SmiR.10.2.9									
	SONCC-SmiR.10.2.9.1	$17,008						$17,008	NGO
	SONCC-SmiR.10.2.9.2	$17,008						$17,008	NGO
	Action Total:	*$34,015*						*$34,015*	
SONCC-SmiR.10.2.10									
	SONCC-SmiR.10.2.10.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SmiR.10.2.11									
	SONCC-SmiR.10.2.11.1	$34,015						$34,015	RWQCB
	SONCC-SmiR.10.2.11.2	$1,152,092						$1,152,092	RWQCB
	Action Total:	*$1,186,107*						*$1,186,107*	
SONCC-SmiR.10.2.51									
	SONCC-SmiR.10.2.51.1	$34,015						$34,015	RWQCB
	SONCC-SmiR.10.2.51.2	$1,152,092						$1,152,092	RWQCB
	Action Total:	*$1,186,107*						*$1,186,107*	
SONCC-SmiR.10.2.53									
	SONCC-SmiR.10.2.53.1	$17,008						$17,008	NGO
	SONCC-SmiR.10.2.53.2	$17,008						$17,008	NGO
	Action Total:	*$34,015*						*$34,015*	
SONCC-SmiR.7.1.6									
	SONCC-SmiR.7.1.6.1	$17,008						$17,008	USFS
	SONCC-SmiR.7.1.6.2	$383,520						$383,520	USFS
	SONCC-SmiR.7.1.6.3	$2,790,720						$2,790,720	USFS
	Action Total:	*$3,191,248*						*$3,191,248*	
SONCC-SmiR.7.1.64									
	SONCC-SmiR.7.1.64.1	$17,008						$17,008	USFS
	SONCC-SmiR.7.1.64.2	$383,520						$383,520	USFS
	SONCC-SmiR.7.1.64.3	$2,790,720						$2,790,720	USFS
	Action Total:	*$3,191,248*						*$3,191,248*	
SONCC-SmiR.1.3.50									
	SONCC-SmiR.1.3.50.1	$18,385						$18,385	CDFW
	SONCC-SmiR.1.3.50.2	$300,285						$300,285	CDFW
	Action Total:	*$318,670*						*$318,670*	
SONCC-SmiR.1.3.39									
	SONCC-SmiR.1.3.39.1	$18,385						$18,385	CDFW
	SONCC-SmiR.1.3.39.2	$300,285						$300,285	CDFW
	Action Total:	*$318,670*						*$318,670*	
SONCC-SmiR.5.2.63									
	SONCC-SmiR.5.2.63.1	$18,385						$18,385	CDFW
	SONCC-SmiR.5.2.63.2	$113,640						$113,640	CDFW
	Action Total:	*$132,025*						*$132,025*	
SONCC-SmiR.5.2.38									
	SONCC-SmiR.5.2.38.1	$18,385						$18,385	CDFW
	SONCC-SmiR.5.2.38.2	$113,640						$113,640	CDFW
	Action Total:	*$132,025*						*$132,025*	
SONCC-SmiR.5.1.40									
	SONCC-SmiR.5.1.40.1	$44,540						$44,540	CDFW
	SONCC-SmiR.5.1.40.2	$636,360						$636,360	CDFW
	Action Total:	*$680,900*						*$680,900*	
SONCC-SmiR.3.1.17									
	SONCC-SmiR.3.1.17.1	$18,385						$18,385	SWRCB
	SONCC-SmiR.3.1.17.2	$0						$0	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-SmiR.3.1.60									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SmiR.3.1.60.1	$18,385						$18,385	SWRCB
	SONCC-SmiR.3.1.60.2	$0						$0	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-SmiR.7.1.7									
	SONCC-SmiR.7.1.7.1	$17,008						$17,008	NRCS/RCD
	SONCC-SmiR.7.1.7.2	$17,008						$17,008	NRCS/RCD
	SONCC-SmiR.7.1.7.3	$963,470						$963,470	NRCS/RCD
	SONCC-SmiR.7.1.7.4	$32,569						$32,569	NRCS/RCD
	SONCC-SmiR.7.1.7.5	$1,214						$1,214	NRCS/RCD
	Action Total:	*$1,031,268*						*$1,031,268*	
SONCC-SmiR.7.1.65									
	SONCC-SmiR.7.1.65.1	$17,008						$17,008	NRCS/RCD
	SONCC-SmiR.7.1.65.2	$17,008						$17,008	NRCS/RCD
	SONCC-SmiR.7.1.65.3	$963,470						$963,470	NRCS/RCD
	SONCC-SmiR.7.1.65.4	$32,569						$32,569	NRCS/RCD
	SONCC-SmiR.7.1.65.5	$1,214						$1,214	NRCS/RCD
	Action Total:	*$1,031,268*						*$1,031,268*	
SONCC-SmiR.8.1.15									
	SONCC-SmiR.8.1.15.1	$1,042,644						$1,042,644	USFS
	SONCC-SmiR.8.1.15.2	$21,135,340						$21,135,340	USFS
	SONCC-SmiR.8.1.15.3	$4,043,782						$4,043,782	USFS
	SONCC-SmiR.8.1.15.4	$1,820,418					$1,820,418	$3,640,836	USFS
	Action Total:	*$28,042,184*					*$1,820,418*	*$29,862,602*	
SONCC-SmiR.8.1.67									
	SONCC-SmiR.8.1.67.1	$1,042,644						$1,042,644	USFS
	SONCC-SmiR.8.1.67.2	$21,135,340						$21,135,340	USFS
	SONCC-SmiR.8.1.67.3	$4,043,782						$4,043,782	USFS
	SONCC-SmiR.8.1.67.4	$1,820,418					$1,820,418	$3,640,836	USFS
	Action Total:	*$28,042,184*					*$1,820,418*	*$29,862,602*	
SONCC-SmiR.10.2.52									
	SONCC-SmiR.10.2.52.1	$22,963						$22,963	CDFW
	SONCC-SmiR.10.2.52.2	$38,068						$38,068	CDFW
	Action Total:	*$61,031*						*$61,031*	
SONCC-SmiR.10.2.37									
	SONCC-SmiR.10.2.37.1	$22,963						$22,963	CDFW
	SONCC-SmiR.10.2.37.2	$38,068						$38,068	CDFW
	Action Total:	*$61,031*						*$61,031*	
SONCC-SmiR.10.7.54									
	SONCC-SmiR.10.7.54.1	$8,504						$8,504	CDFW
	SONCC-SmiR.10.7.54.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-SmiR.10.7.48									
	SONCC-SmiR.10.7.48.1	$8,504						$8,504	CDFW
	SONCC-SmiR.10.7.48.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-SmiR.1.2.32									
	SONCC-SmiR.1.2.32.1	$34,015						$34,015	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SmiR.1.2.32.2	$34,015						$34,015	CDFW
	SONCC-SmiR.1.2.32.3	$682,150						$682,150	CDFW
	Action Total:	*$750,180*						*$750,180*	
SONCC-SmiR.16.2.23									
	SONCC-SmiR.16.2.23.1	$34,015						$34,015	NMFS
	SONCC-SmiR.16.2.23.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SmiR.16.2.24									
	SONCC-SmiR.16.2.24.1	$34,015						$34,015	NMFS
	SONCC-SmiR.16.2.24.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SmiR.17.2.20									
	SONCC-SmiR.17.2.20.1	$0						$0	CDFW
	SONCC-SmiR.17.2.20.2	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-SmiR.8.1.16									
	SONCC-SmiR.8.1.16.1	$113,193						$113,193	USFS
	SONCC-SmiR.8.1.16.2	$1,197,344						$1,197,344	USFS
	Action Total:	*$1,310,537*						*$1,310,537*	
SONCC-SmiR.27.2.28									
	SONCC-SmiR.27.2.28.1	$136,060						$136,060	CDFW
	SONCC-SmiR.27.2.28.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-SmiR.27.2.29									
	SONCC-SmiR.27.2.29.1	$4,959,073		$4,959,073		$4,959,073		$14,877,219	CDFW
	Action Total:	*$4,959,073*		*$4,959,073*		*$4,959,073*		*$14,877,219*	
SONCC-SmiR.27.2.30									
	SONCC-SmiR.27.2.30.1	$4,959,073		$4,959,073		$4,959,073		$14,877,219	CDFW
	Action Total:	*$4,959,073*		*$4,959,073*		*$4,959,073*		*$14,877,219*	
SONCC-SmiR.27.2.31									
	SONCC-SmiR.27.2.31.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-SmiR.27.2.43									
	SONCC-SmiR.27.2.43.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SmiR.27.2.34									
	SONCC-SmiR.27.2.34.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-SmiR.27.2.36									
	SONCC-SmiR.27.2.36.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-SmiR.27.2.47									
	SONCC-SmiR.27.2.47.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,228	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,228*	
SONCC-SmiR.27.1.25									
	SONCC-SmiR.27.1.25.1	$578,565	$578,565	$578,565	$578,565	$578,565	$578,565	$3,471,390	CDFW
	Action Total:	*$578,565*	*$578,565*	*$578,565*	*$578,565*	*$578,565*	*$578,565*	*$3,471,390*	
SONCC-SmiR.27.1.26									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SmiR.27.1.26.1	$192,855	$192,855	$192,855	$192,855	$192,855	$192,855	$1,157,130	CDFW
	Action Total:	*$192,855*	*$192,855*	*$192,855*	*$192,855*	*$192,855*	*$192,855*	*$1,157,130*	
SONCC-SmiR.27.1.27									
	SONCC-SmiR.27.1.27.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-SmiR.27.1.33									
	SONCC-SmiR.27.1.33.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-SmiR.27.1.35									
	SONCC-SmiR.27.1.35.1	$34,015						$34,015	NMFS
	SONCC-SmiR.27.1.35.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-SmiR.27.1.45									
	SONCC-SmiR.27.1.45.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-SmiR.27.4.41									
	SONCC-SmiR.27.4.41.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-SmiR.27.4.42									
	SONCC-SmiR.27.4.42.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-SmiR.27.4.44									
	SONCC-SmiR.27.4.44.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
	Population Total:	***$99,364,744***	***$2,571,143***	***$12,543,549***	***$2,571,143***	***$12,543,549***	***$6,211,979***	***$135,806,107***	

Population: South Fork Eel River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFER.3.1.5									
	SONCC-SFER.3.1.5.1	$36,077						$36,077	CDFW
	SONCC-SFER.3.1.5.2	$36,077						$36,077	CDFW
	SONCC-SFER.3.1.5.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-SFER.3.1.6									
	SONCC-SFER.3.1.6.3	$73,540						$73,540	SWRCB
	SONCC-SFER.3.1.6.4	$76,136						$76,136	SWRCB
	Action Total:	*$149,676*						*$149,676*	
SONCC-SFER.3.1.71									
	SONCC-SFER.3.1.71.1	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-SFER.3.1.72									
	SONCC-SFER.3.1.72.1	$175,000						$175,000	NGO
	SONCC-SFER.3.1.72.2	$1,250	$1,250	$1,250	$1,250	$1,250	$1,250	$7,500	NGO
	Action Total:	*$176,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$182,500*	
SONCC-SFER.3.1.70									
	SONCC-SFER.3.1.70.1	$38,068						$38,068	NGO
	Action Total:	*$38,068*						*$38,068*	
SONCC-SFER.3.1.49									
	SONCC-SFER.3.1.49.1	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFER.3.1.51									
	SONCC-SFER.3.1.51.1	$73,540						$73,540	CDFW
	SONCC-SFER.3.1.51.2	$36,770						$36,770	CDFW
	SONCC-SFER.3.1.51.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-SFER.3.1.7									
	SONCC-SFER.3.1.7.1	$175,000						$175,000	NGO
	SONCC-SFER.3.1.7.2	$1,250	$1,250	$1,250	$1,250	$1,250	$1,250	$7,500	NGO
	Action Total:	*$176,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$1,250*	*$182,500*	
SONCC-SFER.3.1.10									
	SONCC-SFER.3.1.10.1	$38,068						$38,068	NGO
	Action Total:	*$38,068*						*$38,068*	
SONCC-SFER.3.1.11									
	SONCC-SFER.3.1.11.1	$0						$0	SWRCB
	SONCC-SFER.3.1.11.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-SFER.2.1.67									
	SONCC-SFER.2.1.67.1	$17,008						$17,008	CDFW
	SONCC-SFER.2.1.67.2	$5,916,780						$5,916,780	CDFW
	Action Total:	*$5,933,788*						*$5,933,788*	
SONCC-SFER.2.1.1									
	SONCC-SFER.2.1.1.1	$17,008						$17,008	CDFW
	SONCC-SFER.2.1.1.2	$5,916,780						$5,916,780	CDFW
	Action Total:	*$5,933,788*						*$5,933,788*	
SONCC-SFER.2.2.68									
	SONCC-SFER.2.2.68.1	$36,770						$36,770	CDFW
	SONCC-SFER.2.2.68.2	$87,260						$87,260	CDFW
	Action Total:	*$124,030*						*$124,030*	
SONCC-SFER.2.2.69									
	SONCC-SFER.2.2.69.1	$17,008						$17,008	CDFW
	SONCC-SFER.2.2.69.2	$1,104,386						$1,104,386	CDFW
	Action Total:	*$1,121,394*						*$1,121,394*	
SONCC-SFER.2.2.2									
	SONCC-SFER.2.2.2.1	$36,770						$36,770	CDFW
	SONCC-SFER.2.2.2.2	$87,260						$87,260	CDFW
	Action Total:	*$124,030*						*$124,030*	
SONCC-SFER.2.2.3									
	SONCC-SFER.2.2.3.1	$17,008						$17,008	CDFW
	SONCC-SFER.2.2.3.2	$1,104,386						$1,104,386	CDFW
	Action Total:	*$1,121,394*						*$1,121,394*	
SONCC-SFER.5.1.74									
	SONCC-SFER.5.1.74.1	$22,270						$22,270	Caltrans
	SONCC-SFER.5.1.74.2	$741,277						$741,277	Caltrans
	Action Total:	*$763,547*						*$763,547*	
SONCC-SFER.5.1.75									
	SONCC-SFER.5.1.75.1	$34,015						$34,015	CDFW
	SONCC-SFER.5.1.75.2	$39,245						$39,245	CDFW
	Action Total:	*$73,260*						*$73,260*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFER.5.1.46									
	SONCC-SFER.5.1.46.1	$34,015						$34,015	CDFW
	SONCC-SFER.5.1.46.2	$39,245						$39,245	CDFW
	Action Total:	*$73,260*						*$73,260*	
SONCC-SFER.5.1.25									
	SONCC-SFER.5.1.25.1	$22,270						$22,270	Caltrans
	SONCC-SFER.5.1.25.2	$741,277						$741,277	Caltrans
	Action Total:	*$763,547*						*$763,547*	
SONCC-SFER.1.2.43									
	SONCC-SFER.1.2.43.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-SFER.26.1.63									
	SONCC-SFER.26.1.63.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SFER.14.2.14									
	SONCC-SFER.14.2.14.1	$68,030						$68,030	CDFW
	SONCC-SFER.14.2.14.2	$15,996,908						$15,996,908	CDFW
	Action Total:	*$16,064,938*						*$16,064,938*	
SONCC-SFER.10.1.64									
	SONCC-SFER.10.1.64.1	$17,008						$17,008	CDFW
	SONCC-SFER.10.1.64.2	$2,355,755						$2,355,755	CDFW
	SONCC-SFER.10.1.64.3	$3,000,024						$3,000,024	CDFW
	Action Total:	*$5,372,787*						*$5,372,787*	
SONCC-SFER.10.1.48									
	SONCC-SFER.10.1.48.1	$17,008						$17,008	CDFW
	SONCC-SFER.10.1.48.2	$2,355,755						$2,355,755	CDFW
	SONCC-SFER.10.1.48.3	$3,000,024						$3,000,024	CDFW
	Action Total:	*$5,372,787*						*$5,372,787*	
SONCC-SFER.7.1.45									
	SONCC-SFER.7.1.45.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-SFER.3.1.13									
	SONCC-SFER.3.1.13.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-SFER.5.1.9									
	SONCC-SFER.5.1.9.1	$89,080						$89,080	CSP
	SONCC-SFER.5.1.9.2	$568,181						$568,181	CSP
	Action Total:	*$657,261*						*$657,261*	
SONCC-SFER.8.1.76									
	SONCC-SFER.8.1.76.1	$721,996						$721,996	NGO
	SONCC-SFER.8.1.76.2	$26,060,273						$26,060,273	NGO
	SONCC-SFER.8.1.76.3	$2,250,136						$2,250,136	NGO
	SONCC-SFER.8.1.76.4	$1,646,021					$1,646,021	$3,292,042	NGO
	Action Total:	*$30,678,426*					*$1,646,021*	*$32,324,447*	
SONCC-SFER.8.1.77									
	SONCC-SFER.8.1.77.1	$523,559						$523,559	NGO
	SONCC-SFER.8.1.77.2	$3,607,084						$3,607,084	NGO
	Action Total:	*$4,130,643*						*$4,130,643*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFER.8.1.78									
	SONCC-SFER.8.1.78.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-SFER.8.1.50									
	SONCC-SFER.8.1.50.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-SFER.8.1.15									
	SONCC-SFER.8.1.15.1	$721,996						$721,996	NGO
	SONCC-SFER.8.1.15.2	$26,060,273						$26,060,273	NGO
	SONCC-SFER.8.1.15.3	$2,250,136						$2,250,136	NGO
	SONCC-SFER.8.1.15.4	$1,646,021					$1,646,021	$3,292,042	NGO
	Action Total:	*$30,678,426*					*$1,646,021*	*$32,324,447*	
SONCC-SFER.8.1.18									
	SONCC-SFER.8.1.18.1	$523,559						$523,559	NGO
	SONCC-SFER.8.1.18.2	$3,607,084						$3,607,084	NGO
	Action Total:	*$4,130,643*						*$4,130,643*	
SONCC-SFER.10.2.65									
	SONCC-SFER.10.2.65.1	$125,000						$125,000	County
	Action Total:	*$125,000*						*$125,000*	
SONCC-SFER.10.2.19									
	SONCC-SFER.10.2.19.1	$125,000						$125,000	County
	Action Total:	*$125,000*						*$125,000*	
SONCC-SFER.10.7.66									
	SONCC-SFER.10.7.66.1	$8,504						$8,504	CDFW
	SONCC-SFER.10.7.66.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-SFER.10.7.62									
	SONCC-SFER.10.7.62.1	$8,504						$8,504	CDFW
	SONCC-SFER.10.7.62.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-SFER.3.1.4									
	SONCC-SFER.3.1.4.1	$8,503						$8,503	County
	Action Total:	*$8,503*						*$8,503*	
SONCC-SFER.7.1.21									
	SONCC-SFER.7.1.21.1	$34,015						$34,015	NGO
	SONCC-SFER.7.1.21.2	$830,960						$830,960	NGO
	SONCC-SFER.7.1.21.3	$6,027,955						$6,027,955	NGO
	Action Total:	*$6,892,930*						*$6,892,930*	
SONCC-SFER.7.1.22									
	SONCC-SFER.7.1.22.1	$18,200						$18,200	NGO
	SONCC-SFER.7.1.22.2	$14,846,976						$14,846,976	NGO
	Action Total:	*$14,865,176*						*$14,865,176*	
SONCC-SFER.7.1.23									
	SONCC-SFER.7.1.23.1	$34,015						$34,015	County
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFER.7.1.24									
	SONCC-SFER.7.1.24.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFER.16.1.28									
	SONCC-SFER.16.1.28.1	$34,015						$34,015	NMFS
	SONCC-SFER.16.1.28.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFER.16.1.29									
	SONCC-SFER.16.1.29.1	$34,015						$34,015	NMFS
	SONCC-SFER.16.1.29.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFER.16.2.30									
	SONCC-SFER.16.2.30.1	$34,015						$34,015	NMFS
	SONCC-SFER.16.2.30.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFER.16.2.31									
	SONCC-SFER.16.2.31.1	$34,015						$34,015	NMFS
	SONCC-SFER.16.2.31.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFER.8.1.16									
	SONCC-SFER.8.1.16.1	$2,640						$2,640	BLM
	Action Total:	*$2,640*						*$2,640*	
SONCC-SFER.8.1.17									
	SONCC-SFER.8.1.17.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-SFER.27.2.56									
	SONCC-SFER.27.2.56.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-SFER.27.2.57									
	SONCC-SFER.27.2.57.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFER.27.2.59									
	SONCC-SFER.27.2.59.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SFER.27.2.37									
	SONCC-SFER.27.2.37.1	$136,060						$136,060	CDFW
	SONCC-SFER.27.2.37.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-SFER.27.2.38									
	SONCC-SFER.27.2.38.1	$7,715,561		$7,715,561		$7,715,561		$23,146,683	CDFW
	Action Total:	*$7,715,561*		*$7,715,561*		*$7,715,561*		*$23,146,683*	
SONCC-SFER.27.2.39									
	SONCC-SFER.27.2.39.1	$7,715,561		$7,715,561		$7,715,561		$23,146,683	CDFW
	Action Total:	*$7,715,561*		*$7,715,561*		*$7,715,561*		*$23,146,683*	
SONCC-SFER.27.2.40									
	SONCC-SFER.27.2.40.1	$7,715,561		$7,715,561		$7,715,561		$23,146,683	CDFW
	Action Total:	*$7,715,561*		*$7,715,561*		*$7,715,561*		*$23,146,683*	
SONCC-SFER.27.2.41									
	SONCC-SFER.27.2.41.1	$7,715,561		$7,715,561		$7,715,561		$23,146,683	CDFW
	Action Total:	*$7,715,561*		*$7,715,561*		*$7,715,561*		*$23,146,683*	
SONCC-SFER.27.2.42									
	SONCC-SFER.27.2.42.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFER.27.2.42.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-SFER.27.2.61									
	SONCC-SFER.27.2.61.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-SFER.27.1.58									
	SONCC-SFER.27.1.58.1	$240,555	$240,555	$240,555	$240,555	$240,555	$240,555	$1,443,330	CDFW
	Action Total:	*$240,555*	*$240,555*	*$240,555*	*$240,555*	*$240,555*	*$240,555*	*$1,443,330*	
SONCC-SFER.27.1.44									
	SONCC-SFER.27.1.44.1	$34,015						$34,015	NMFS
	SONCC-SFER.27.1.44.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFER.27.1.32									
	SONCC-SFER.27.1.32.1	$721,665	$721,665	$721,665	$721,665	$721,665	$721,665	$4,329,990	CDFW
	Action Total:	*$721,665*	*$721,665*	*$721,665*	*$721,665*	*$721,665*	*$721,665*	*$4,329,990*	
SONCC-SFER.27.1.33									
	SONCC-SFER.27.1.33.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-SFER.27.1.34									
	SONCC-SFER.27.1.34.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-SFER.27.1.35									
	SONCC-SFER.27.1.35.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-SFER.27.1.36									
	SONCC-SFER.27.1.36.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-SFER.27.1.36.2	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	CDFW
	Action Total:	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$612,270*	
SONCC-SFER.27.4.52									
	SONCC-SFER.27.4.52.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-SFER.27.4.53									
	SONCC-SFER.27.4.53.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-SFER.27.4.54									
	SONCC-SFER.27.4.54.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-SFER.27.4.55									
	SONCC-SFER.27.4.55.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SFER.27.4.60									
	SONCC-SFER.27.4.60.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$170,560,131***	***$3,008,718***	***$33,891,207***	***$3,008,718***	***$33,891,207***	***$6,300,760***	***$250,660,739***	

Population: South Fork Trinity River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFTR.3.1.70									
	SONCC-SFTR.3.1.70.1	$17,008						$17,008	SWRCB
	SONCC-SFTR.3.1.70.2	$17,008						$17,008	SWRCB

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.3.1.72									
	SONCC-SFTR.3.1.72.1	$18,385						$18,385	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-SFTR.3.1.74									
	SONCC-SFTR.3.1.74.1	$36,526						$36,526	SWRCB
	Action Total:	*$36,526*						*$36,526*	
SONCC-SFTR.3.1.40									
	SONCC-SFTR.3.1.40.1	$17,008						$17,008	SWRCB
	SONCC-SFTR.3.1.40.2	$17,008						$17,008	SWRCB
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.3.1.42									
	SONCC-SFTR.3.1.42.1	$625,520						$625,520	City
	Action Total:	*$625,520*						*$625,520*	
SONCC-SFTR.3.1.47									
	SONCC-SFTR.3.1.47.1	$18,385						$18,385	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-SFTR.3.1.8									
	SONCC-SFTR.3.1.8.1	$36,526						$36,526	SWRCB
	Action Total:	*$36,526*						*$36,526*	
SONCC-SFTR.17.2.46									
	SONCC-SFTR.17.2.46.1	$0						$0	CDFW
	SONCC-SFTR.17.2.46.2	$34,015						$34,015	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.3.1.67									
	SONCC-SFTR.3.1.67.1	$17,008						$17,008	CDFW
	SONCC-SFTR.3.1.67.2	$14,773						$14,773	DWR
	SONCC-SFTR.3.1.67.3	$8,523	$10,227	$10,227	$10,227	$10,227	$10,227	$59,658	DWR
	SONCC-SFTR.3.1.67.4	$18,385						$18,385	DWR
	Action Total:	*$58,688*	*$10,227*	*$10,227*	*$10,227*	*$10,227*	*$10,227*	*$109,823*	
SONCC-SFTR.3.1.68									
	SONCC-SFTR.3.1.68.1	$17,008						$17,008	NRCS/RCD
	SONCC-SFTR.3.1.68.2	$23,856						$23,856	NRCS/RCD
	Action Total:	*$40,864*						*$40,864*	
SONCC-SFTR.3.1.69									
	SONCC-SFTR.3.1.69.1	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$750,000	DWR
	Action Total:	*$125,000*	*$125,000*	*$125,000*	*$125,000*	*$125,000*	*$125,000*	*$750,000*	
SONCC-SFTR.3.1.73									
	SONCC-SFTR.3.1.73.1	$22,963						$22,963	CDFW
	SONCC-SFTR.3.1.73.2	$1,750,000	$175,000	$175,000	$175,000	$175,000	$175,000	$2,625,000	CDFW
	SONCC-SFTR.3.1.73.3	$1,250	$1,250	$1,250	$1,250	$1,250	$1,250	$7,500	CDFW
	Action Total:	*$1,774,213*	*$176,250*	*$176,250*	*$176,250*	*$176,250*	*$176,250*	*$2,655,463*	
SONCC-SFTR.3.1.1									
	SONCC-SFTR.3.1.1.1	$17,008						$17,008	CDFW
	SONCC-SFTR.3.1.1.2	$14,773						$14,773	DWR
	SONCC-SFTR.3.1.1.3	$8,523	$10,227	$10,227	$10,227	$10,227	$10,227	$59,658	DWR
	SONCC-SFTR.3.1.1.4	$18,385						$18,385	DWR
	Action Total:	*$58,688*	*$10,227*	*$10,227*	*$10,227*	*$10,227*	*$10,227*	*$109,823*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-SFTR.3.1.2									
	SONCC-SFTR.3.1.2.1	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$750,000	DWR
	Action Total:	*$125,000*	*$125,000*	*$125,000*	*$125,000*	*$125,000*	*$125,000*	*$750,000*	
SONCC-SFTR.3.1.3									
	SONCC-SFTR.3.1.3.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-SFTR.3.1.4									
	SONCC-SFTR.3.1.4.1	$0						$0	SWRCB
	SONCC-SFTR.3.1.4.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-SFTR.3.1.6									
	SONCC-SFTR.3.1.6.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-SFTR.3.1.7									
	SONCC-SFTR.3.1.7.1	$22,963						$22,963	CDFW
	SONCC-SFTR.3.1.7.2	$1,750,000	$175,000	$175,000	$175,000	$175,000	$175,000	$2,625,000	CDFW
	SONCC-SFTR.3.1.7.3	$1,250	$1,250	$1,250	$1,250	$1,250	$1,250	$7,500	CDFW
	Action Total:	*$1,774,213*	*$176,250*	*$176,250*	*$176,250*	*$176,250*	*$176,250*	*$2,655,463*	
SONCC-SFTR.3.1.10									
	SONCC-SFTR.3.1.10.1	$17,008						$17,008	NRCS/RCD
	SONCC-SFTR.3.1.10.2	$23,856						$23,856	NRCS/RCD
	Action Total:	*$40,864*						*$40,864*	
SONCC-SFTR.3.1.59									
	SONCC-SFTR.3.1.59.1	$36,077						$36,077	CDFW
	SONCC-SFTR.3.1.59.2	$36,077						$36,077	CDFW
	SONCC-SFTR.3.1.59.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-SFTR.10.3.61									
	SONCC-SFTR.10.3.61.1	$17,008						$17,008	CDFW
	SONCC-SFTR.10.3.61.2	$17,008						$17,008	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.10.3.62									
	SONCC-SFTR.10.3.62.1	$17,008						$17,008	CDFW
	SONCC-SFTR.10.3.62.2	$42,519						$42,519	CDFW
	Action Total:	*$59,526*						*$59,526*	
SONCC-SFTR.10.3.13									
	SONCC-SFTR.10.3.13.1	$17,008						$17,008	CDFW
	SONCC-SFTR.10.3.13.2	$17,008						$17,008	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.10.3.14									
	SONCC-SFTR.10.3.14.1	$17,008						$17,008	CDFW
	SONCC-SFTR.10.3.14.2	$42,519						$42,519	CDFW
	Action Total:	*$59,526*						*$59,526*	
SONCC-SFTR.10.1.60									
	SONCC-SFTR.10.1.60.1	$18,385	$18,385	$18,385	$18,385	$18,385	$18,385	$110,310	USFS
	SONCC-SFTR.10.1.60.2	$18,385	$18,385	$18,385	$18,385	$18,385	$18,385	$110,310	USFS
	Action Total:	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$220,620*	
SONCC-SFTR.10.1.12									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFTR.10.1.12.1	$18,385	$18,385	$18,385	$18,385	$18,385	$18,385	$110,310	USFS
	SONCC-SFTR.10.1.12.2	$18,385	$18,385	$18,385	$18,385	$18,385	$18,385	$110,310	USFS
	Action Total:	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$220,620*	
SONCC-SFTR.1.2.44									
	SONCC-SFTR.1.2.44.1	$0						$0	BIA/Tribe
	Action Total:	*$0*						*$0*	
SONCC-SFTR.26.1.58									
	SONCC-SFTR.26.1.58.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SFTR.10.1.11									
	SONCC-SFTR.10.1.11.1	$34,015						$34,015	USFS
	SONCC-SFTR.10.1.11.2	$239,700						$239,700	USFS
	SONCC-SFTR.10.1.11.3	$1,744,200						$1,744,200	USFS
	Action Total:	*$2,017,915*						*$2,017,915*	
SONCC-SFTR.3.1.71									
	SONCC-SFTR.3.1.71.1	$17,008						$17,008	CDFW
	SONCC-SFTR.3.1.71.2	$42,519	$42,519	$42,519	$42,519	$42,519	$42,519	$255,111	CDFW
	Action Total:	*$59,526*	*$42,519*	*$42,519*	*$42,519*	*$42,519*	*$42,519*	*$272,119*	
SONCC-SFTR.3.1.41									
	SONCC-SFTR.3.1.41.1	$17,008						$17,008	CDFW
	SONCC-SFTR.3.1.41.2	$42,519	$42,519	$42,519	$42,519	$42,519	$42,519	$255,111	CDFW
	Action Total:	*$59,526*	*$42,519*	*$42,519*	*$42,519*	*$42,519*	*$42,519*	*$272,119*	
SONCC-SFTR.3.1.48									
	SONCC-SFTR.3.1.48.1	$73,540						$73,540	CDFW
	SONCC-SFTR.3.1.48.2	$36,770						$36,770	CDFW
	SONCC-SFTR.3.1.48.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-SFTR.2.1.64									
	SONCC-SFTR.2.1.64.1	$17,008						$17,008	CDFW
	SONCC-SFTR.2.1.64.2	$4,364,995						$4,364,995	CDFW
	Action Total:	*$4,382,003*						*$4,382,003*	
SONCC-SFTR.2.1.23									
	SONCC-SFTR.2.1.23.1	$17,008						$17,008	CDFW
	SONCC-SFTR.2.1.23.2	$4,364,995						$4,364,995	CDFW
	Action Total:	*$4,382,003*						*$4,382,003*	
SONCC-SFTR.2.2.66									
	SONCC-SFTR.2.2.66.1	$17,008						$17,008	CDFW
	SONCC-SFTR.2.2.66.2	$835,090						$835,090	CDFW
	Action Total:	*$852,097*						*$852,097*	
SONCC-SFTR.2.2.24									
	SONCC-SFTR.2.2.24.1	$17,008						$17,008	CDFW
	SONCC-SFTR.2.2.24.2	$835,090						$835,090	CDFW
	Action Total:	*$852,097*						*$852,097*	
SONCC-SFTR.8.1.75									
	SONCC-SFTR.8.1.75.1	$707,945						$707,945	USFS
	SONCC-SFTR.8.1.75.2	$1,806,808						$1,806,808	USFS
	Action Total:	*$2,514,753*						*$2,514,753*	
SONCC-SFTR.8.1.76									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFTR.8.1.76.1	$1,253,034						$1,253,034	USFS
	SONCC-SFTR.8.1.76.2	$23,109,301						$23,109,301	USFS
	SONCC-SFTR.8.1.76.3	$1,686,388						$1,686,388	USFS
	SONCC-SFTR.8.1.76.4	$2,225,354					$2,225,354	$4,450,707	USFS
	Action Total:	*$28,274,076*					*$2,225,354*	*$30,499,429*	
SONCC-SFTR.8.1.17									
	SONCC-SFTR.8.1.17.1	$707,945						$707,945	USFS
	SONCC-SFTR.8.1.17.2	$1,806,808						$1,806,808	USFS
	Action Total:	*$2,514,753*						*$2,514,753*	
SONCC-SFTR.8.1.18									
	SONCC-SFTR.8.1.18.1	$1,253,034						$1,253,034	USFS
	SONCC-SFTR.8.1.18.2	$23,109,301						$23,109,301	USFS
	SONCC-SFTR.8.1.18.3	$1,686,388						$1,686,388	USFS
	SONCC-SFTR.8.1.18.4	$2,225,354					$2,225,354	$4,450,707	USFS
	Action Total:	*$28,274,076*					*$2,225,354*	*$30,499,429*	
SONCC-SFTR.2.2.65									
	SONCC-SFTR.2.2.65.1	$17,008						$17,008	CDFW
	SONCC-SFTR.2.2.65.2	$814,741						$814,741	CDFW
	Action Total:	*$831,748*						*$831,748*	
SONCC-SFTR.2.2.20									
	SONCC-SFTR.2.2.20.1	$17,008						$17,008	CDFW
	SONCC-SFTR.2.2.20.2	$814,741						$814,741	CDFW
	Action Total:	*$831,748*						*$831,748*	
SONCC-SFTR.8.1.77									
	SONCC-SFTR.8.1.77.1	$17,008						$17,008	NRCS/RCD
	SONCC-SFTR.8.1.77.2	$17,008						$17,008	NRCS/RCD
	SONCC-SFTR.8.1.77.3	$477,830						$477,830	NRCS/RCD
	SONCC-SFTR.8.1.77.4	$8,158						$8,158	NRCS/RCD
	SONCC-SFTR.8.1.77.5	$304						$304	NRCS/RCD
	Action Total:	*$520,306*						*$520,306*	
SONCC-SFTR.8.1.19									
	SONCC-SFTR.8.1.19.1	$17,008						$17,008	NRCS/RCD
	SONCC-SFTR.8.1.19.2	$17,008						$17,008	NRCS/RCD
	SONCC-SFTR.8.1.19.3	$477,830						$477,830	NRCS/RCD
	SONCC-SFTR.8.1.19.4	$8,158						$8,158	NRCS/RCD
	SONCC-SFTR.8.1.19.5	$304						$304	NRCS/RCD
	Action Total:	*$520,306*						*$520,306*	
SONCC-SFTR.10.7.63									
	SONCC-SFTR.10.7.63.1	$8,504						$8,504	CDFW
	SONCC-SFTR.10.7.63.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-SFTR.10.7.57									
	SONCC-SFTR.10.7.57.1	$8,504						$8,504	CDFW
	SONCC-SFTR.10.7.57.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-SFTR.7.1.25									
	SONCC-SFTR.7.1.25.1	$76,136						$76,136	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFTR.7.1.25.2	$36,400						$36,400	USFS
	SONCC-SFTR.7.1.25.3	$420,480						$420,480	USFS
	Action Total:	*$533,016*						*$533,016*	
SONCC-SFTR.7.1.26									
	SONCC-SFTR.7.1.26.1	$34,015						$34,015	USFS
	SONCC-SFTR.7.1.26.2	$11,200						$11,200	USFS
	Action Total:	*$45,215*						*$45,215*	
SONCC-SFTR.16.1.27									
	SONCC-SFTR.16.1.27.1	$34,015						$34,015	NMFS
	SONCC-SFTR.16.1.27.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFTR.16.1.28									
	SONCC-SFTR.16.1.28.1	$34,015						$34,015	NMFS
	SONCC-SFTR.16.1.28.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFTR.16.1.55									
	SONCC-SFTR.16.1.55.1	$34,015						$34,015	NMFS
	SONCC-SFTR.16.1.55.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFTR.16.1.56									
	SONCC-SFTR.16.1.56.1	$34,015						$34,015	BIA/Tribe
	SONCC-SFTR.16.1.56.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFTR.16.2.29									
	SONCC-SFTR.16.2.29.1	$34,015						$34,015	NMFS
	SONCC-SFTR.16.2.29.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFTR.16.2.30									
	SONCC-SFTR.16.2.30.1	$34,015						$34,015	NMFS
	SONCC-SFTR.16.2.30.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-SFTR.8.1.16									
	SONCC-SFTR.8.1.16.1	$0						$0	CDF
	Action Total:	*$0*						*$0*	
SONCC-SFTR.27.2.53									
	SONCC-SFTR.27.2.53.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-SFTR.27.2.49									
	SONCC-SFTR.27.2.49.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-SFTR.27.2.34									
	SONCC-SFTR.27.2.34.1	$136,060						$136,060	CDFW
	SONCC-SFTR.27.2.34.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-SFTR.27.2.35									
	SONCC-SFTR.27.2.35.1	$1,949,465		$1,949,465		$1,949,465		$5,848,395	CDFW
	Action Total:	*$1,949,465*		*$1,949,465*		*$1,949,465*		*$5,848,395*	
SONCC-SFTR.27.2.36									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-SFTR.27.2.36.1	$1,949,465		$1,949,465		$1,949,465		$5,848,395	CDFW
	Action Total:	*$1,949,465*		*$1,949,465*		*$1,949,465*		*$5,848,395*	
SONCC-SFTR.27.2.37									
	SONCC-SFTR.27.2.37.1	$1,949,465		$1,949,465		$1,949,465		$5,848,395	CDFW
	Action Total:	*$1,949,465*		*$1,949,465*		*$1,949,465*		*$5,848,395*	
SONCC-SFTR.27.2.38									
	SONCC-SFTR.27.2.38.1	$1,949,465		$1,949,465		$1,949,465		$5,848,395	CDFW
	Action Total:	*$1,949,465*		*$1,949,465*		*$1,949,465*		*$5,848,395*	
SONCC-SFTR.27.2.39									
	SONCC-SFTR.27.2.39.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-SFTR.27.2.39.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-SFTR.27.2.54									
	SONCC-SFTR.27.2.54.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-SFTR.27.1.43									
	SONCC-SFTR.27.1.43.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-SFTR.27.1.45									
	SONCC-SFTR.27.1.45.1	$34,015						$34,015	NMFS
	SONCC-SFTR.27.1.45.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-SFTR.27.1.50									
	SONCC-SFTR.27.1.50.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-SFTR.27.1.31									
	SONCC-SFTR.27.1.31.1	$362,752	$362,752	$362,752	$362,752	$362,752	$362,752	$2,176,512	CDFW
	Action Total:	*$362,752*	*$362,752*	*$362,752*	*$362,752*	*$362,752*	*$362,752*	*$2,176,512*	
SONCC-SFTR.27.1.32									
	SONCC-SFTR.27.1.32.1	$120,917	$120,917	$120,917	$120,917	$120,917	$120,917	$725,502	CDFW
	Action Total:	*$120,917*	*$120,917*	*$120,917*	*$120,917*	*$120,917*	*$120,917*	*$725,502*	
SONCC-SFTR.27.1.33									
	SONCC-SFTR.27.1.33.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-SFTR.27.4.51									
	SONCC-SFTR.27.4.51.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-SFTR.27.4.52									
	SONCC-SFTR.27.4.52.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-SFTR.2.2.21									
	SONCC-SFTR.2.2.21.1							$0	CDFW
	SONCC-SFTR.2.2.21.2							$0	CDFW
	SONCC-SFTR.2.2.21.3							$0	CDFW
	Action Total:							*$0*	
SONCC-SFTR.2.2.22									
	SONCC-SFTR.2.2.22.1							$0	CDFW
	Action Total:							*$0*	
	Population Total:	***$92,640,325***	***$1,982,653***	***$9,800,758***	***$1,982,653***	***$9,800,758***	***$6,433,360***	***$122,640,504***	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
Population: Strawberry Creek									
SONCC-StrC.5.1.32									
	SONCC-StrC.5.1.32.1	$17,008						$17,008	County
	SONCC-StrC.5.1.32.2	$441,860						$441,860	County
	SONCC-StrC.5.1.32.3	$406,977						$406,977	CalTrans
	Action Total:	*$865,844*						*$865,844*	
SONCC-StrC.5.1.1									
	SONCC-StrC.5.1.1.1	$17,008						$17,008	County
	SONCC-StrC.5.1.1.2	$441,860						$441,860	County
	SONCC-StrC.5.1.1.3	$406,977						$406,977	CalTrans
	Action Total:	*$865,844*						*$865,844*	
SONCC-StrC.1.2.8									
	SONCC-StrC.1.2.8.1	$34,015						$34,015	County
	SONCC-StrC.1.2.8.2	$290,070						$290,070	County
	Action Total:	*$324,085*						*$324,085*	
SONCC-StrC.1.2.9									
	SONCC-StrC.1.2.9.1	$1,054,406						$1,054,406	CCC
	Action Total:	*$1,054,406*						*$1,054,406*	
SONCC-StrC.1.4.7									
	SONCC-StrC.1.4.7.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-StrC.2.1.31									
	SONCC-StrC.2.1.31.1	$17,008						$17,008	CDFW
	SONCC-StrC.2.1.31.2	$176,682						$176,682	CDFW
	Action Total:	*$193,689*						*$193,689*	
SONCC-StrC.2.1.13									
	SONCC-StrC.2.1.13.1	$17,008						$17,008	CDFW
	SONCC-StrC.2.1.13.2	$176,682						$176,682	CDFW
	Action Total:	*$193,689*						*$193,689*	
SONCC-StrC.10.7.30									
	SONCC-StrC.10.7.30.1	$8,504						$8,504	CDFW
	SONCC-StrC.10.7.30.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-StrC.10.7.29									
	SONCC-StrC.10.7.29.1	$8,504						$8,504	CDFW
	SONCC-StrC.10.7.29.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-StrC.5.1.18									
	SONCC-StrC.5.1.18.1	$319,767						$319,767	County
	Action Total:	*$319,767*						*$319,767*	
SONCC-StrC.2.2.2									
	SONCC-StrC.2.2.2.1	$34,015						$34,015	NGO
	SONCC-StrC.2.2.2.2	$639,033						$639,033	NGO
	Action Total:	*$673,048*						*$673,048*	
SONCC-StrC.27.2.11									
	SONCC-StrC.27.2.11.1	$136,060						$136,060	CDFW
	SONCC-StrC.27.2.11.2			$81,800			$81,800	$163,600	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$136,060*		*$81,800*			*$81,800*	*$299,660*	
SONCC-StrC.27.2.17									
	SONCC-StrC.27.2.17.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-StrC.27.2.20									
	SONCC-StrC.27.2.20.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-StrC.27.2.21									
	SONCC-StrC.27.2.21.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-StrC.27.2.22									
	SONCC-StrC.27.2.22.1	$1,087		$1,087		$1,087		$3,261	CDFW
	Action Total:	*$1,087*		*$1,087*		*$1,087*		*$3,261*	
SONCC-StrC.27.2.23									
	SONCC-StrC.27.2.23.1	$1,087		$1,087		$1,087		$3,261	CDFW
	Action Total:	*$1,087*		*$1,087*		*$1,087*		*$3,261*	
SONCC-StrC.27.2.28									
	SONCC-StrC.27.2.28.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,228	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,228*	
SONCC-StrC.27.1.27									
	SONCC-StrC.27.1.27.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-StrC.27.1.15									
	SONCC-StrC.27.1.15.1	$2,855	$2,855	$2,855	$2,855	$2,855	$2,855	$17,130	CDFW
	Action Total:	*$2,855*	*$2,855*	*$2,855*	*$2,855*	*$2,855*	*$2,855*	*$17,130*	
SONCC-StrC.27.1.16									
	SONCC-StrC.27.1.16.1	$34,015						$34,015	NMFS
	SONCC-StrC.27.1.16.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-StrC.27.4.25									
	SONCC-StrC.27.4.25.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-StrC.27.4.26									
	SONCC-StrC.27.4.26.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-StrC.7.1.5									
	SONCC-StrC.7.1.5.1							$0	NRCS/RCD
	SONCC-StrC.7.1.5.2							$0	NRCS/RCD
	SONCC-StrC.7.1.5.3							$0	NRCS/RCD
	SONCC-StrC.7.1.5.4							$0	NRCS/RCD
	SONCC-StrC.7.1.5.5							$0	NRCS/RCD
	Action Total:							*$0*	
SONCC-StrC.7.1.6									
	SONCC-StrC.7.1.6.1							$0	County
	SONCC-StrC.7.1.6.2							$0	County
	Action Total:							*$0*	
SONCC-StrC.2.1.19									
	SONCC-StrC.2.1.19.1							$0	CDFW
	Action Total:							*$0*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-StrC.2.2.14									
	SONCC-StrC.2.2.14.1							$0	CDFW
	SONCC-StrC.2.2.14.2							$0	CDFW
	Action Total:							*$0*	
SONCC-StrC.8.1.10									
	SONCC-StrC.8.1.10.1							$0	County
	Action Total:							*$0*	
SONCC-StrC.10.2.3									
	SONCC-StrC.10.2.3.1							$0	County
	SONCC-StrC.10.2.3.2							$0	County
	Action Total:							*$0*	
SONCC-StrC.10.2.4									
	SONCC-StrC.10.2.4.1							$0	County
	Action Total:							*$0*	
SONCC-StrC.10.2.12									
	SONCC-StrC.10.2.12.1							$0	County
	Action Total:							*$0*	
SONCC-StrC.10.2.24									
	SONCC-StrC.10.2.24.1							$0	CDFW
	SONCC-StrC.10.2.24.2							$0	CDFW
	Action Total:							*$0*	
	Population Total:	***$5,124,884***	***$309,196***	***$461,200***	***$309,196***	***$379,399***	***$390,996***	***$6,974,869***	

Population: Upper Klamath River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UKR.5.1.19									
	SONCC-UKR.5.1.19.1	$450,000,000						$450,000,000	DOI/FERC
	Action Total:	*$450,000,000*						*$450,000,000*	
SONCC-UKR.3.1.5									
	SONCC-UKR.3.1.5.1	$73,540						$73,540	BOR
	SONCC-UKR.3.1.5.2	$91,925	$91,925					$183,850	BOR
	Action Total:	*$165,465*	*$91,925*					*$257,390*	
SONCC-UKR.1.2.49									
	SONCC-UKR.1.2.49.1	$0						$0	BIA/Tribe
	Action Total:	*$0*						*$0*	
SONCC-UKR.30.1.25									
	SONCC-UKR.30.1.25.1	$68,030						$68,030	NMFS
	SONCC-UKR.30.1.25.2	$68,030						$68,030	NMFS
	Action Total:	*$136,060*						*$136,060*	
SONCC-UKR.5.1.79									
	SONCC-UKR.5.1.79.1	$18,385						$18,385	BIA/Tribe
	SONCC-UKR.5.1.79.2	$58,140						$58,140	BIA/Tribe
	Action Total:	*$76,525*						*$76,525*	
SONCC-UKR.5.1.20									
	SONCC-UKR.5.1.20.1	$18,385						$18,385	BIA/Tribe
	SONCC-UKR.5.1.20.2	$58,140						$58,140	BIA/Tribe
	Action Total:	*$76,525*						*$76,525*	
SONCC-UKR.3.1.75									
	SONCC-UKR.3.1.75.1	$34,015						$34,015	NRCS/RCD

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UKR.3.1.75.2	$38,068						$38,068	NRCS/RCD
	SONCC-UKR.3.1.75.3	$36,770						$36,770	DWR
	Action Total:	*$108,853*						*$108,853*	
SONCC-UKR.3.1.6									
	SONCC-UKR.3.1.6.1	$34,015						$34,015	NRCS/RCD
	SONCC-UKR.3.1.6.2	$38,068						$38,068	NRCS/RCD
	SONCC-UKR.3.1.6.3	$36,770						$36,770	DWR
	Action Total:	*$108,853*						*$108,853*	
SONCC-UKR.3.1.77									
	SONCC-UKR.3.1.77.1	$18,385						$18,385	SWRCB
	SONCC-UKR.3.1.77.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-UKR.3.1.66									
	SONCC-UKR.3.1.66.1	$18,385						$18,385	SWRCB
	SONCC-UKR.3.1.66.2	$36,770						$36,770	SWRCB
	Action Total:	*$55,155*						*$55,155*	
SONCC-UKR.5.2.81									
	SONCC-UKR.5.2.81.1	$22,270						$22,270	CDFW
	SONCC-UKR.5.2.81.2	$85,230						$85,230	CDFW
	Action Total:	*$107,500*						*$107,500*	
SONCC-UKR.5.2.24									
	SONCC-UKR.5.2.24.1	$22,270						$22,270	CDFW
	SONCC-UKR.5.2.24.2	$85,230						$85,230	CDFW
	Action Total:	*$107,500*						*$107,500*	
SONCC-UKR.2.1.71									
	SONCC-UKR.2.1.71.1	$17,008						$17,008	USFS
	SONCC-UKR.2.1.71.2	$8,902,563						$8,902,563	USFS
	Action Total:	*$8,919,570*						*$8,919,570*	
SONCC-UKR.2.1.4									
	SONCC-UKR.2.1.4.1	$17,008						$17,008	USFS
	SONCC-UKR.2.1.4.2	$8,902,563						$8,902,563	USFS
	Action Total:	*$8,919,570*						*$8,919,570*	
SONCC-UKR.26.1.65									
	SONCC-UKR.26.1.65.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-UKR.2.2.72									
	SONCC-UKR.2.2.72.1	$18,385						$18,385	USFS
	SONCC-UKR.2.2.72.2	$87,210						$87,210	USFS
	Action Total:	*$105,595*						*$105,595*	
SONCC-UKR.2.2.73									
	SONCC-UKR.2.2.73.1	$17,008						$17,008	USFS
	SONCC-UKR.2.2.73.2	$1,666,805						$1,666,805	USFS
	Action Total:	*$1,683,813*						*$1,683,813*	
SONCC-UKR.2.2.1									
	SONCC-UKR.2.2.1.1	$89,080						$89,080	CDFW
	SONCC-UKR.2.2.1.2	$217,969						$217,969	CDFW
	Action Total:	*$307,049*						*$307,049*	
SONCC-UKR.2.2.2									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UKR.2.2.2.1	$18,385						$18,385	USFS
	SONCC-UKR.2.2.2.2	$87,210						$87,210	USFS
	Action Total:	*$105,595*						*$105,595*	
SONCC-UKR.2.2.3									
	SONCC-UKR.2.2.3.1	$17,008						$17,008	USFS
	SONCC-UKR.2.2.3.2	$1,666,805						$1,666,805	USFS
	Action Total:	*$1,683,813*						*$1,683,813*	
SONCC-UKR.17.2.18									
	SONCC-UKR.17.2.18.2	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-UKR.8.1.83									
	SONCC-UKR.8.1.83.1	$1,649,105						$1,649,105	USFS
	SONCC-UKR.8.1.83.2	$25,641,554						$25,641,554	USFS
	SONCC-UKR.8.1.83.3	$4,088,959						$4,088,959	USFS
	SONCC-UKR.8.1.83.4	$3,346,989					$3,346,989	$6,693,978	USFS
	Action Total:	*$34,726,606*					*$3,346,989*	*$38,073,595*	
SONCC-UKR.8.1.28									
	SONCC-UKR.8.1.28.1	$1,649,105						$1,649,105	USFS
	SONCC-UKR.8.1.28.2	$25,641,554						$25,641,554	USFS
	SONCC-UKR.8.1.28.3	$4,088,959						$4,088,959	USFS
	SONCC-UKR.8.1.28.4	$3,346,989					$3,346,989	$6,693,978	USFS
	Action Total:	*$34,726,606*					*$3,346,989*	*$38,073,595*	
SONCC-UKR.30.1.26									
	SONCC-UKR.30.1.26.1	$68,030						$68,030	CDFW
	SONCC-UKR.30.1.26.2	$68,030						$68,030	CDFW
	Action Total:	*$136,060*						*$136,060*	
SONCC-UKR.10.1.68									
	SONCC-UKR.10.1.68.1	$17,008						$17,008	NRCS/RCD
	SONCC-UKR.10.1.68.2	$82,474						$82,474	NRCS/RCD
	Action Total:	*$99,482*						*$99,482*	
SONCC-UKR.10.1.16									
	SONCC-UKR.10.1.16.1	$17,008						$17,008	NRCS/RCD
	SONCC-UKR.10.1.16.2	$82,474						$82,474	NRCS/RCD
	Action Total:	*$99,482*						*$99,482*	
SONCC-UKR.5.1.80									
	SONCC-UKR.5.1.80.1	$22,270						$22,270	CDFW
	SONCC-UKR.5.1.80.2	$319,767						$319,767	CDFW
	Action Total:	*$342,037*						*$342,037*	
SONCC-UKR.5.1.21									
	SONCC-UKR.5.1.21.1	$22,270						$22,270	CDFW
	SONCC-UKR.5.1.21.2	$319,767						$319,767	CDFW
	Action Total:	*$342,037*						*$342,037*	
SONCC-UKR.3.1.74									
	SONCC-UKR.3.1.74.1	$13,068						$13,068	USFS
	SONCC-UKR.3.1.74.2	$19,888	$19,888	$19,888	$19,888	$19,888	$19,888	$119,325	USFS
	Action Total:	*$32,956*	*$19,888*	*$19,888*	*$19,888*	*$19,888*	*$19,888*	*$132,393*	
SONCC-UKR.3.1.48									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UKR.3.1.48.1	$13,068						$13,068	USFS
	SONCC-UKR.3.1.48.2	$19,888	$19,888	$19,888	$19,888	$19,888	$19,888	$119,325	USFS
	Action Total:	*$32,956*	*$19,888*	*$19,888*	*$19,888*	*$19,888*	*$19,888*	*$132,393*	
SONCC-UKR.3.2.78									
	SONCC-UKR.3.2.78.1	$17,008						$17,008	CDFW
	SONCC-UKR.3.2.78.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-UKR.3.2.78.3	$10,000						$10,000	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-UKR.3.2.11									
	SONCC-UKR.3.2.11.1	$17,008						$17,008	CDFW
	SONCC-UKR.3.2.11.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-UKR.3.2.11.3	$10,000						$10,000	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-UKR.3.2.12									
	SONCC-UKR.3.2.12.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-UKR.5.1.22									
	SONCC-UKR.5.1.22.1	$44,540						$44,540	CDFW
	SONCC-UKR.5.1.22.2	$568,181						$568,181	CDFW
	SONCC-UKR.5.1.22.3	$26,136						$26,136	CDFW
	SONCC-UKR.5.1.22.4	$39,775	$39,775	$39,775	$39,775	$39,775	$39,775	$238,650	CDFW
	Action Total:	*$678,632*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$877,507*	
SONCC-UKR.3.1.8									
	SONCC-UKR.3.1.8.1	$0						$0	SWRCB
	SONCC-UKR.3.1.8.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-UKR.3.2.10									
	SONCC-UKR.3.2.10.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-UKR.3.1.76									
	SONCC-UKR.3.1.76.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	SWRCB
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-UKR.3.1.64									
	SONCC-UKR.3.1.64.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	SWRCB
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-UKR.3.1.67									
	SONCC-UKR.3.1.67.1	$36,077						$36,077	CDFW
	SONCC-UKR.3.1.67.2	$36,077						$36,077	CDFW
	SONCC-UKR.3.1.67.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-UKR.7.1.82									
	SONCC-UKR.7.1.82.1	$17,008						$17,008	NRCS/RCD
	SONCC-UKR.7.1.82.2	$17,008						$17,008	NRCS/RCD
	SONCC-UKR.7.1.82.3	$1,571,372						$1,571,372	NRCS/RCD
	SONCC-UKR.7.1.82.4	$53,119						$53,119	NRCS/RCD
	SONCC-UKR.7.1.82.5	$2,125						$2,125	NRCS/RCD
	Action Total:	*$1,660,630*						*$1,660,630*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UKR.7.1.13									
	SONCC-UKR.7.1.13.1	$17,008						$17,008	NRCS/RCD
	SONCC-UKR.7.1.13.2	$17,008						$17,008	NRCS/RCD
	SONCC-UKR.7.1.13.3	$1,571,372						$1,571,372	NRCS/RCD
	SONCC-UKR.7.1.13.4	$53,119						$53,119	NRCS/RCD
	SONCC-UKR.7.1.13.5	$2,125						$2,125	NRCS/RCD
	Action Total:	*$1,660,630*						*$1,660,630*	
SONCC-UKR.8.2.27									
	SONCC-UKR.8.2.27.1	$36,770						$36,770	BIA/Tribe
	SONCC-UKR.8.2.27.2	$336,000	$336,000	$336,000	$336,000	$336,000	$336,000	$2,016,000	BIA/Tribe
	Action Total:	*$372,770*	*$336,000*	*$336,000*	*$336,000*	*$336,000*	*$336,000*	*$2,052,770*	
SONCC-UKR.8.1.84									
	SONCC-UKR.8.1.84.1	$238,139						$238,139	USFS
	SONCC-UKR.8.1.84.2	$9,055,305						$9,055,305	USFS
	Action Total:	*$9,293,444*						*$9,293,444*	
SONCC-UKR.8.1.29									
	SONCC-UKR.8.1.29.1	$238,139						$238,139	USFS
	SONCC-UKR.8.1.29.2	$9,055,305						$9,055,305	USFS
	Action Total:	*$9,293,444*						*$9,293,444*	
SONCC-UKR.10.2.69									
	SONCC-UKR.10.2.69.1	$17,008						$17,008	CDFW
	SONCC-UKR.10.2.69.2	$38,068						$38,068	CDFW
	Action Total:	*$55,076*						*$55,076*	
SONCC-UKR.10.2.51									
	SONCC-UKR.10.2.51.1	$17,008						$17,008	CDFW
	SONCC-UKR.10.2.51.2	$38,068						$38,068	CDFW
	Action Total:	*$55,076*						*$55,076*	
SONCC-UKR.10.7.70									
	SONCC-UKR.10.7.70.1	$8,504						$8,504	CDFW
	SONCC-UKR.10.7.70.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-UKR.10.7.63									
	SONCC-UKR.10.7.63.1	$8,504						$8,504	CDFW
	SONCC-UKR.10.7.63.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-UKR.16.1.30									
	SONCC-UKR.16.1.30.1	$34,015						$34,015	NMFS
	SONCC-UKR.16.1.30.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UKR.16.1.31									
	SONCC-UKR.16.1.31.1	$34,015						$34,015	NMFS
	SONCC-UKR.16.1.31.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UKR.16.1.61									
	SONCC-UKR.16.1.61.1	$34,015						$34,015	NMFS
	SONCC-UKR.16.1.61.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UKR.16.1.62									
	SONCC-UKR.16.1.62.1	$34,015						$34,015	BIA/Tribe
	SONCC-UKR.16.1.62.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-UKR.16.2.32									
	SONCC-UKR.16.2.32.1	$34,015						$34,015	NMFS
	SONCC-UKR.16.2.32.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UKR.16.2.33									
	SONCC-UKR.16.2.33.1	$34,015						$34,015	NMFS
	SONCC-UKR.16.2.33.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UKR.27.2.56									
	SONCC-UKR.27.2.56.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-UKR.27.2.57									
	SONCC-UKR.27.2.57.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-UKR.27.2.59									
	SONCC-UKR.27.2.59.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-UKR.27.2.42									
	SONCC-UKR.27.2.42.1	$136,060						$136,060	CDFW
	SONCC-UKR.27.2.42.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-UKR.27.2.43									
	SONCC-UKR.27.2.43.1	$6,012,619		$6,012,619		$6,012,619		$18,037,857	CDFW
	Action Total:	*$6,012,619*		*$6,012,619*		*$6,012,619*		*$18,037,857*	
SONCC-UKR.27.2.44									
	SONCC-UKR.27.2.44.1	$6,012,619		$6,012,619		$6,012,619		$18,037,857	CDFW
	Action Total:	*$6,012,619*		*$6,012,619*		*$6,012,619*		*$18,037,857*	
SONCC-UKR.27.2.45									
	SONCC-UKR.27.2.45.1	$6,012,619		$6,012,619		$6,012,619		$18,037,857	CDFW
	Action Total:	*$6,012,619*		*$6,012,619*		*$6,012,619*		*$18,037,857*	
SONCC-UKR.27.2.46									
	SONCC-UKR.27.2.46.1	$6,012,619		$6,012,619		$6,012,619		$18,037,857	CDFW
	Action Total:	*$6,012,619*		*$6,012,619*		*$6,012,619*		*$18,037,857*	
SONCC-UKR.27.2.47									
	SONCC-UKR.27.2.47.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-UKR.27.2.47.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-UKR.27.2.60									
	SONCC-UKR.27.2.60.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UKR.27.1.58									
	SONCC-UKR.27.1.58.1	$212,355	$212,355	$212,355	$212,355	$212,355	$212,355	$1,274,130	CDFW
	Action Total:	*$212,355*	*$212,355*	*$212,355*	*$212,355*	*$212,355*	*$212,355*	*$1,274,130*	
SONCC-UKR.27.1.50									
	SONCC-UKR.27.1.50.1	$34,015						$34,015	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UKR.27.1.50.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-UKR.27.1.34									
	SONCC-UKR.27.1.34.1	$34,015						$34,015	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-UKR.27.1.35									
	SONCC-UKR.27.1.35.1	$637,065	$637,065	$637,065	$637,065	$637,065	$637,065	$3,822,390	CDFW
	Action Total:	*$637,065*	*$637,065*	*$637,065*	*$637,065*	*$637,065*	*$637,065*	*$3,822,390*	
SONCC-UKR.27.1.36									
	SONCC-UKR.27.1.36.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-UKR.27.1.37									
	SONCC-UKR.27.1.37.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-UKR.27.1.38									
	SONCC-UKR.27.1.38.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UKR.27.1.39									
	SONCC-UKR.27.1.39.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UKR.27.1.40									
	SONCC-UKR.27.1.40.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UKR.27.1.41									
	SONCC-UKR.27.1.41.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UKR.27.4.52									
	SONCC-UKR.27.4.52.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-UKR.27.4.53									
	SONCC-UKR.27.4.53.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-UKR.27.4.54									
	SONCC-UKR.27.4.54.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-UKR.27.4.55									
	SONCC-UKR.27.4.55.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-UKR.5.1.23									
	SONCC-UKR.5.1.23.1							$0	BIA/Tribe
	SONCC-UKR.5.1.23.2							$0	BIA/Tribe
	Action Total:							*$0*	
SONCC-UKR.3.1.7									
	SONCC-UKR.3.1.7.1							$0	NGO
	Action Total:							*$0*	
SONCC-UKR.7.1.14									
	SONCC-UKR.7.1.14.1							$0	USFS
	SONCC-UKR.7.1.14.2							$0	USFS
	SONCC-UKR.7.1.14.3							$0	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:							*$0*	
SONCC-UKR.7.1.15									
	SONCC-UKR.7.1.15.1							$0	USFS
	SONCC-UKR.7.1.15.2							$0	USFS
	Action Total:							*$0*	
	Population Total:	***$594,582,758***	***$3,698,505***	***$27,711,316***	***$3,606,580***	***$27,711,316***	***$10,300,558***	***$667,611,033***	
Population: Upper Mainstem Eel River									
SONCC-UMER.5.2.59									
	SONCC-UMER.5.2.59.1	$34,015						$34,015	CDFW
	SONCC-UMER.5.2.59.2	$5,682						$5,682	CDFW
	Action Total:	*$39,697*						*$39,697*	
SONCC-UMER.5.2.7									
	SONCC-UMER.5.2.7.1	$34,015						$34,015	CDFW
	SONCC-UMER.5.2.7.2	$5,682						$5,682	CDFW
	Action Total:	*$39,697*						*$39,697*	
SONCC-UMER.10.1.52									
	SONCC-UMER.10.1.52.1	$17,008						$17,008	CDFW
	SONCC-UMER.10.1.52.2	$246,533						$246,533	CDFW
	Action Total:	*$263,540*						*$263,540*	
SONCC-UMER.10.1.33									
	SONCC-UMER.10.1.33.1	$17,008						$17,008	CDFW
	SONCC-UMER.10.1.33.2	$246,533						$246,533	CDFW
	Action Total:	*$263,540*						*$263,540*	
SONCC-UMER.1.2.29									
	SONCC-UMER.1.2.29.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-UMER.3.1.34									
	SONCC-UMER.3.1.34.1	$34,015						$34,015	CDFW
	SONCC-UMER.3.1.34.2	$0						$0	CDFW
	Action Total:	*$34,015*						*$34,015*	
SONCC-UMER.3.1.39									
	SONCC-UMER.3.1.39.1	$73,540						$73,540	CDFW
	SONCC-UMER.3.1.39.2	$36,770						$36,770	CDFW
	SONCC-UMER.3.1.39.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-UMER.3.1.3									
	SONCC-UMER.3.1.3.1	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-UMER.3.1.4									
	SONCC-UMER.3.1.4.1	$76,136						$76,136	CDFW
	Action Total:	*$76,136*						*$76,136*	
SONCC-UMER.3.1.5									
	SONCC-UMER.3.1.5.1	$0						$0	NRCS/RCD
	Action Total:	*$0*						*$0*	
SONCC-UMER.3.1.6									
	SONCC-UMER.3.1.6.1	$76,136						$76,136	NRCS/RCD
	Action Total:	*$76,136*						*$76,136*	
SONCC-UMER.2.1.32									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UMER.2.1.32.1	$17,008						$17,008	CDFW
	SONCC-UMER.2.1.32.2	$115,041						$115,041	CDFW
	Action Total:	*$132,048*						*$132,048*	
SONCC-UMER.2.1.55									
	SONCC-UMER.2.1.55.1	$17,008						$17,008	CDFW
	SONCC-UMER.2.1.55.2	$115,041						$115,041	CDFW
	Action Total:	*$132,048*						*$132,048*	
SONCC-UMER.2.1.10									
	SONCC-UMER.2.1.10.1	$17,008						$17,008	CDFW
	SONCC-UMER.2.1.10.2	$246,533						$246,533	CDFW
	Action Total:	*$263,540*						*$263,540*	
SONCC-UMER.8.1.14									
	SONCC-UMER.8.1.14.1	$543,918						$543,918	USFS
	SONCC-UMER.8.1.14.2	$11,524,742						$11,524,742	USFS
	SONCC-UMER.8.1.14.3	$2,357,908						$2,357,908	USFS
	SONCC-UMER.8.1.14.4	$1,724,858				$1,724,858		$3,449,716	USFS
	Action Total:	*$16,151,426*				*$1,724,858*		*$17,876,284*	
SONCC-UMER.14.2.8									
	SONCC-UMER.14.2.8.1	$34,015						$34,015	CDFW
	SONCC-UMER.14.2.8.2	$1,799,158						$1,799,158	CDFW
	Action Total:	*$1,833,173*						*$1,833,173*	
SONCC-UMER.3.1.1									
	SONCC-UMER.3.1.1.1	$34,015						$34,015	FERC
	SONCC-UMER.3.1.1.2	$34,015						$34,015	FERC
	Action Total:	*$68,030*						*$68,030*	
SONCC-UMER.5.1.2									
	SONCC-UMER.5.1.2.1	$230,650						$230,650	NMFS
	SONCC-UMER.5.1.2.2	$230,650						$230,650	NMFS
	SONCC-UMER.5.1.2.3	$2,215,850						$2,215,850	NMFS
	Action Total:	*$2,677,150*						*$2,677,150*	
SONCC-UMER.7.1.11									
	SONCC-UMER.7.1.11.1	$34,015						$34,015	NRCS/RCD
	SONCC-UMER.7.1.11.2	$86,292						$86,292	NRCS/RCD
	SONCC-UMER.7.1.11.3	$627,912						$627,912	NRCS/RCD
	Action Total:	*$748,219*						*$748,219*	
SONCC-UMER.2.1.38									
	SONCC-UMER.2.1.38.1	$17,008						$17,008	CDFW
	SONCC-UMER.2.1.38.2	$616,332						$616,332	CDFW
	Action Total:	*$633,339*						*$633,339*	
SONCC-UMER.2.1.57									
	SONCC-UMER.2.1.57.1	$17,008						$17,008	CDFW
	SONCC-UMER.2.1.57.2	$616,332						$616,332	CDFW
	Action Total:	*$633,339*						*$633,339*	
SONCC-UMER.10.7.53									
	SONCC-UMER.10.7.53.1	$8,504						$8,504	CDFW
	SONCC-UMER.10.7.53.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UMER.10.7.51									
	SONCC-UMER.10.7.51.1	$8,504						$8,504	CDFW
	SONCC-UMER.10.7.51.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-UMER.3.1.35									
	SONCC-UMER.3.1.35.1	$39,775	$39,775	$39,775	$39,775	$39,775	$39,775	$238,650	NGO
	Action Total:	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$238,650*	
SONCC-UMER.7.1.12									
	SONCC-UMER.7.1.12.1	$5,669						$5,669	CDF
	Action Total:	*$5,669*						*$5,669*	
SONCC-UMER.7.1.13									
	SONCC-UMER.7.1.13.1	$18,200						$18,200	USFS
	SONCC-UMER.7.1.13.2	$898,560						$898,560	USFS
	Action Total:	*$916,760*						*$916,760*	
SONCC-UMER.16.1.16									
	SONCC-UMER.16.1.16.1	$34,015						$34,015	NMFS
	SONCC-UMER.16.1.16.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UMER.16.1.17									
	SONCC-UMER.16.1.17.1	$34,015						$34,015	NMFS
	SONCC-UMER.16.1.17.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UMER.16.2.18									
	SONCC-UMER.16.2.18.1	$34,015						$34,015	NMFS
	SONCC-UMER.16.2.18.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UMER.16.2.19									
	SONCC-UMER.16.2.19.1	$34,015						$34,015	NMFS
	SONCC-UMER.16.2.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UMER.27.2.42									
	SONCC-UMER.27.2.42.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-UMER.27.2.43									
	SONCC-UMER.27.2.43.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-UMER.27.2.43.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-UMER.27.2.48									
	SONCC-UMER.27.2.48.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-UMER.27.2.49									
	SONCC-UMER.27.2.49.1	$68,030						$68,030	CDFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-UMER.27.2.40									
	SONCC-UMER.27.2.40.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-UMER.27.2.41									
	SONCC-UMER.27.2.41.1	$34,015		$34,015		$34,015		$102,045	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-UMER.27.2.24									
	SONCC-UMER.27.2.24.1	$136,060						$136,060	CDFW
	SONCC-UMER.27.2.24.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-UMER.27.2.25									
	SONCC-UMER.27.2.25.1	$97,596		$97,596		$97,596		$292,788	CDFW
	Action Total:	*$97,596*		*$97,596*		*$97,596*		*$292,788*	
SONCC-UMER.27.2.26									
	SONCC-UMER.27.2.26.1	$97,596		$97,596		$97,596		$292,788	CDFW
	Action Total:	*$97,596*		*$97,596*		*$97,596*		*$292,788*	
SONCC-UMER.27.2.27									
	SONCC-UMER.27.2.27.1	$97,596		$97,596		$97,596		$292,788	CDFW
	Action Total:	*$97,596*		*$97,596*		*$97,596*		*$292,788*	
SONCC-UMER.27.2.28									
	SONCC-UMER.27.2.28.1	$97,596		$97,596		$97,596		$292,788	CDFW
	Action Total:	*$97,596*		*$97,596*		*$97,596*		*$292,788*	
SONCC-UMER.27.2.50									
	SONCC-UMER.27.2.50.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UMER.27.1.31									
	SONCC-UMER.27.1.31.1	$34,015						$34,015	NMFS
	SONCC-UMER.27.1.31.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-UMER.27.1.21									
	SONCC-UMER.27.1.21.1	$27,055	$27,055	$27,055	$27,055	$27,055	$27,055	$162,330	CDFW
	Action Total:	*$27,055*	*$27,055*	*$27,055*	*$27,055*	*$27,055*	*$27,055*	*$162,330*	
SONCC-UMER.27.1.22									
	SONCC-UMER.27.1.22.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UMER.27.1.23									
	SONCC-UMER.27.1.23.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-UMER.27.1.23.2	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	CDFW
	Action Total:	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$102,045*	*$612,270*	
SONCC-UMER.27.4.44									
	SONCC-UMER.27.4.44.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-UMER.27.4.45									
	SONCC-UMER.27.4.45.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-UMER.27.4.46									
	SONCC-UMER.27.4.46.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-UMER.27.4.47									
	SONCC-UMER.27.4.47.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
	Population Total:	***$26,987,457***	***$784,078***	***$1,228,722***	***$784,078***	***$2,953,580***	***$784,078***	***$33,521,990***	

Population: Upper Rogue River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-URR.12.1.50									
	SONCC-URR.12.1.50.1	$0						$0	ODA
	SONCC-URR.12.1.50.2	$0						$0	ODA
	SONCC-URR.12.1.50.3	$0						$0	ODA
	SONCC-URR.12.1.50.4	$0						$0	ODA
	SONCC-URR.12.1.50.5	$0						$0	ODA
	SONCC-URR.12.1.50.6	$0						$0	ODA
	Action Total:	*$0*						*$0*	
SONCC-URR.10.5.14									
	SONCC-URR.10.5.14.1	$68,030						$68,030	ODF
	SONCC-URR.10.5.14.2	$0						$0	ODF
	SONCC-URR.10.5.14.3	$0						$0	ODF
	SONCC-URR.10.5.14.4	$0						$0	ODF
	SONCC-URR.10.5.14.5	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	
SONCC-URR.3.1.4									
	SONCC-URR.3.1.4.1	$36,770						$36,770	OWRD
	Action Total:	*$36,770*						*$36,770*	
SONCC-URR.3.1.5									
	SONCC-URR.3.1.5.1	$73,540						$73,540	OWRD
	Action Total:	*$73,540*						*$73,540*	
SONCC-URR.3.1.6									
	SONCC-URR.3.1.6.1	$36,770						$36,770	OWRD
	Action Total:	*$36,770*						*$36,770*	
SONCC-URR.3.1.7									
	SONCC-URR.3.1.7.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-URR.22.3.47									
	SONCC-URR.22.3.47.1	$0						$0	County
	SONCC-URR.22.3.47.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-URR.2.1.70									
	SONCC-URR.2.1.70.1	$0						$0	BLM
	Action Total:	*$0*						*$0*	
SONCC-URR.2.1.71									
	SONCC-URR.2.1.71.1	$17,008						$17,008	ODFW
	SONCC-URR.2.1.71.2	$21,366,150						$21,366,150	ODFW
	Action Total:	*$21,383,158*						*$21,383,158*	
SONCC-URR.2.1.49									
	SONCC-URR.2.1.49.1	$17,008						$17,008	ODFW
	SONCC-URR.2.1.49.2	$21,366,150						$21,366,150	ODFW
	Action Total:	*$21,383,158*						*$21,383,158*	
SONCC-URR.2.1.11									
	SONCC-URR.2.1.11.1	$0						$0	BLM
	Action Total:	*$0*						*$0*	
SONCC-URR.2.2.72									
	SONCC-URR.2.2.72.1	$17,008						$17,008	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-URR.2.2.72.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-URR.2.2.72.3	$15,000						$15,000	ODFW
	Action Total:	*$117,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$542,233*	
SONCC-URR.2.2.73									
	SONCC-URR.2.2.73.1	$17,008						$17,008	FSA
	SONCC-URR.2.2.73.2	$3,988,062						$3,988,062	FSA
	Action Total:	*$4,005,070*						*$4,005,070*	
SONCC-URR.2.2.9									
	SONCC-URR.2.2.9.1	$17,008						$17,008	FSA
	SONCC-URR.2.2.9.2	$3,988,062						$3,988,062	FSA
	Action Total:	*$4,005,070*						*$4,005,070*	
SONCC-URR.2.2.10									
	SONCC-URR.2.2.10.1	$17,008						$17,008	ODFW
	SONCC-URR.2.2.10.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-URR.2.2.10.3	$15,000						$15,000	ODFW
	Action Total:	*$117,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$542,233*	
SONCC-URR.3.1.74									
	SONCC-URR.3.1.74.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	OWRD
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-URR.3.1.75									
	SONCC-URR.3.1.75.1	$18,385						$18,385	OWRD
	SONCC-URR.3.1.75.2	$36,770						$36,770	OWRD
	Action Total:	*$55,155*						*$55,155*	
SONCC-URR.3.1.44									
	SONCC-URR.3.1.44.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-URR.3.1.65									
	SONCC-URR.3.1.65.1	$123,500	$123,500	$123,500	$123,500	$123,500	$123,500	$741,000	OWRD
	Action Total:	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$123,500*	*$741,000*	
SONCC-URR.3.1.67									
	SONCC-URR.3.1.67.1	$18,385						$18,385	OWRD
	SONCC-URR.3.1.67.2	$36,770						$36,770	OWRD
	Action Total:	*$55,155*						*$55,155*	
SONCC-URR.26.1.66									
	SONCC-URR.26.1.66.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-URR.10.2.43									
	SONCC-URR.10.2.43.1	$76,136						$76,136	ODEQ
	SONCC-URR.10.2.43.2	$0						$0	ODEQ
	Action Total:	*$76,136*						*$76,136*	
SONCC-URR.10.2.48									
	SONCC-URR.10.2.48.1	$0						$0	County
	SONCC-URR.10.2.48.2	$0						$0	County
	SONCC-URR.10.2.48.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-URR.10.1.12									
	SONCC-URR.10.1.12.1	$0						$0	County
	SONCC-URR.10.1.12.2	$0						$0	County

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$0*						*$0*	
SONCC-URR.10.1.13									
	SONCC-URR.10.1.13.1	$34,015						$34,015	USFS
	SONCC-URR.10.1.13.3	$21,628,080						$21,628,080	USFS
	Action Total:	*$21,662,095*						*$21,662,095*	
SONCC-URR.2.2.61									
	SONCC-URR.2.2.61.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-URR.5.1.76									
	SONCC-URR.5.1.76.1	$17,008						$17,008	County
	SONCC-URR.5.1.76.2	$1,351,740						$1,351,740	County
	Action Total:	*$1,368,747*						*$1,368,747*	
SONCC-URR.5.1.20									
	SONCC-URR.5.1.20.1	$17,008						$17,008	County
	SONCC-URR.5.1.20.2	$1,351,740						$1,351,740	County
	Action Total:	*$1,368,747*						*$1,368,747*	
SONCC-URR.10.5.37									
	SONCC-URR.10.5.37.1	$0						$0	BLM
	Action Total:	*$0*						*$0*	
SONCC-URR.7.1.77									
	SONCC-URR.7.1.77.1	$17,008						$17,008	NRCS/RCD
	SONCC-URR.7.1.77.2	$85,038						$85,038	NRCS/RCD
	SONCC-URR.7.1.77.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-URR.7.1.45									
	SONCC-URR.7.1.45.1	$17,008						$17,008	NRCS/RCD
	SONCC-URR.7.1.45.2	$85,038						$85,038	NRCS/RCD
	SONCC-URR.7.1.45.3	$85,038						$85,038	NRCS/RCD
	Action Total:	*$187,083*						*$187,083*	
SONCC-URR.8.1.1									
	SONCC-URR.8.1.1.1	$9,080,364						$9,080,364	NGO
	SONCC-URR.8.1.1.2	$39,878,000						$39,878,000	NGO
	SONCC-URR.8.1.1.3	$14,535,000						$14,535,000	NGO
	SONCC-URR.8.1.1.4	$2,389,000					$2,389,000	$4,778,000	NGO
	Action Total:	*$65,882,364*					*$2,389,000*	*$68,271,364*	
SONCC-URR.8.1.2									
	SONCC-URR.8.1.2.1	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-URR.10.2.42									
	SONCC-URR.10.2.42.1	$22,963						$22,963	ODFW
	SONCC-URR.10.2.42.2	$38,068						$38,068	ODFW
	Action Total:	*$61,031*						*$61,031*	
SONCC-URR.10.2.68									
	SONCC-URR.10.2.68.1	$22,963						$22,963	ODFW
	SONCC-URR.10.2.68.2	$38,068						$38,068	ODFW
	Action Total:	*$61,031*						*$61,031*	
SONCC-URR.10.7.69									
	SONCC-URR.10.7.69.1	$8,504						$8,504	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-URR.10.7.69.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-URR.10.7.64									
	SONCC-URR.10.7.64.1	$8,504						$8,504	ODFW
	SONCC-URR.10.7.64.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-URR.3.1.8									
	SONCC-URR.3.1.8.1	$36,770						$36,770	USACE
	SONCC-URR.3.1.8.2	$36,770						$36,770	USACE
	Action Total:	*$73,540*						*$73,540*	
SONCC-URR.1.2.39									
	SONCC-URR.1.2.39.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-URR.7.1.46									
	SONCC-URR.7.1.46.1	$170,075						$170,075	USFS
	Action Total:	*$170,075*						*$170,075*	
SONCC-URR.16.1.21									
	SONCC-URR.16.1.21.1	$34,015						$34,015	NMFS
	SONCC-URR.16.1.21.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-URR.16.1.22									
	SONCC-URR.16.1.22.1	$34,015						$34,015	NMFS
	SONCC-URR.16.1.22.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-URR.16.2.23									
	SONCC-URR.16.2.23.1	$34,015						$34,015	NMFS
	SONCC-URR.16.2.23.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-URR.16.2.24									
	SONCC-URR.16.2.24.1	$34,015						$34,015	NMFS
	SONCC-URR.16.2.24.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-URR.10.2.15									
	SONCC-URR.10.2.15.1	$76,136						$76,136	County
	Action Total:	*$76,136*						*$76,136*	
SONCC-URR.14.2.19									
	SONCC-URR.14.2.19.1	$68,030						$68,030	ODFW
	SONCC-URR.14.2.19.2	$2,068,150						$2,068,150	ODFW
	Action Total:	*$2,136,180*						*$2,136,180*	
SONCC-URR.10.7.63									
	SONCC-URR.10.7.63.1	$17,008						$17,008	ODFW
	SONCC-URR.10.7.63.2	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$119,258*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$630,508*	
SONCC-URR.27.2.55									
	SONCC-URR.27.2.55.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-URR.27.2.56									
	SONCC-URR.27.2.56.1	$68,030						$68,030	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$68,030*						*$68,030*	
SONCC-URR.27.2.58									
	SONCC-URR.27.2.58.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-URR.27.2.62									
	SONCC-URR.27.2.62.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-URR.27.2.30									
	SONCC-URR.27.2.30.1	$136,060						$136,060	ODFW
	SONCC-URR.27.2.30.2		$81,800		$81,800		$81,800	$245,400	ODFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-URR.27.2.31									
	SONCC-URR.27.2.31.1	$27,933,736		$27,933,736		$27,933,736		$83,801,208	ODFW
	Action Total:	*$27,933,736*		*$27,933,736*		*$27,933,736*		*$83,801,208*	
SONCC-URR.27.2.32									
	SONCC-URR.27.2.32.1	$27,933,736		$27,933,736		$27,933,736		$83,801,208	ODFW
	Action Total:	*$27,933,736*		*$27,933,736*		*$27,933,736*		*$83,801,208*	
SONCC-URR.27.2.33									
	SONCC-URR.27.2.33.1	$27,933,736		$27,933,736		$27,933,736		$83,801,208	ODFW
	Action Total:	*$27,933,736*		*$27,933,736*		*$27,933,736*		*$83,801,208*	
SONCC-URR.27.2.34									
	SONCC-URR.27.2.34.1	$27,933,736		$27,933,736		$27,933,736		$83,801,208	ODFW
	Action Total:	*$27,933,736*		*$27,933,736*		*$27,933,736*		*$83,801,208*	
SONCC-URR.27.2.35									
	SONCC-URR.27.2.35.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	ODFW
	Action Total:	*$65,911*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$264,786*	
SONCC-URR.27.1.38									
	SONCC-URR.27.1.38.1	$457,715	$457,715	$457,715	$457,715	$457,715	$457,715	$2,746,290	ODFW
	Action Total:	*$457,715*	*$457,715*	*$457,715*	*$457,715*	*$457,715*	*$457,715*	*$2,746,290*	
SONCC-URR.27.1.41									
	SONCC-URR.27.1.41.1	$34,015						$34,015	NMFS
	SONCC-URR.27.1.41.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-URR.27.1.60									
	SONCC-URR.27.1.60.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	ODFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-URR.27.1.25									
	SONCC-URR.27.1.25.1	$1,373,145	$1,373,145	$1,373,145	$1,373,145	$1,373,145	$1,373,145	$8,238,870	ODFW
	Action Total:	*$1,373,145*	*$1,373,145*	*$1,373,145*	*$1,373,145*	*$1,373,145*	*$1,373,145*	*$8,238,870*	
SONCC-URR.27.1.26									
	SONCC-URR.27.1.26.1	$68,030		$68,030		$68,030		$204,090	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-URR.27.1.27									
	SONCC-URR.27.1.27.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-URR.27.1.28									
	SONCC-URR.27.1.28.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-URR.27.1.29									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-URR.27.1.29.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-URR.27.4.51									
	SONCC-URR.27.4.51.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-URR.27.4.52									
	SONCC-URR.27.4.52.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-URR.27.4.53									
	SONCC-URR.27.4.53.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-URR.27.4.54									
	SONCC-URR.27.4.54.1	$34,015		$34,015		$34,015		$102,045	ODFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-URR.27.4.57									
	SONCC-URR.27.4.57.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-URR.27.4.59									
	SONCC-URR.27.4.59.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$261,288,821***	***$4,376,970***	***$116,166,174***	***$4,376,970***	***$116,166,174***	***$6,765,970***	***$509,141,079***	
Population: Upper Trinity River									
SONCC-UTR.3.1.18									
	SONCC-UTR.3.1.18.1	$0						$0	SWRCB
	SONCC-UTR.3.1.18.2	$0						$0	SWRCB
	Action Total:	*$0*						*$0*	
SONCC-UTR.3.1.20									
	SONCC-UTR.3.1.20.1	$36,770						$36,770	SWRCB
	Action Total:	*$36,770*						*$36,770*	
SONCC-UTR.3.1.65									
	SONCC-UTR.3.1.65.1	$175,000						$175,000	CDFW
	SONCC-UTR.3.1.65.2	$12,500	$12,500	$12,500	$12,500	$12,500	$12,500	$75,000	CDFW
	Action Total:	*$187,500*	*$12,500*	*$12,500*	*$12,500*	*$12,500*	*$12,500*	*$250,000*	
SONCC-UTR.3.1.67									
	SONCC-UTR.3.1.67.1	$18,385						$18,385	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-UTR.3.1.36									
	SONCC-UTR.3.1.36.1	$175,000						$175,000	CDFW
	SONCC-UTR.3.1.36.2	$12,500	$12,500	$12,500	$12,500	$12,500	$12,500	$75,000	CDFW
	Action Total:	*$187,500*	*$12,500*	*$12,500*	*$12,500*	*$12,500*	*$12,500*	*$250,000*	
SONCC-UTR.3.1.37									
	SONCC-UTR.3.1.37.1	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$300,000	City
	Action Total:	*$50,000*	*$50,000*	*$50,000*	*$50,000*	*$50,000*	*$50,000*	*$300,000*	
SONCC-UTR.3.1.44									
	SONCC-UTR.3.1.44.1	$18,385						$18,385	SWRCB
	Action Total:	*$18,385*						*$18,385*	
SONCC-UTR.3.1.21									
	SONCC-UTR.3.1.21.1	$34,015						$34,015	SWRCB

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UTR.3.1.21.2	$34,015						$34,015	SWRCB
	Action Total:	*$68,030*						*$68,030*	
SONCC-UTR.17.2.1									
	SONCC-UTR.17.2.1.1	$68,030						$68,030	CDFW
	SONCC-UTR.17.2.1.2	$107,157	$5,112	$5,112	$5,112	$5,112	$5,112	$132,717	CDFW
	SONCC-UTR.17.2.1.3	$40,900	$40,900	$40,900	$40,900	$40,900	$40,900	$245,400	CDFW
	SONCC-UTR.17.2.1.4	$17,077						$17,077	CDFW
	SONCC-UTR.17.2.1.5	$34,015						$34,015	CDFW
	SONCC-UTR.17.2.1.6	$340,333	$340,333	$340,333	$340,333	$340,333	$340,333	$2,041,998	CDFW
	Action Total:	*$607,512*	*$386,345*	*$386,345*	*$386,345*	*$386,345*	*$386,345*	*$2,539,237*	
SONCC-UTR.5.1.35									
	SONCC-UTR.5.1.35.1	$44,540						$44,540	BOR
	SONCC-UTR.5.1.35.2	$1,227,227	$204,500	$204,500	$204,500	$204,500	$204,500	$2,249,727	BOR
	Action Total:	*$1,271,767*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$204,500*	*$2,294,267*	
SONCC-UTR.1.2.41									
	SONCC-UTR.1.2.41.1	$0						$0	BIA/Tribe
	Action Total:	*$0*						*$0*	
SONCC-UTR.3.1.59									
	SONCC-UTR.3.1.59.1	$36,077						$36,077	CDFW
	SONCC-UTR.3.1.59.2	$36,077						$36,077	CDFW
	SONCC-UTR.3.1.59.3	$36,077						$36,077	CDFW
	Action Total:	*$108,231*						*$108,231*	
SONCC-UTR.2.1.62									
	SONCC-UTR.2.1.62.1	$17,008						$17,008	CDFW
	SONCC-UTR.2.1.62.2	$4,382,800						$4,382,800	CDFW
	Action Total:	*$4,399,808*						*$4,399,808*	
SONCC-UTR.2.1.9									
	SONCC-UTR.2.1.9.1	$17,008						$17,008	CDFW
	SONCC-UTR.2.1.9.2	$4,382,800						$4,382,800	CDFW
	Action Total:	*$4,399,808*						*$4,399,808*	
SONCC-UTR.26.1.58									
	SONCC-UTR.26.1.58.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	CDFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-UTR.2.2.63									
	SONCC-UTR.2.2.63.1	$17,008						$17,008	CDFW
	SONCC-UTR.2.2.63.2	$818,064						$818,064	CDFW
	Action Total:	*$835,072*						*$835,072*	
SONCC-UTR.2.2.7									
	SONCC-UTR.2.2.7.1	$17,008						$17,008	CDFW
	SONCC-UTR.2.2.7.2	$818,064						$818,064	CDFW
	Action Total:	*$835,072*						*$835,072*	
SONCC-UTR.14.2.22									
	SONCC-UTR.14.2.22.1	$34,015						$34,015	CDFW
	SONCC-UTR.14.2.22.2	$5,112	$5,112	$5,112	$5,112	$5,112	$5,112	$30,672	CDFW
	Action Total:	*$39,127*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$5,112*	*$64,687*	
SONCC-UTR.10.1.60									
	SONCC-UTR.10.1.60.1	$18,385	$18,385	$18,385	$18,385	$18,385	$18,385	$110,310	USFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UTR.10.1.60.2	$18,385	$18,385	$18,385	$18,385	$18,385	$18,385	$110,310	USFS
	Action Total:	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$220,620*	
SONCC-UTR.10.1.14									
	SONCC-UTR.10.1.14.1	$18,385	$18,385	$18,385	$18,385	$18,385	$18,385	$110,310	USFS
	SONCC-UTR.10.1.14.2	$18,385	$18,385	$18,385	$18,385	$18,385	$18,385	$110,310	USFS
	Action Total:	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$36,770*	*$220,620*	
SONCC-UTR.3.1.66									
	SONCC-UTR.3.1.66.1	$17,008						$17,008	CDFW
	SONCC-UTR.3.1.66.2	$42,519	$42,519	$42,519	$42,519	$42,519	$42,519	$255,111	CDFW
	Action Total:	*$59,526*	*$42,519*	*$42,519*	*$42,519*	*$42,519*	*$42,519*	*$272,119*	
SONCC-UTR.3.1.38									
	SONCC-UTR.3.1.38.1	$17,008						$17,008	CDFW
	SONCC-UTR.3.1.38.2	$42,519	$42,519	$42,519	$42,519	$42,519	$42,519	$255,111	CDFW
	Action Total:	*$59,526*	*$42,519*	*$42,519*	*$42,519*	*$42,519*	*$42,519*	*$272,119*	
SONCC-UTR.3.1.45									
	SONCC-UTR.3.1.45.1	$73,540						$73,540	CDFW
	SONCC-UTR.3.1.45.2	$36,770						$36,770	CDFW
	SONCC-UTR.3.1.45.3	$73,540						$73,540	CDFW
	Action Total:	*$183,850*						*$183,850*	
SONCC-UTR.3.1.16									
	SONCC-UTR.3.1.16.1	$34,015						$34,015	NMFS
	SONCC-UTR.3.1.16.3	$18,385						$18,385	BOR
	Action Total:	*$52,400*						*$52,400*	
SONCC-UTR.3.1.17									
	SONCC-UTR.3.1.17.1	$76,136						$76,136	NGO
	Action Total:	*$76,136*						*$76,136*	
SONCC-UTR.5.1.68									
	SONCC-UTR.5.1.68.1	$22,270						$22,270	CDFW
	SONCC-UTR.5.1.68.2	$261,627						$261,627	CDFW
	Action Total:	*$283,897*						*$283,897*	
SONCC-UTR.5.1.69									
	SONCC-UTR.5.1.69.1	$22,270						$22,270	CDFW
	SONCC-UTR.5.1.69.2	$72,675						$72,675	CDFW
	Action Total:	*$94,945*						*$94,945*	
SONCC-UTR.5.1.10									
	SONCC-UTR.5.1.10.1	$22,270						$22,270	CDFW
	SONCC-UTR.5.1.10.2	$261,627						$261,627	CDFW
	Action Total:	*$283,897*						*$283,897*	
SONCC-UTR.5.1.11									
	SONCC-UTR.5.1.11.1	$22,270						$22,270	CDFW
	SONCC-UTR.5.1.11.2	$72,675						$72,675	CDFW
	Action Total:	*$94,945*						*$94,945*	
SONCC-UTR.2.2.64									
	SONCC-UTR.2.2.64.1	$27,008						$27,008	CDFW
	SONCC-UTR.2.2.64.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-UTR.2.2.8									
	SONCC-UTR.2.2.8.1	$13,504						$13,504	CDFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-UTR.2.2.8.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$98,541*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$523,729*	
SONCC-UTR.10.1.13									
	SONCC-UTR.10.1.13.1	$36,770						$36,770	BOR
	SONCC-UTR.10.1.13.2	$45,962	$45,962	$45,962	$45,962	$45,962	$45,962	$275,772	BOR
	Action Total:	*$82,732*	*$45,962*	*$45,962*	*$45,962*	*$45,962*	*$45,962*	*$312,542*	
SONCC-UTR.10.7.61									
	SONCC-UTR.10.7.61.1	$8,504						$8,504	CDFW
	SONCC-UTR.10.7.61.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-UTR.10.7.57									
	SONCC-UTR.10.7.57.1	$8,504						$8,504	CDFW
	SONCC-UTR.10.7.57.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-UTR.16.1.23									
	SONCC-UTR.16.1.23.1	$34,015						$34,015	NMFS
	SONCC-UTR.16.1.23.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UTR.16.1.24									
	SONCC-UTR.16.1.24.1	$34,015						$34,015	NMFS
	SONCC-UTR.16.1.24.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UTR.16.1.55									
	SONCC-UTR.16.1.55.1	$34,015						$34,015	NMFS
	SONCC-UTR.16.1.55.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UTR.16.1.56									
	SONCC-UTR.16.1.56.1	$34,015						$34,015	BIA/Tribe
	SONCC-UTR.16.1.56.2	$34,015						$34,015	BIA/Tribe
	Action Total:	*$68,030*						*$68,030*	
SONCC-UTR.16.2.25									
	SONCC-UTR.16.2.25.1	$34,015						$34,015	NMFS
	SONCC-UTR.16.2.25.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UTR.16.2.26									
	SONCC-UTR.16.2.26.1	$34,015						$34,015	NMFS
	SONCC-UTR.16.2.26.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-UTR.2.2.43									
	SONCC-UTR.2.2.43.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-UTR.27.2.46									
	SONCC-UTR.27.2.46.1	$34,015		$34,015		$34,015		$102,045	CDFW
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-UTR.27.2.32									
	SONCC-UTR.27.2.32.1	$136,060						$136,060	CDFW
	SONCC-UTR.27.2.32.2		$81,800		$81,800		$81,800	$245,400	CDFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-UTR.27.2.33									
	SONCC-UTR.27.2.33.1	$137,947		$137,947		$137,947		$413,841	CDFW
	Action Total:	*$137,947*		*$137,947*		*$137,947*		*$413,841*	
SONCC-UTR.27.2.34									
	SONCC-UTR.27.2.34.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	CDFW
	SONCC-UTR.27.2.34.2	$34,015						$34,015	CDFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-UTR.27.2.54									
	SONCC-UTR.27.2.54.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UTR.27.1.40									
	SONCC-UTR.27.1.40.1	$32,165	$32,165	$32,165	$32,165	$32,165	$32,165	$192,990	CDFW
	Action Total:	*$32,165*	*$32,165*	*$32,165*	*$32,165*	*$32,165*	*$32,165*	*$192,990*	
SONCC-UTR.27.1.42									
	SONCC-UTR.27.1.42.1	$34,015						$34,015	NMFS
	SONCC-UTR.27.1.42.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-UTR.27.1.48									
	SONCC-UTR.27.1.48.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-UTR.27.1.27									
	SONCC-UTR.27.1.27.1	$96,496	$96,496	$96,496	$96,496	$96,496	$96,496	$578,976	CDFW
	Action Total:	*$96,496*	*$96,496*	*$96,496*	*$96,496*	*$96,496*	*$96,496*	*$578,976*	
SONCC-UTR.27.1.28									
	SONCC-UTR.27.1.28.1	$68,030		$68,030		$68,030		$204,090	CDFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-UTR.27.1.29									
	SONCC-UTR.27.1.29.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UTR.27.1.30									
	SONCC-UTR.27.1.30.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UTR.27.1.31									
	SONCC-UTR.27.1.31.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-UTR.27.1.53									
	SONCC-UTR.27.1.53.1	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$6,120,000	CDFW
	Action Total:	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$1,020,000*	*$6,120,000*	
SONCC-UTR.27.4.49									
	SONCC-UTR.27.4.49.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-UTR.27.4.50									
	SONCC-UTR.27.4.50.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-UTR.27.4.51									
	SONCC-UTR.27.4.51.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-UTR.27.4.52									
	SONCC-UTR.27.4.52.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
	Population Total:	***$17,400,504***	***$3,013,525***	***$3,171,717***	***$3,013,525***	***$3,171,716***	***$3,013,525***	***$32,784,510***	

Population: Wilson Creek

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-WilC.2.1.26									
	SONCC-WilC.2.1.26.1	$17,008						$17,008	NGO
	SONCC-WilC.2.1.26.2	$436,910						$436,910	NGO
	Action Total:	*$453,918*						*$453,918*	
SONCC-WilC.2.1.1									
	SONCC-WilC.2.1.1.1	$17,008						$17,008	NGO
	SONCC-WilC.2.1.1.2	$436,910						$436,910	NGO
	Action Total:	*$453,918*						*$453,918*	
SONCC-WilC.2.2.27									
	SONCC-WilC.2.2.27.1	$17,008						$17,008	CDFW
	SONCC-WilC.2.2.27.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-WilC.2.2.27.3	$10,000						$10,000	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-WilC.2.2.28									
	SONCC-WilC.2.2.28.1	$17,008						$17,008	NGO
	SONCC-WilC.2.2.28.2	$81,551						$81,551	NGO
	Action Total:	*$98,558*						*$98,558*	
SONCC-WilC.2.2.10									
	SONCC-WilC.2.2.10.1	$17,008						$17,008	CDFW
	SONCC-WilC.2.2.10.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	CDFW
	SONCC-WilC.2.2.10.3	$10,000						$10,000	CDFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-WilC.2.2.11									
	SONCC-WilC.2.2.11.1	$17,008						$17,008	NGO
	SONCC-WilC.2.2.11.2	$81,551						$81,551	NGO
	Action Total:	*$98,558*						*$98,558*	
SONCC-WilC.5.1.29									
	SONCC-WilC.5.1.29.1	$22,270						$22,270	NGO
	SONCC-WilC.5.1.29.2	$319,767						$319,767	NGO
	Action Total:	*$342,037*						*$342,037*	
SONCC-WilC.5.1.4									
	SONCC-WilC.5.1.4.1	$44,540						$44,540	CDFW
	SONCC-WilC.5.1.4.2	$639,534						$639,534	CDFW
	Action Total:	*$684,074*						*$684,074*	
SONCC-WilC.5.1.5									
	SONCC-WilC.5.1.5.1	$22,270						$22,270	NGO
	SONCC-WilC.5.1.5.2	$319,767						$319,767	NGO
	Action Total:	*$342,037*						*$342,037*	
SONCC-WilC.7.1.2									
	SONCC-WilC.7.1.2.1	$34,015						$34,015	Private
	SONCC-WilC.7.1.2.2	$60,724						$60,724	Private
	SONCC-WilC.7.1.2.3	$446,515						$446,515	Private
	Action Total:	*$541,254*						*$541,254*	
SONCC-WilC.2.2.21									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-WilC.2.2.21.1	$0						$0	CDFW
	Action Total:	*$0*						*$0*	
SONCC-WilC.8.1.30									
	SONCC-WilC.8.1.30.1	$2,099,057						$2,099,057	NGO
	Action Total:	*$2,099,057*						*$2,099,057*	
SONCC-WilC.8.1.7									
	SONCC-WilC.8.1.7.1	$2,099,057						$2,099,057	CDFW
	Action Total:	*$2,099,057*						*$2,099,057*	
SONCC-WilC.10.7.25									
	SONCC-WilC.10.7.25.1	$8,504						$8,504	CDFW
	SONCC-WilC.10.7.25.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-WilC.10.7.23									
	SONCC-WilC.10.7.23.1	$8,504						$8,504	CDFW
	SONCC-WilC.10.7.23.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	CDFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-WilC.7.1.3									
	SONCC-WilC.7.1.3.1	$0						$0	Private
	Action Total:	*$0*						*$0*	
SONCC-WilC.2.1.24									
	SONCC-WilC.2.1.24.1	$34,015						$34,015	CDFW
	SONCC-WilC.2.1.24.2	$68,030						$68,030	CDFW
	Action Total:	*$102,045*						*$102,045*	
SONCC-WilC.27.2.8									
	SONCC-WilC.27.2.8.1	$136,060						$136,060	CDFW
	SONCC-WilC.27.2.8.2			$81,800			$81,800	$163,600	CDFW
	Action Total:	*$136,060*		*$81,800*			*$81,800*	*$299,660*	
SONCC-WilC.27.2.15									
	SONCC-WilC.27.2.15.1	$10,069		$10,069		$10,069		$30,207	CDFW
	Action Total:	*$10,069*		*$10,069*		*$10,069*		*$30,207*	
SONCC-WilC.27.2.16									
	SONCC-WilC.27.2.16.1	$10,069		$10,069		$10,069		$30,207	CDFW
	Action Total:	*$10,069*		*$10,069*		*$10,069*		*$30,207*	
SONCC-WilC.27.2.17									
	SONCC-WilC.27.2.17.1	$10,069		$10,069		$10,069		$30,207	CDFW
	Action Total:	*$10,069*		*$10,069*		*$10,069*		*$30,207*	
SONCC-WilC.27.2.22									
	SONCC-WilC.27.2.22.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-WilC.27.1.20									
	SONCC-WilC.27.1.20.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-WilC.27.1.9									
	SONCC-WilC.27.1.9.1	$34,015						$34,015	CSP
	SONCC-WilC.27.1.9.2	$34,015						$34,015	CSP
	Action Total:	*$68,030*						*$68,030*	
SONCC-WilC.27.1.12									
	SONCC-WilC.27.1.12.1	$8,690	$8,690	$8,690	$8,690	$8,690	$8,690	$52,140	CDFW
	Action Total:	*$8,690*	*$8,690*	*$8,690*	*$8,690*	*$8,690*	*$8,690*	*$52,140*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-WilC.27.1.13									
	SONCC-WilC.27.1.13.1	$34,015						$34,015	NMFS
	SONCC-WilC.27.1.13.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-WilC.27.4.18									
	SONCC-WilC.27.4.18.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-WilC.27.4.19									
	SONCC-WilC.27.4.19.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-WilC.8.1.6									
	SONCC-WilC.8.1.6.1							$0	Private
	SONCC-WilC.8.1.6.2							$0	Private
	Action Total:							*$0*	
	Population Total:	***$8,138,951***	***$485,105***	***$597,112***	***$485,105***	***$515,312***	***$566,905***	***$10,788,489***	

Population: Winchuck River

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-WinR.10.6.46									
	SONCC-WinR.10.6.46.1	$0						$0	ODA
	SONCC-WinR.10.6.46.2	$0						$0	ODA
	SONCC-WinR.10.6.46.3	$0						$0	ODA
	SONCC-WinR.10.6.46.4	$0						$0	ODA
	SONCC-WinR.10.6.46.5	$0						$0	ODA
	SONCC-WinR.10.6.46.6	$0						$0	ODA
	Action Total:	*$0*						*$0*	
SONCC-WinR.19.1.47									
	SONCC-WinR.19.1.47.1	$68,030						$68,030	ODF
	SONCC-WinR.19.1.47.2	$0						$0	ODF
	SONCC-WinR.19.1.47.3	$0						$0	ODF
	SONCC-WinR.19.1.47.4	$0						$0	ODF
	SONCC-WinR.19.1.47.5	$0						$0	ODF
	Action Total:	*$68,030*						*$68,030*	
SONCC-WinR.2.1.63									
	SONCC-WinR.2.1.63.1	$17,008						$17,008	USFS
	SONCC-WinR.2.1.63.2	$372,538						$372,538	USFS
	Action Total:	*$389,546*						*$389,546*	
SONCC-WinR.2.1.7									
	SONCC-WinR.2.1.7.1	$17,008						$17,008	USFS
	SONCC-WinR.2.1.7.2	$372,538						$372,538	USFS
	Action Total:	*$389,546*						*$389,546*	
SONCC-WinR.2.2.64									
	SONCC-WinR.2.2.64.1	$17,008						$17,008	USFS
	SONCC-WinR.2.2.64.2	$69,535						$69,535	USFS
	Action Total:	*$86,543*						*$86,543*	
SONCC-WinR.2.2.65									
	SONCC-WinR.2.2.65.1	$17,008						$17,008	ODFW
	SONCC-WinR.2.2.65.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-WinR.2.2.65.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-WinR.2.2.5									
	SONCC-WinR.2.2.5.1	$17,008						$17,008	USFS
	SONCC-WinR.2.2.5.2	$69,535						$69,535	USFS
	Action Total:	*$86,543*						*$86,543*	
SONCC-WinR.2.2.6									
	SONCC-WinR.2.2.6.1	$17,008						$17,008	ODFW
	SONCC-WinR.2.2.6.2	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	SONCC-WinR.2.2.6.3	$10,000						$10,000	ODFW
	Action Total:	*$112,045*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$537,233*	
SONCC-WinR.2.4.42									
	SONCC-WinR.2.4.42.1	$34,015						$34,015	ODFW
	SONCC-WinR.2.4.42.2	$126,600						$126,600	ODFW
	Action Total:	*$160,615*						*$160,615*	
SONCC-WinR.10.4.60									
	SONCC-WinR.10.4.60.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-WinR.10.4.39									
	SONCC-WinR.10.4.39.1	$0						$0	OWRD
	Action Total:	*$0*						*$0*	
SONCC-WinR.2.5.43									
	SONCC-WinR.2.5.43.1	$44,540						$44,540	ODFW
	SONCC-WinR.2.5.43.2	$45,633						$45,633	ODFW
	Action Total:	*$90,173*						*$90,173*	
SONCC-WinR.2.7.66									
	SONCC-WinR.2.7.66.1	$17,008						$17,008	FSA
	SONCC-WinR.2.7.66.2	$85,038						$85,038	FSA
	SONCC-WinR.2.7.66.3	$85,038						$85,038	FSA
	Action Total:	*$187,083*						*$187,083*	
SONCC-WinR.2.7.4									
	SONCC-WinR.2.7.4.1	$17,008						$17,008	FSA
	SONCC-WinR.2.7.4.2	$85,038						$85,038	FSA
	SONCC-WinR.2.7.4.3	$85,038						$85,038	FSA
	Action Total:	*$187,083*						*$187,083*	
SONCC-WinR.22.3.40									
	SONCC-WinR.22.3.40.1	$0						$0	County
	SONCC-WinR.22.3.40.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-WinR.10.2.16									
	SONCC-WinR.10.2.16.1	$0						$0	EPA
	Action Total:	*$0*						*$0*	
SONCC-WinR.2.7.3									
	SONCC-WinR.2.7.3.1	$34,015						$34,015	USFS
	SONCC-WinR.2.7.3.3	$376,747						$376,747	USFS
	Action Total:	*$410,762*						*$410,762*	
SONCC-WinR.26.1.59									
	SONCC-WinR.26.1.59.1	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$306,750*	
SONCC-WinR.2.2.55									
	SONCC-WinR.2.2.55.1	$0						$0	ODFW
	Action Total:	*$0*						*$0*	
SONCC-WinR.10.2.38									
	SONCC-WinR.10.2.38.1	$76,136						$76,136	ODEQ
	SONCC-WinR.10.2.38.2	$0						$0	ODEQ
	Action Total:	*$76,136*						*$76,136*	
SONCC-WinR.10.2.41									
	SONCC-WinR.10.2.41.1	$0						$0	County
	SONCC-WinR.10.2.41.2	$0						$0	County
	SONCC-WinR.10.2.41.3	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-WinR.10.2.15									
	SONCC-WinR.10.2.15.1	$76,136						$76,136	OWRD
	Action Total:	*$76,136*						*$76,136*	
SONCC-WinR.28.3.67									
	SONCC-WinR.28.3.67.1	$22,270						$22,270	Watershed Cnsl
	SONCC-WinR.28.3.67.2	$190,909						$190,909	Watershed Cnsl
	Action Total:	*$213,179*						*$213,179*	
SONCC-WinR.28.3.12									
	SONCC-WinR.28.3.12.1	$22,270						$22,270	Watershed Cnsl
	SONCC-WinR.28.3.12.2	$190,909						$190,909	Watershed Cnsl
	Action Total:	*$213,179*						*$213,179*	
SONCC-WinR.1.2.30									
	SONCC-WinR.1.2.30.1	$34,015						$34,015	ODFW
	SONCC-WinR.1.2.30.2	$34,015						$34,015	ODFW
	SONCC-WinR.1.2.30.3	$341,075						$341,075	ODFW
	Action Total:	*$409,105*						*$409,105*	
SONCC-WinR.10.4.61									
	SONCC-WinR.10.4.61.1	$17,008						$17,008	OWRD
	SONCC-WinR.10.4.61.2	$13,068						$13,068	OWRD
	SONCC-WinR.10.4.61.3	$8,523	$8,523	$8,523	$8,523	$8,523	$8,523	$51,135	OWRD
	SONCC-WinR.10.4.61.4	$18,385						$18,385	OWRD
	Action Total:	*$56,983*	*$8,523*	*$8,523*	*$8,523*	*$8,523*	*$8,523*	*$99,596*	
SONCC-WinR.10.4.8									
	SONCC-WinR.10.4.8.1	$17,008						$17,008	OWRD
	SONCC-WinR.10.4.8.2	$13,068						$13,068	OWRD
	SONCC-WinR.10.4.8.3	$8,523	$8,523	$8,523	$8,523	$8,523	$8,523	$51,135	OWRD
	SONCC-WinR.10.4.8.4	$18,385						$18,385	OWRD
	Action Total:	*$56,983*	*$8,523*	*$8,523*	*$8,523*	*$8,523*	*$8,523*	*$99,596*	
SONCC-WinR.10.4.9									
	SONCC-WinR.10.4.9.1	$76,136						$76,136	OWRD
	Action Total:	*$76,136*						*$76,136*	
SONCC-WinR.3.1.58									
	SONCC-WinR.3.1.58.1	$36,770						$36,770	OWRD
	Action Total:	*$36,770*						*$36,770*	
SONCC-WinR.2.7.1									

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	SONCC-WinR.2.7.1.1	$0						$0	County
	SONCC-WinR.2.7.1.2	$0						$0	County
	Action Total:	*$0*						*$0*	
SONCC-WinR.28.1.13									
	SONCC-WinR.28.1.13.1	$150,909						$150,909	USFS
	SONCC-WinR.28.1.13.2	$1,276,096						$1,276,096	USFS
	SONCC-WinR.28.1.13.3	$225,293						$225,293	USFS
	SONCC-WinR.28.1.13.4	$370,295						$370,295	USFS
	Action Total:	*$2,022,593*						*$2,022,593*	
SONCC-WinR.10.7.62									
	SONCC-WinR.10.7.62.1	$8,504						$8,504	ODFW
	SONCC-WinR.10.7.62.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-WinR.10.7.57									
	SONCC-WinR.10.7.57.1	$8,504						$8,504	ODFW
	SONCC-WinR.10.7.57.2	$51,125	$51,125	$51,125	$51,125	$51,125	$51,125	$306,750	ODFW
	Action Total:	*$59,629*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$51,125*	*$315,254*	
SONCC-WinR.10.2.37									
	SONCC-WinR.10.2.37.1	$45,925						$45,925	ODFW
	SONCC-WinR.10.2.37.2	$76,136						$76,136	ODFW
	Action Total:	*$122,061*						*$122,061*	
SONCC-WinR.16.1.17									
	SONCC-WinR.16.1.17.1	$34,015						$34,015	NMFS
	SONCC-WinR.16.1.17.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-WinR.16.1.18									
	SONCC-WinR.16.1.18.1	$34,015						$34,015	NMFS
	SONCC-WinR.16.1.18.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-WinR.16.2.19									
	SONCC-WinR.16.2.19.1	$34,015						$34,015	NMFS
	SONCC-WinR.16.2.19.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-WinR.16.2.20									
	SONCC-WinR.16.2.20.1	$34,015						$34,015	NMFS
	SONCC-WinR.16.2.20.2	$34,015						$34,015	NMFS
	Action Total:	*$68,030*						*$68,030*	
SONCC-WinR.14.3.44									
	SONCC-WinR.14.3.44.1	$76,047						$76,047	NRCS/RCD
	Action Total:	*$76,047*						*$76,047*	
SONCC-WinR.27.2.52									
	SONCC-WinR.27.2.52.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-WinR.27.2.53									
	SONCC-WinR.27.2.53.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	NGO
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
SONCC-WinR.27.2.29									
	SONCC-WinR.27.2.29.1	$34,015		$34,015		$34,015		$102,045	ODFW

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
	Action Total:	*$34,015*		*$34,015*		*$34,015*		*$102,045*	
SONCC-WinR.27.2.34									
	SONCC-WinR.27.2.34.1	$65,911	$39,775	$39,775	$39,775	$39,775	$39,775	$264,786	ODFW
	SONCC-WinR.27.2.34.2	$34,015						$34,015	ODFW
	Action Total:	*$99,926*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$39,775*	*$298,801*	
SONCC-WinR.27.2.24									
	SONCC-WinR.27.2.24.1	$136,060						$136,060	ODFW
	SONCC-WinR.27.2.24.2		$81,800		$81,800		$81,800	$245,400	ODFW
	Action Total:	*$136,060*	*$81,800*		*$81,800*		*$81,800*	*$381,460*	
SONCC-WinR.27.2.25									
	SONCC-WinR.27.2.25.1	$106,400		$106,400		$106,400		$319,200	ODFW
	Action Total:	*$106,400*		*$106,400*		*$106,400*		*$319,200*	
SONCC-WinR.27.2.26									
	SONCC-WinR.27.2.26.1	$106,400		$106,400		$106,400		$319,200	ODFW
	Action Total:	*$106,400*		*$106,400*		*$106,400*		*$319,200*	
SONCC-WinR.27.2.27									
	SONCC-WinR.27.2.27.1	$106,400		$106,400		$106,400		$319,200	ODFW
	Action Total:	*$106,400*		*$106,400*		*$106,400*		*$319,200*	
SONCC-WinR.27.2.28									
	SONCC-WinR.27.2.28.1	$106,400		$106,400		$106,400		$319,200	ODFW
	Action Total:	*$106,400*		*$106,400*		*$106,400*		*$319,200*	
SONCC-WinR.27.2.56									
	SONCC-WinR.27.2.56.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-WinR.27.1.51									
	SONCC-WinR.27.1.51.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	NMFS
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-WinR.27.1.33									
	SONCC-WinR.27.1.33.1	$68,030		$68,030		$68,030		$204,090	ODFW
	Action Total:	*$68,030*		*$68,030*		*$68,030*		*$204,090*	
SONCC-WinR.27.1.35									
	SONCC-WinR.27.1.35.1	$34,015						$34,015	NMFS
	SONCC-WinR.27.1.35.2	$0						$0	NMFS
	Action Total:	*$34,015*						*$34,015*	
SONCC-WinR.27.1.36									
	SONCC-WinR.27.1.36.1	$68,030						$68,030	ODFW
	Action Total:	*$68,030*						*$68,030*	
SONCC-WinR.27.1.21									
	SONCC-WinR.27.1.21.1	$84,747	$84,747	$84,747	$84,747	$84,747	$84,747	$508,482	ODFW
	Action Total:	*$84,747*	*$84,747*	*$84,747*	*$84,747*	*$84,747*	*$84,747*	*$508,482*	
SONCC-WinR.27.1.22									
	SONCC-WinR.27.1.22.1	$28,249	$28,249	$28,249	$28,249	$28,249	$28,249	$169,494	ODFW
	Action Total:	*$28,249*	*$28,249*	*$28,249*	*$28,249*	*$28,249*	*$28,249*	*$169,494*	
SONCC-WinR.27.1.23									
	SONCC-WinR.27.1.23.1	$85,038	$85,038	$85,038	$85,038	$85,038	$85,038	$510,225	ODFW
	Action Total:	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$85,038*	*$510,225*	
SONCC-WinR.27.4.48									
	SONCC-WinR.27.4.48.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	

ActionID	Step ID	Cost 5yrs	Cost 10yrs	Cost 15yrs	Cost 20yrs	Cost 25yrs	Cost >25yrs	Total Cost	Potent. Lead
SONCC-WinR.27.4.49									
	SONCC-WinR.27.4.49.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-WinR.27.4.50									
	SONCC-WinR.27.4.50.1	$17,008	$17,008	$17,008	$17,008	$17,008	$17,008	$102,045	NMFS
	Action Total:	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$17,008*	*$102,045*	
SONCC-WinR.27.4.54									
	SONCC-WinR.27.4.54.1	$102,250	$102,250	$102,250	$102,250	$102,250	$102,250	$613,500	ODFW
	Action Total:	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$102,250*	*$613,500*	
	Population Total:	***$7,715,159***	***$1,085,701***	***$1,531,546***	***$1,085,701***	***$1,531,546***	***$1,085,701***	***$14,035,354***	
	ESU Total:	***$3,525,089,272***	***$82,051,639***	***$510,905,992***	***$77,709,714***	***$506,828,130***	***$257,160,106***	***$4,959,744,852***	

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Appendix H. Glossary and List of Abbreviations and Acronyms

H.1 Glossary

abundance: The number of individuals in a population or subpopulation.

adaptive management: In salmon recovery planning, a method of decision making in the face of uncertainty. A plan for monitoring, evaluation, and feedback is incorporated into an overall implementation plan so that the results of action can become feedback on design and implementation of future actions.

alevins: Larval life stage which lives in a redd and is dependent on food stored in a yolk sac.

anadromous: Species (e.g., salmon) that migrate as juveniles from freshwater to saltwater and then return as adults to spawn in freshwater.

anthropogenic: Of, relating to, or resulting from the influence of human beings on nature (Webster 2001).

artificial propagation: Any assistance provided by man in the reproduction of salmon. This assistance includes, but is not limited to, spawning and rearing in hatcheries, stock transfers, creation of spawning habitat, egg bank programs, captive breeding broodstock programs, and cryopreservation (Hard et al. 1992).

basin: Area of land where surface water converges to a single point, usually the exit of the basin, where the waters join another water body. Examples of basins are the Eel River basin, Rogue River basin, and Klamath-Trinity River basin. The basin is the largest classification unit in a hierarchical drainage system adopted by NMFS for the SONCC coho salmon ESU recovery plan. This hierarchical drainage system is made up of basins (largest scale), sub-basins (intermediate scale), and watersheds (smallest scale). See also *sub-basin* and *watershed*.

biological review team (BRT): The team of scientists from the National Marine Fisheries Service formed to conduct a status review.

broad-sense recovery: Goal of having populations of naturally produced salmon sufficiently abundant, productive, and diverse (in terms of life history and geographic distribution) that the ESU/DPS as a whole (a) will be self-sustaining, and (b) will provide significant ecological, cultural, and economic benefits (ODFW and NMFS 2011). This goal is consistent with ESA delisting, but is designed to achieve a level of performance for the ESUs and constituent population that is far more robust than that needed to remove the ESU from ESA protection (ODFW and NMFS 2011).

captive broodstock program: A form of artificial propagation involving the collection of individuals or gametes from a natural population and rearing of these individuals to maturity in captivity (Hard et al. 1992).

carrying capacity: The maximum population of a species that an area or specific ecosystem can support indefinitely without deterioration of the character and quality of the resource (NOAA 2006).

coefficient of variation (cv): the ratio of the standard deviation to the mean, which shows the extent of variability in relation to the mean.

confluence: A flowing together of two or more streams.

critical habitat: The specific areas within the geographical area occupied by the listed species at the time it is listed in accordance with the provisions of section 4 the ESA, on which are found those physical or biological features that are essential to the conservation of the species and which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the ESA, upon a determination by the Secretary that such areas are essential for the conservation of the species (ESA of 1973, as amended, 16 U.S.C. §1531 et seq.).

delist: When an ESA-listed species is removed from the list of species protected under the ESA.

delisting criteria: Criteria used to determine whether an ESA-listed species no longer needs the protections of the ESA and may be delisted.

dependent population: Populations that rely upon immigration from surrounding populations to persist. Without these inputs, Dependent Populations would have a lower likelihood of persisting over 100 years (Williams et al. 2006).

demographic: the statistics of a given population, such as abundance or growth rate.

depensation: The effect where a decrease in spawning stock leads to reduced survival or production of eggs through either (1) increased predation per egg given constant predator pressure, or (2) the "Allee effect" (the positive relationship between population density and the reproduction and survival of individuals) with reduced likelihood of finding a mate (Liermann and Hilborn 2001).

diversity: All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population (NOAA 2006). Diversity includes diversity of (potential) selective environments, diversity of phenotypes, including life history types, and diversity of genetic variation, both neutral and selected (Williams et al. 2006).

diversity stratum: Groups of populations that span the diversity and distribution that currently exists or historically existed within the ESU (Williams et al. 2006). Diversity, broadly defined, was the basis for delineating these groups (Williams et al. 2006).

domestication selection: Natural selection operating on a population during artificial propagation that encourages adaptation to the hatchery environment at the expense of adaptation to the natural environment (Hard et al. 1992).

El Niño: A warming of the ocean surface off the western coast of South America that occurs every 4 to 12 years when upwelling of cold, nutrient-rich water does not occur. It causes die-offs of plankton and fish and affects Pacific jet stream winds, altering storm tracks and creating unusual weather patterns in various parts of the world (NOAA 2006).

ephemeral population: Populations which have a substantial likelihood of going extinct within a 100-year time period in isolation, and do not receive sufficient immigration to affect this likelihood. Habitats that support such populations are expected to be occupied only for relatively short periods of time, and rarely at high densities (Williams et al. 2006).

estuary: A coastal ecological ecosystem that is partially enclosed, receives freshwater input from land, and has a horizontal fresh-salt salinity gradient; the average salinity of estuarine waters is defined as being 30 practical salinity units (PSU) for at least 1 month per year (NOAA 2006).

extant: Not destroyed or lost (Webster 2001).

extinction: In evolutionary biology, the failure of groups of organisms of varying size and inclusiveness (e.g., local geographic or temporally-defined groups to species) to have surviving descendants.

extinction risk: The probability that a given population will become extinct within 100 years. Low probability of extinction is defined for this purpose as 5 percent over 100 years (Williams et al. 2006).

extirpation: Population-level extinction.

fry: A life stage of coho salmon defined by emergence from gravel in redds; the smallest fry are typically 30 to 45 mm, and at 50 to 60 mm they transition to the "juvenile" life stage. Both fry and juveniles are called "young of the year".

functionally independent population: Populations with a high likelihood of persisting in isolation over a 100-year time scale, which are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006).

hatchery: Salmon hatcheries typically spawn adults in captivity and raise the resulting progeny in fresh water for release into the natural environment. In some cases, fertilized eggs are out-planted (usually in "hatch-boxes"), but it is more common to release fry (young juveniles) or smolts (juveniles that are physiologically prepared to undergo the migration into salt water). The fish are released either at the hatchery (on-station release) or away from the hatchery (off-station release). Releases may also be classified as within basin (occurring within the river basin in which the hatchery is located or the stock originated from) or out-of-basin (occurring in a river basin other than that in which the hatchery is located or the stock originated from). The broodstock of some hatcheries is based on adults that return to the hatchery each year; others rely on fish or eggs from other hatcheries, or capture adults in the wild each year (Hard et al. 1992).

hatchery fish: Fish that have spent some portion of their lives, usually their early lives, in a hatchery.

hatchery-origin fish: See *hatchery fish*.

independent population: Any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals with other populations (Williams et al. 2008). Also see “potentially independent population” and “functionally independent population”.

Intrinsic Potential: The potential of the landscape to support a population. The Intrinsic Potential of a watershed or stream reach, is used to evaluate the likelihood of the area to support fish, and is used when population characteristics are unknown (Williams et al. 2006).

jacks: Male salmon that return from the ocean to spawn one or more years before full-sized adults return. For coho salmon in California, Oregon, Washington, and southern British Columbia, jacks are 2 years old, having spent only 6 months in the ocean, in contrast to adults, which are 3 years old after spending 1½ years in the ocean (NOAA 2006).

juvenile: Life stage after the fry stage, beginning at about 50 to 60 mm. Juveniles typically rear in fresh water for up to 15 months, then migrate to the ocean as ‘‘smolts’’ in the spring.

key limiting stresses: Those stresses which have the greatest impact on current population viability.

key limiting threats: Those threats which have the greatest impact on current population viability.

large woody debris: Any large piece of woody material that intrudes into a stream channel, whose smallest diameter is greater than 10cm, and whose length is greater than 1 m.

limiting factor: An environmental factor that limits the growth or activities of an organism or that restricts the size of a population or its geographical range.

listed species: Any species of fish, wildlife or plant which has been determined to be endangered or threatened under the ESA.

natural fish: See *wild fish*.

natural-origin fish: See *wild fish*.

osmoregulation: The active regulation of an organism’s fluids to keep them from becoming too diluted or too concentrated.

pelagic: Of or pertaining to the open ocean.

phenotype: The observable physical or biochemical characteristics of an organism, as determined by both genetic makeup and environmental influences.

pinniped: Carnivorous aquatic mammals that include the seals, walrus, and similar animals having finlike flippers as organs of locomotion.

population: A group of individuals of the same species that live in the same place at the same time and exhibit some level of reproductive isolation from other such groups. In some contexts, a randomly mating group of individuals that is reproductively isolated from other groups is considered a population. A population may consist of a single isolated run or more than one connected run. Synonymous with *stock* (McElhany et al. 2000).

population size: The number of adults in a population.

potentially independent population: Populations with a high likelihood of persisting in isolation over a 100-year time scale, but which are too strongly influenced by immigration from other populations to exhibit independent dynamics (Williams et al. 2006).

power analysis: A statistical procedure to determine the probability of detecting a trend when a trend in fact exists.

productivity: The population growth rate, measured as the spawner-to-spawner ratio (returns per spawner or recruits per spawner).

recovery: The reestablishment or rehabilitation of a threatened or endangered species to a self-sustaining level in its natural ecosystem (NOAA 2006).

recovery domain: The geographic area for which a Technical Recovery Team is responsible.

recovery plan: Under the ESA, a document identifying actions needed to improve the status of a species or ESU to the point that it no longer requires protection (*Hard et al. 1992*) (see ESA Section 4(f), 16 U.S.C. §1533(f), for applicable requirements).

recovery supplementation: Short-term artificial propagation designed to reduce the risk of extinction of a small or chaotically fluctuating recovering population in its natural habitat by temporarily increasing population size using recovery hatchery fish, while maintaining available genetic diversity and avoiding genetic change in the natural and hatchery populations.

redd: Gravel nest excavated by spawning female coho salmon.

refugia: An area where special environment circumstances occur, enabling individuals to survive in specific life stages.

residualization: The process by which anadromous juvenile salmonids fail to emigrate seawards within the primary migration period.

riparian area: An area with distinctive soils and vegetation between a stream or other body of water and the adjacent upland. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation (Belsky et al. 1999).

riparian vegetation: Vegetation growing on or near the banks of a stream or other body of water in soils that exhibit some wetness characteristics during some portion of the growing season (Welsch 1991).

self-sustaining population: A population that perpetuates itself without human intervention, without chronic decline, and in its natural ecosystem, at sufficient levels that the protections of the ESA are no longer required.

smoltification: The process whereby a salmonid fry transforms into the smolt life stage.

spatial structure: The spatial distribution of individuals in a population.

spawner surveys: Spawner surveys utilize counts of live fish, redds (nests dug by females in which they deposit their eggs) and fish carcasses to estimate spawner abundance and identify habitat being used by spawning fish. Annual surveys can be used to compare the relative magnitude of spawning activity between years.

species: Generally, a fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding. Under the ESA, it includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature (ESA of 1973, as amended, 16 U.S.C. §1531 et seq.)

stochastic: The term is used to describe natural events or processes that are random. Examples include environmental conditions such as rainfall, runoff, and storms, or life-cycle events, such as survival or fecundity rates.

stock: See *population.*

stress: The physical, biological, or chemical conditions and associated ecological processes that may impede SONCC coho salmon ESU recovery. Stresses are caused by threats.

sub-basin: Area of land draining into a stream or river within a large basin. Examples of sub-basins are the Middle Klamath River, the Upper Mainstem Eel River, the Lower Rogue River, and the South Fork Trinity River. The sub-basin is the intermediate classification in a hierarchical drainage system adopted by NMFS for the SONCC coho salmon ESU recovery plan. This hierarchical drainage system is made up of basins (largest scale), sub-basins (intermediate scale), and watersheds (smallest scale). See also *basin* and *watershed*.

take: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct to a Federally listed species (ESA of 1973, as amended, 16 U.S.C. §1531 et seq.).

technical recovery team (TRT): The team of scientists from NMFS and other entities formed to develop biological viability criteria for listed Evolutionarily Significant Units (ESUs) that will be considered in setting recovery goals (Williams et al. 2006).

threat: Activities or impacts that cause or contribute to the stresses that limit recovery of the SONCC coho salmon ESU.

threatened species: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (ESA, as amended, 16 U.S.C. §1531 et seq.).

viability: The likelihood that a population will sustain itself over a 100-year time frame (McElhany et al. 2000).

viable salmonid population: An independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats for demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame (McElhany et al. 2000).

watershed: Area of land draining into a stream or river within a basin or sub-basin. The watershed is the smallest classification in a hierarchical drainage system adopted by NMFS for the SONCC coho salmon ESU recovery plan. This hierarchical drainage system is made up of basins (largest scale), sub-basins (intermediate scale), and watersheds (smallest scale). See also *basin* and *sub-basin*.

wild fish: Fish that are offspring of parents that spawned in the wild. Wild fish spend their entire lives in the natural environment.

young-of-the-year: Term used to collectively refer to fry and juvenile life stages.

H.2 Abbreviations and Acronyms

The following are is a list of selected acronyms and abbreviations used throughout the plan.

ACOE	-U.S. Army Corps of Engineers
ACS	-Aquatic Conservation Strategy
ARWC	-Applegate River Watershed Council
BCWC	-Bear Creek Watershed Council
BLM	-Bureau of Land Management
BMPs	-Best Management Practice
BOF	-California Board of Forestry
BRT	-Biological review teams
CAP	-Conservation Action Planning
CalFire	-California Department of Forestry and Fire Protection
CDFG	-California Department of Fish and Game (now California Department of Fish and Wildlife)
CDFW	-California Department of Fish and Wildlife (formerly California Department of Fish and Game)
CDWR	-California Department of Water Resources
CEQA	-California Environmental Quality Act
CFR	-Code of Federal Regulations
cfs	-Cubic feet per second
CPS	-Coastal Pelagic Species
CWA	-Federal Clean Water Act
dbh	-Diameter at breast height
DIDSON	-Dual-frequency IDentification SONar
DPS	-Distinct Population Segment
EPT	-Ephemeroptera Plecoptera Trichoptera
ESA	-Federal Endangered Species Act
ESU	-Evolutionarily Significant Unit
FEMAT	-Forest Ecosystem Management Assessment Team
FERC	-Federal Energy Regulatory Commission
FR	-Federal Register
ft	-Feet
GDRC	-Green Diamond Resource Company
GIS	-Geographic Information System
HBHRCD	-Humboldt Bay Harbor, Recreation, and Conservation District
HBMWD	-Humboldt Bay Municipal Water District
HBWAC	-Humboldt Bay Watershed Advisory Council
HCP	-Habitat Conservation Plan
HCRCD	-Humboldt County Resource Conservation District
HGMP	-Hatchery and Genetic Management Plan
HRC	-Humboldt Redwood Company
HSRG	-Hatchery Scientific Review Group
HSA	-Hydrologic Subarea
HVT	-Hoopa Valley Tribe

IBI	-Index of Biological Integrity
IMST	-Independent Multidisciplinary Science Team
IP	-Intrinsic Potential
KNF	-Klamath National Forest
KRIS	-Klamath River Information System
LCM	-Life Cycle Monitoring
LRMP	-Land and Resource Management Plan
LWD	-Large Woody Debris
MKWC	-Middle Klamath Watershed Council
MRC	-Mendocino Redwood Company OR Mattole Restoration Council
MRSD	-Minimum required spawner density
MSA	-Magnuson-Stevens Fishery Conservation and Management Act
MWAT	-Mean Weekly Average Temperature
MWMT	-Mean Weekly Mean Temperature
NA or N/A	-Not Applicable
NCCP	-Natural Community Conservation Plan
NCRWQCB	-North Coast Regional Quality Control Board
NCWAP	-North Coast Watershed Assessment Program
NMFS	-National Marine Fisheries Service
NOAA	-National Oceanic and Atmospheric Administration
NPDES	-National Pollutant Discharge Elimination System
NRC	-National Research Council
NRCS	-Natural Resources Conservation Service
NTU	-Nephelometric Turbidity Unit
NWFP	-Northwest Forest Plan
ODEQ	-Oregon Department of Environmental Quality
ODFW	-Oregon Department of Fish and Wildlife
ODOT	-Oregon Department of Transportation
OFPA	-Oregon Forest Practices Act
OWEB	-Oregon Watershed Enhancement Board
OWRD	-Oregon Water Rights Division
PALCO	-Pacific Lumber Company
PDO	-Pacific Decadal Oscillation
PFMC	-Pacific Fishery Management Council
PIT	-Passive Integrated Transponder
PWA	-Pacific Watershed Associates
RCD	-Resource Conservation District
RM	-River Mile
RNSP	-Redwood National and State Parks
RWQCB	-Regional Water Quality Control Board
SCWC	-South Coast Watershed Council
SOD	-Sudden oak death
SONCC	-Southern Oregon/Northern California Coast Coho
Sq mi	-Square mile
SRRC	-Salmon River Restoration Council
SWRCB	-California State Water Resources Control Board

SRWC	-Scott River Watershed Council
TMDL	-Total Maximum Daily Load
TNC	-The Nature Conservancy
TRH	-Trinity River Hatchery
USDA	-United States Department of Agriculture
USDOI	-United States Department of the Interior
USEPA	-United States Environmental Protection Agency
USFS	-United States Forest Service
USFWS	-United States Fish and Wildlife Service
USGS	-United States Geological Survey
VSP	-Viable Salmonid Population
WCF	- Watershed Condition Framework
YTFP	- Yurok Tribal Fisheries Program

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Appendix I. Electronic Maps Used in Threats Assessment

I.1 Overview

NOAA's National Marine Fisheries Service (NMFS) created GIS (Geographic Information System) maps using the instream monitoring and landscape data compiled for each population. *These maps are available upon request from the SONCC recovery coordinator in Adobe Acrobat (PDF) format and are designed to be used as electronic documents, not printed*. The many layers in the maps can be toggled on/off and users can zoom in to see more detail. There are two PDF maps included for each population. The main set of maps contains the stress and threats data, in addition to base layers such as coho salmon IP and streams, and was completed in May 2010. The second set of maps was completed in December 2009 and includes canopy change over various time periods and tree size. Due to the large number of layers in the maps, full legends could not be included within the individual maps; therefore, a separate legend PDF is provided for each of the two map types. These maps were used to analyze and interpret habitat condition across the landscape.

I.2 Inventory of Electronic Files

There are 92 electronic map files in PDF format:

- One introductory guide that explains how to use the stresses and threats PDF maps, and provides a legend for the layers in the stresses and threats map. File name:
  - soncc_pop_maps_legend_and_instructions_2011_12_11.pdf
- 40 PDF maps (one for each population in the SONCC coho salmon ESU) with stress data and threats data. The file name of each map starts with the population name, then ends with "_soncc_cap_indicators_sources.pdf":
  - Bear River_soncc_cap_indicators_sources.pdf
  - Brush Creek_soncc_cap_indicators_sources.pdf
  - Chetco River_soncc_cap_indicators_sources.pdf
  - Elk Creek_soncc_cap_indicators_sources.pdf
  - Elk River_soncc_cap_indicators_sources.pdf
  - Guthrie Creek_soncc_cap_indicators_sources.pdf
  - Humboldt Bay Tributaries_soncc_cap_indicators_source.pdf
  - Hunter Creek_soncc_cap_indicators_sources.pdf
  - Illinois River_soncc_cap_indicators_sources.pdf
  - Little River_soncc_cap_indicators_sources.pdf
  - Lower Eel - Van Duzen Rivers_soncc_cap_indicators_source.pdf
  - Lower Klamath River_soncc_cap_indicators_sources.pdf
  - Lower Rogue_soncc_cap_indicators_sources.pdf
  - Lower Trinity River_soncc_cap_indicators_sources.pdf
  - Mad River_soncc_cap_indicators_sources.pdf
  - Mainstem Eel River_soncc_cap_indicators_sources.pdf

  - Maple Creek - Big Lagoon_soncc_cap_indicators_source.pdf
  - Mattole River_soncc_cap_indicators_sources.pdf
  - Middle Fork Eel River_soncc_cap_indicators_sources.pdf
  - Middle Klamath River_soncc_cap_indicators_sources.pdf
  - Middle Mainstem Eel River_soncc_cap_indicators_sourc.pdf
  - Middle Rogue - Applegate Rivers_soncc_cap_indicators.pdf
  - Mussel Creek_soncc_cap_indicators_sources.pdf
  - North Fork Eel River_soncc_cap_indicators_sources.pdf
  - Norton - Widow White Creek_soncc_cap_indicators_source.pdf
  - Pistol River_soncc_cap_indicators_sources.pdf
  - Redwood Creek_soncc_cap_indicators_sources.pdf
  - Salmon River_soncc_cap_indicators_sources.pdf
  - Scott River_soncc_cap_indicators_sources.pdf
  - Shasta River_soncc_cap_indicators_sources.pdf
  - Smith River_soncc_cap_indicators_sources.pdf
  - South Fork Eel River_soncc_cap_indicators_sources.pdf
  - South Fork Trinity River_soncc_cap_indicators_source.pdf
  - Strawberry Creek_soncc_cap_indicators_sources.pdf
  - Upper Klamath River_soncc_cap_indicators_sources.pdf
  - Upper Mainstem Eel River_soncc_cap_indicators_source.pdf
  - Upper Rogue_soncc_cap_indicators_sources.pdf
  - Upper Trinity River_soncc_cap_indicators_sources.pdf
  - Wilson Creek_soncc_cap_indicators_sources.pdf
  - Winchuck River_soncc_cap_indicators_sources.pdf

- One introductory guide that explains how to use the canopy change and tree size PDF maps, and provides a legend for the layers in the stresses and threats map. File name:

  - change_detect_legend_and_instructions_2011_12_11.pdf

- 40 PDF maps (one for each population in the SONCC coho salmon ESU) of the canopy change and tree size data. The file name of each map starts with the population name, then ends with "_change_detect.pdf":

  - Bear River_change_detect.pdf
  - Brush Creek_change_detect.pdf
  - Chetco River_change_detect.pdf
  - Elk Creek_change_detect.pdf
  - Elk River_change_detect.pdf
  - Guthrie Creek_change_detect.pdf
  - Humboldt Bay Tributaries_change_detect.pdf
  - Hunter Creek_change_detect.pdf
  - Illinois River_change_detect.pdf
  - Little River_change_detect.pdf
  - Lower Eel - Van Duzen Rivers_change_detect.pdf
  - Lower Klamath River_change_detect.pdf
  - Lower Rogue_change_detect.pdf

- Lower Trinity River_change_detect.pdf
- Mad River_change_detect.pdf
- Mainstem Eel River_change_detect.pdf
- Maple Creek - Big Lagoon_change_detect.pdf
- Mattole River_change_detect.pdf
- Middle Fork Eel River_change_detect.pdf
- Middle Klamath River_change_detect.pdf
- Middle Mainstem Eel River_change_detect.pdf
- Middle Rogue - Applegate Rivers_change_detect.pdf
- Mussel Creek_change_detect.pdf
- North Fork Eel River_change_detect.pdf
- Norton - Widow White Creek_change_detect.pdf
- Pistol River_change_detect.pdf
- Redwood Creek_change_detect.pdf
- Salmon River_change_detect.pdf
- Scott River_change_detect.pdf
- Shasta River_change_detect.pdf
- Smith River_change_detect.pdf
- South Fork Eel River_change_detect.pdf
- South Fork Trinity River_change_detect.pdf
- Strawberry Creek_change_detect.pdf
- Upper Klamath River_change_detect.pdf
- Upper Mainstem Eel River_change_detect.pdf
- Upper Rogue_change_detect.pdf
- Upper Trinity River_change_detect.pdf
- Wilson Creek_change_detect.pdf
- Winchuck River_change_detect.pdf

I.3 Example Images Created from the PDF Map Files

Figure I-1 and Figure I-2 show example images for the Mattole River created from the map files described above.

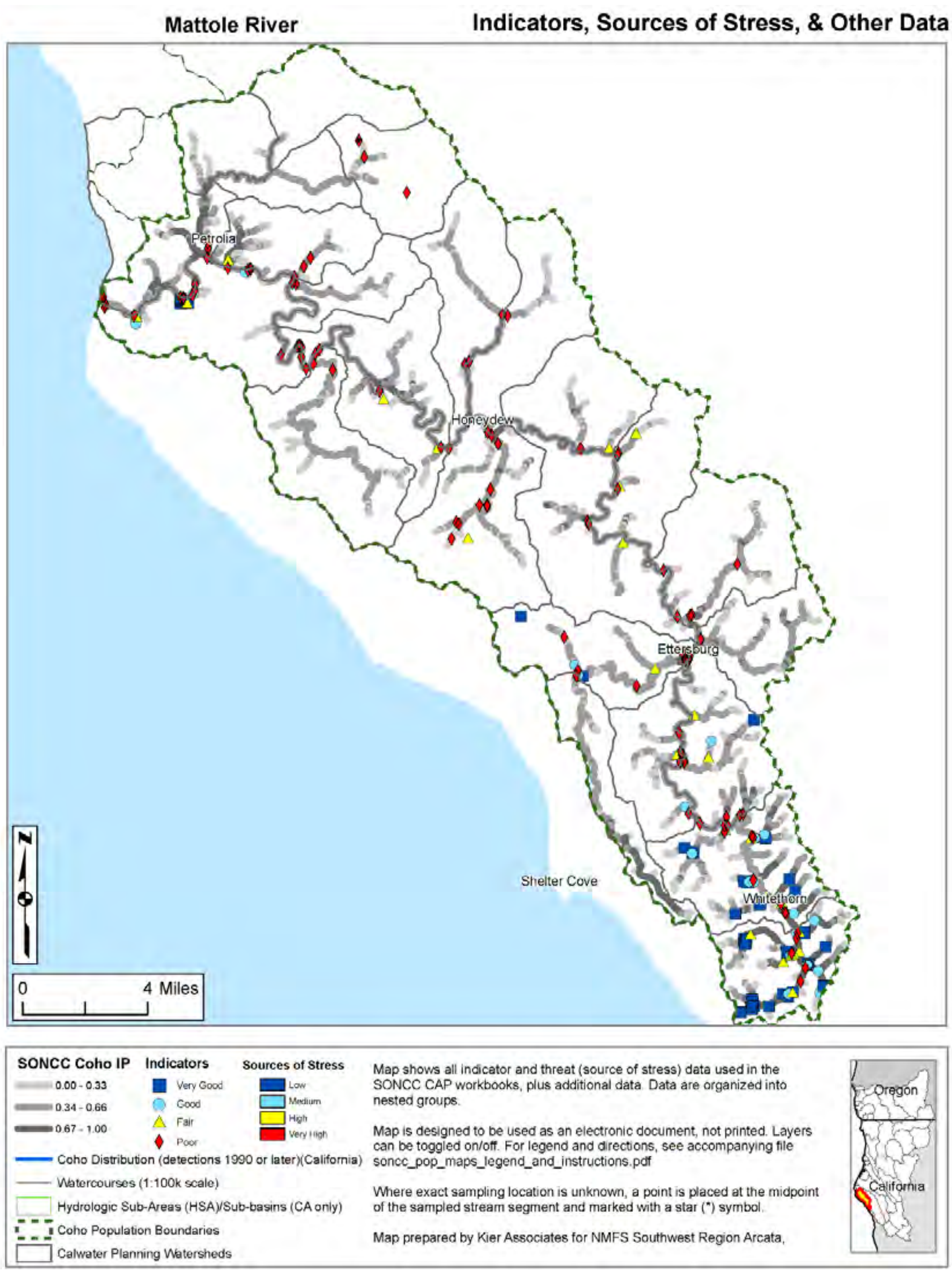

Figure I-1. Example image from map of Mattole River stress data. Map shows water temperature monitoring stations, modeled Intrinsic Potential (IP) of coho salmon habitat, and boundaries of Calwater Planning Watersheds (all other layers in map are turned off). These are just a few many data layers available in the "Mattole River_soncc_cap_indicators_sources.pdf" map file. Complete legend is available in "soncc_pop_maps_legend_and_instructions_2011_12_11.pdf".

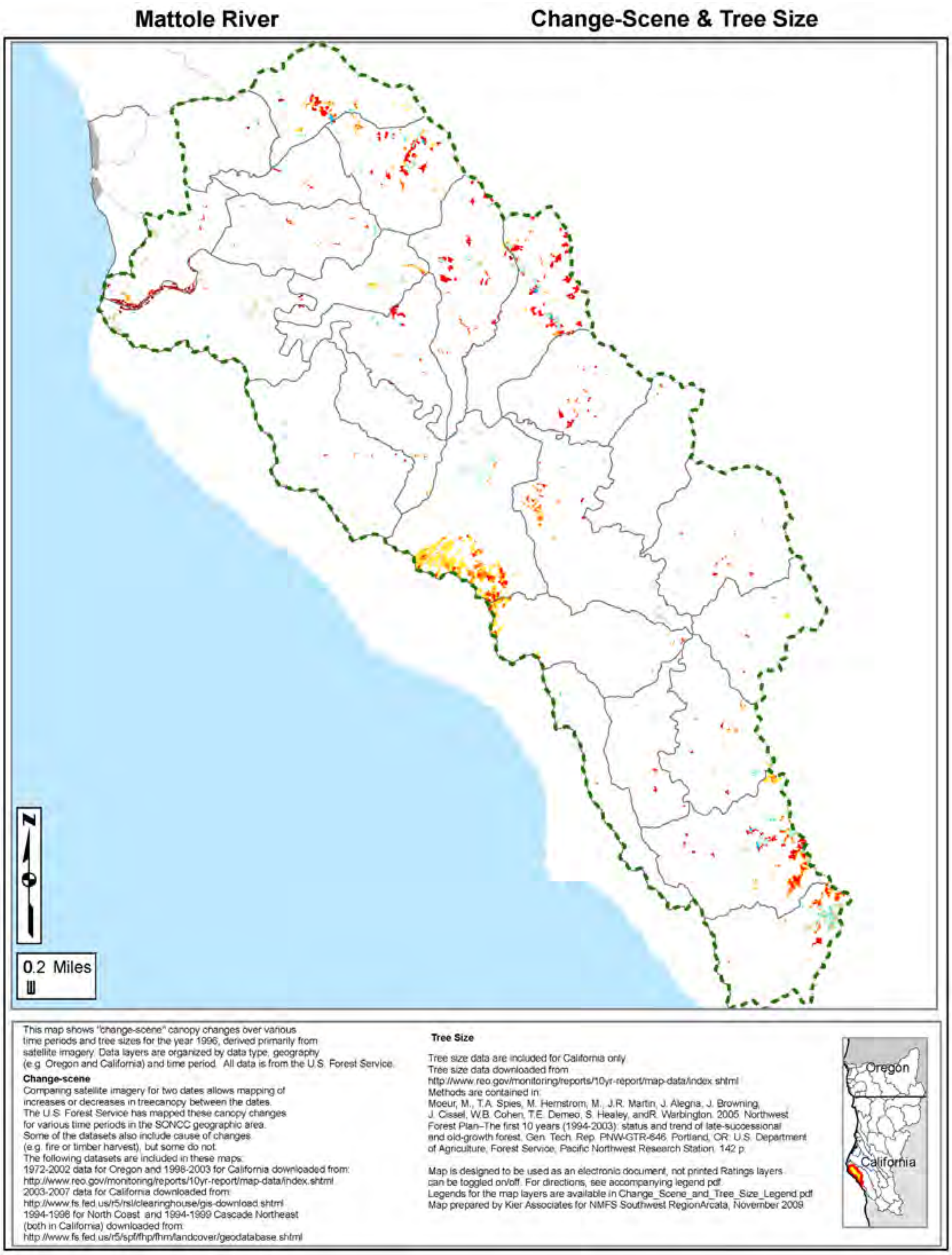

Figure I-2. Example image from PDF map of Mattole River canopy change and tree size data. Map shows areas where remote sensing detected canopy change in the years 1994 to 2007 and boundaries of Calwater Planning Watersheds (all other layers in map are turned off). These are just a few several data layers available in the “Mattole River_change_detect.pdf” map file. Complete legend is available in “change_detect_legend_and_instructions_2011_12_11.pdf”.

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7. Elk River Population

Northern Coastal Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

2,400 Spawners Required for ESU Viability

93 mi^2 watershed (78% Federal ownership)

63 IP-km (39 IP-mi) (23% High)

Dominant Land Uses are Agriculture and Recreation

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Impaired Water Quality'

Key Limiting Threats are 'Agricultural Practices' and 'Channelization/Diking'

Highest Priority Recovery Actions

• Develop total maximum daily loads (TMDLs) for water bodies listed under Clean Water Act Section 303(d) • Increase large woody debris (LWD), boulders, or other instream structure • Increase instream flows	• Improve timber harvest practices by revising Oregon Forest Practices Act • Improve regulatory mechanisms regarding agricultural practices • Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows

7.1 History of Habitat and Land Use

Historically, the lower Elk River provided the most important habitat for coho salmon in the population area. Large wood jams spanning the lower Elk River channel would dislodge and relocate with winter high flows. Impacts to the Elk River basin include timber harvest (and associated road-building) in the lower basin and extensive placer and hydraulic mining in the upper basin (Maguire 2001a). The legacy of mining in the Elk River basin may be substantial because hydraulic mining used water cannons to blast away alluvial deposits that caused potentially long lasting impacts on channel structure. Over time, settlement and associated agriculture encroached on the lower Elk River floodplain which confined the channel and reduced wetlands. These human settlements greatly reduced or eliminated wood jams and beaver that had previously helped form coho salmon rearing habitat. Basin-wide disturbances occurred from 1950 to 1990 and were associated with expansion of the road network and industrial timber harvest on public and private lands (U.S. Forest Service [USFS] 1998a). Extensive road networks were developed to support timber harvest, and these roads and timber harvesting practices greatly damaged the landscape surrounding the Elk River and impacted the water quality and habitat in the river and its tributaries. Between 1954 and 1989, over 300 million board feet of timber were removed from the Elk River population area and the cumulative effects to streams were substantial, particularly following large storm events (USFS 1998a). Between 1952 and 1986, road and harvest-related landslides within the basin delivered 2.2 times more fine sediment volume than naturally-occurring landslides (USFS 1998a). Currently, the Elk River is recognized as a Key Watershed under the Northwest Forest Plan, (USDA and USDI 1994) and much of the USFS land is managed as Late Successional Reserve or as part of the Copper Salmon Wilderness. Private timberlands are limited in the population area. In the last two decades, cranberry farming has expanded into lower tributary watersheds, where on and off-stream storage reservoirs have been built. Cranberry farming has contributed to the loss of function in three low gradient tributaries that were mostly high IP coho salmon habitat. Residential development has also increased in the lower basin.

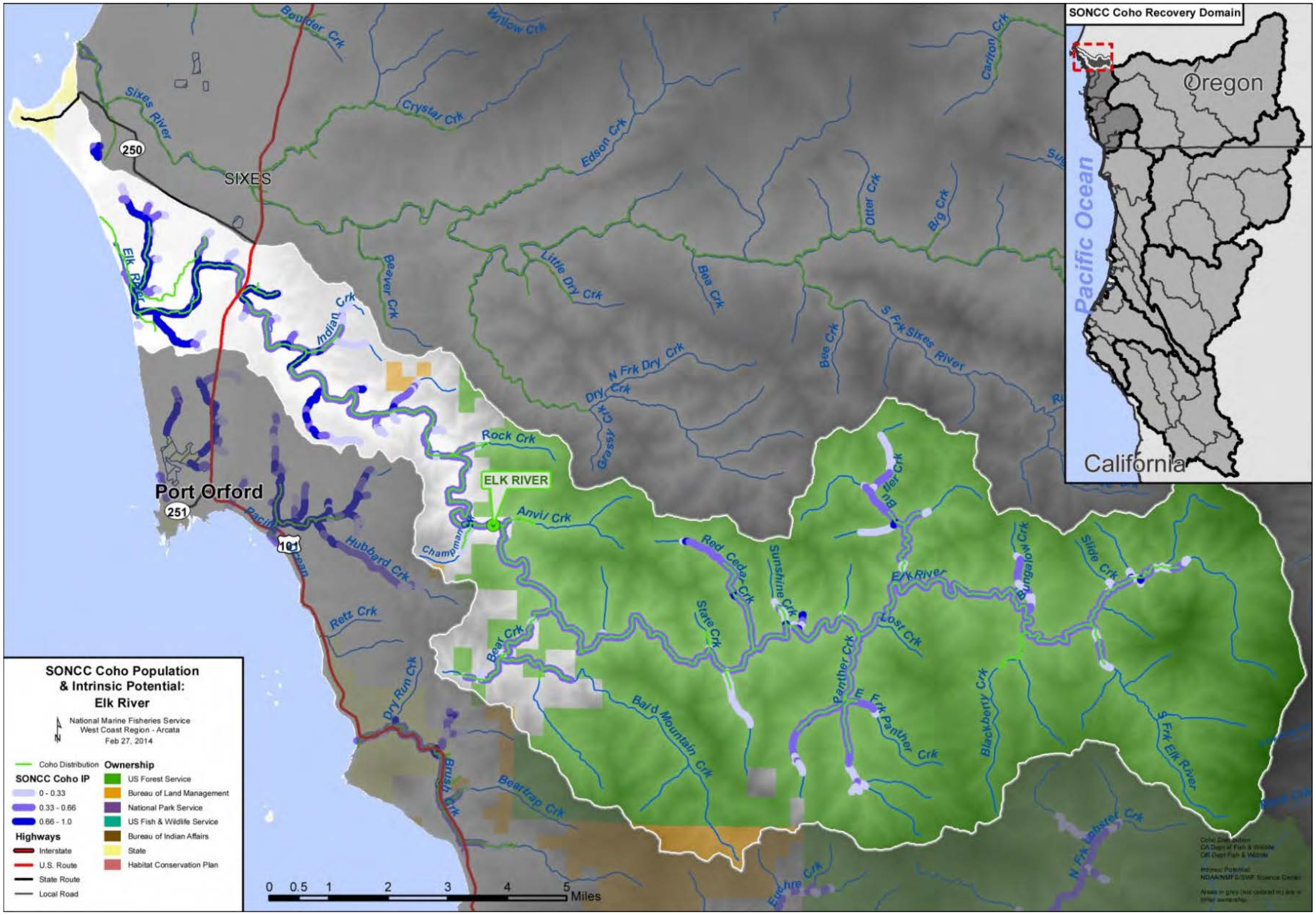

Figure 7-1. The geographic boundaries of the Elk River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

7.2 Historic Fish Distribution and Abundance

The Elk River basin has 63 total Intrinsic Potential-kilometers (IP-km) of coho salmon habitat (Williams et al. 2008). Approximately 7.7 km of IP habitat is currently inaccessible due to a dam. The coho salmon habitat with highest IP is concentrated in the lower Elk River, including all tributaries of the alluvial coastal plain downstream of Rock Creek (Williams et al. 2008) (Figure 7-1). Short, low gradient stream reaches in upper tributaries, such as the North Fork Elk River, Red Cedar Creek, Panther Creek and Butler Creek also have optimal IP habitat.

Historically, coho salmon were more abundant in the Elk River basin than they are today. Contemporary distribution of coho salmon is much reduced from the period of early Anglo-American settlement beginning in the 1850s. This reduction may be due to habitat modification in the lower reaches, including diking and channelization of the mainstem, which eliminated summer and winter rearing habitat (Maguire 2001a). Smaller tributaries, such as one near the mouth of Elk River and upstream of Highway 101, are now disconnected or dammed for agricultural water supply. In 1927, the gillnet catch from the Elk River was dominated by 13,334 pounds of coho salmon (USFS 1998a). Tributaries with the highest IP are shown in Table 7-1.

Table 7-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Lower Elk River and Estuary	Panther Creek	Sunshine Creek
Indian Creek	Red Cedar Creek	Butler Creek
Bagley Creek	Swamp Creek	

7.3 Status of Elk River Coho Salmon

Spatial Structure and Diversity

Oregon Department of Fish and Wildlife (ODFW) has conducted adult coho salmon carcass and redd counts (ODFW 2008a) and juvenile snorkel surveys (ODFW 2005a) in the mainstem Elk River and its tributaries. The South Coast Watershed Council (SCWC) conducted smolt trap surveys in 2012 in Swamp Creek and Cedar Creek (SCSC 2012). There are far more surveys with no sightings than those where coho salmon were found. Adult coho salmon were found in Anvil, Indian, Butler, and Red Cedar creeks as well as the mainstem Elk River between Sunshine Creek and Red Cedar Creek. Juvenile coho salmon were found in Panther, Red Cedar, Swamp, Cedar, and Blackberry creeks as well as the middle mainstem Elk River. USFS (1998a) identified Red Cedar, the North Fork Elk, Panther Creek, and Anvil Creeks as those most important for coho salmon production, as they appeared to account for most coho salmon production in the basin. The very low number of adult fish observed by ODFW and low density of juveniles in summer surveys indicates a very small population which would likely have restricted genetic diversity.

Population Size and Productivity

In 1997, adult coho salmon populations for the entire Elk River population area ranged between 100 and 200 (USFS 1998a). Estimated returns were zero in many years between 1998 and 2007, and at most 501 in 1998 (ODFW 2009a) (Table 7-2). Large differences in effort between years and incomplete survey coverage could account for observed differences in estimates. In addition, high flows may have occurred in some years, which could affect the ability to carry out sampling consistently or effectively.

Table 7-2. Estimates of annual spawning escapement of coho salmon for the Elk River (ODFW 2009a).

Year	Population Estimate	Year	Population Estimate	Year	Population Estimate
1998	501	2002	104	2006	0
1999	Not estimated	2003	187	2007	230
2000	0	2004	0	2008	Not estimated
2001	Not estimated	2005	0		

Extinction Risk

The Elk River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

In addition, the areas where juvenile coho salmon currently rear are concentrated in the low gradient reaches of steeper upper basin tributaries, recognized by Frissell (1992) as alluviated canyons. These areas are prone to alteration by floods and populations dependent on them are vulnerable to periodic disturbance and habitat alterations. Therefore, even the low numbers of coho salmon observed in some years are at high risk of losing their habitat.

Role in SONCC Coho Salmon ESU Viability

The Elk River population is considered to be a core, Functionally Independent population within the Northern Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Elk River core population needs to have at least 2,400 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Elk River population may serve as a source of spawner strays for nearby coastal populations. At present, the capacity of the Elk River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from nearby rivers may enhance recovery of the Elk River population.

7.4 Plans and Assessments

State of Oregon

Expert Panel on Limiting Factors for Oregon's SONCC coho salmon populations

ODFW (2008b) convened a panel of fisheries and watershed scientists as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, concerns for the Elk River population are as follows:

> Key concerns were primarily loss of over-winter tributary and freshwater estuarine habitat complexity and floodplain connectivity for juveniles, especially in the lowlands which are naturally limited in this system and have been impacted by past and current agricultural practices. Secondary concerns were primarily related to high water temperatures in tributaries for summer parr (excluding the mainstem, where rearing is not expected) and loss of tributary habitat for juveniles and adults due to road crossings (especially in Bagley and Blackberry Creeks).

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The State of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is a comprehensive plan that includes voluntary actions for all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary.

Cumulative Effects of Southwest Oregon Coastal Land Use on Salmon Habitat

Oregon State University's Oak Creek Labs conducted a study funded by ODFW and the Oregon Department of Forestry to determine relationships between forest harvest and Pacific salmon productivity (Frissell 1992). The study assessed basins along the Oregon coast extending from the Sixes River to the southern border during the period from 1986 to 1992 with the most extensive research conducted in Euchre Creek to the south of the Elk River.

Oregon Clean Water Act 303(d) Impaired Water Body List

The mainstem Elk River and estuary, Bald Mountain Creek and Butler Creek are recognized as water quality impaired on the Oregon Clean Water Act 303(d) impaired water body list due to temperature problems and habitat modification. No TMDL has been approved.

U.S. Forest Service

Elk River Watershed Analysis (USFS 1998a)

The Elk River watershed analysis was developed to implement the Northwest Forest Plan and provides the watershed context for fishery protection, restoration, and enhancement efforts. The following is a summary of the most relevant findings: (1) Excessive sediment from natural and management activities has decreased pool depth; (2) Reduction of pool depth decreases available habitat and fish production and provides a competitive advantage to steelhead over other salmonids; (3) High road densities change hillslope hydrology, which contributes to elevated peak flows that damage streams; and (4) Over-winter survival for juvenile salmonids may be decreased due to low habitat complexity (i.e., no slow velocity marginal habitats behind large wood jams or old growth riparian trees).

Sufficiency Assessment: Forest Service and Bureau of Land Management Programs in Support of SONCC Coho Salmon Recovery (USFS and BLM 2011)

The USFS has adopted a Watershed Condition Framework assessment and planning approach (USFS and BLM 2011). The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, Upper Elk River was identified as a high priority 6th field sub-watershed in the Rogue-Siskiyou National Forest (USFS and BLM 2011).

South Coast Watershed Council

Elk River Watershed Assessment (Maguire 2001a)

The Elk River watershed assessment includes a compilation, summary, and synthesis of existing data and information pertaining to watershed conditions in the Elk River basin. Some findings relevant to coho salmon recovery include issues with water temperature, highly altered wetlands, weak riparian cover (especially in the lower sections), sediment sources (present and potential), and noxious weed invasions. The assessment describes variation in run timing of coho salmon in the Elk River basin, with “early” coho salmon entering streams beginning in about mid-November and spawning soon after, while “late” coho salmon delay spawning until as late as March or April.

Elk River Action Plan (Massingill 2001a)

The Elk River action plan is a companion to Maguire (2001a) and defines specific action items for restoration of the Elk River basin.

7.5 Stresses

Table 7-3. Severity of stresses affecting each life stage of coho salmon in the Elk River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	High	High	Very High[1]	Very High	Very High	Very High
2	Impaired Water Quality[1]		High	Very High[1]	High	Low	High
3	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
4	Impaired Estuary/Mainstem Function	-	Low	Medium	High	Low	Medium
5	Altered Hydrologic Function	Low	Low	High	High	High	High
6	Altered Sediment Supply	Medium	Medium	Medium	Low	Medium	Medium
7	Barriers	-	Medium	Medium	Low	Medium	Medium
8	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low
9	Increased Disease/Predation/Competition	Low	Low	Low	Low	Low	Low
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking for the population. Lack of floodplain and channel structure and impaired water quality are the two most limiting stresses. Juvenile summer rearing habitat is impaired by high temperatures resulting from degraded riparian conditions and water withdrawals. Winter rearing habitat has been reduced by channelization, diking, and filling of wetlands. Timber removal has decreased the source of large wood, and most historically available habitat in the estuary has been altered by development, channelization, sedimentation, and diking. Overall, these findings are consistent with those of the Oregon Expert Panel (ODFW 2008b) (Section 7.4), but the expert panel considered water temperature to be only a secondary, not primary, concern.

The IP habitat in the Elk River basin is concentrated in the low gradient reaches of the basin near the ocean. No thermal refugia have been noted. Off-channel juvenile rearing habitat with suitable temperature is vital to coho salmon recovery in this river. Habitat currently occupied by coho salmon is at a premium and should be prioritized for protection.

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure is the greatest constraint to coho salmon production in the Elk River. The lower Elk River channel is disconnected from its floodplain, wetlands, and tributaries (Figure 7-2). This has significantly reduced what was once optimal habitat for coho salmon spawning, egg incubation, and rearing. The ODFW (2008b) Expert Panel found that loss of floodplain connectivity and access to off-channel habitat was a major limiting factor in this population. This stress applies to both freshwater and tidally-influenced freshwater areas. Tributary channels are also altered by agricultural activities, as evidenced in aerial photos (Figure 7-2). One entire fork of Swamp Creek is no longer discernible on aerial photos and has been completely filled in. Large woody debris was historically important and available in the lower Elk River but today there is little large wood (ODFW 2008b).

Figure 7-2. Aerial image from Google Earth of the Lower Elk River above and below Highway 101 (yellow line is highway). Rectangular beige shapes are cranberry bogs. Filled river meanders, cutoff wetlands and streams, and an irrigation pond on a tributary (right) are highlighted with red arrows.

Impaired Water Quality

Water temperature in the mainstem Elk River, Bald Mountain, Panther and Butler creeks does not meet the Oregon Department of Environmental Quality (ODEQ) maximum average weekly temperature (temperature) standard of 64 ºF. Water temperatures are suitable during the time of adult returns and when eggs are in the gravel. Data from the South Coast Watershed Council's monitoring program from 1991 to 2000 indicate that the warmest 7-day maximum recorded in the Elk River basin was 74.1 °F on the mainstem of the Elk River below Camp Creek. The water temperature at Bagley Creek is 3 to 4 °F warmer than that observed upstream at the National Forest boundary (Maguire 2001a). Butler, Bald Mountain, and Panther creeks were warm and ranged from 66 °F to 68 °F (USFS 1998a). Swamp Creek, a tributary to the estuary, also had impaired water temperature conditions of 69.7 °F (USFS 1998a). Fecal coliform levels exceeded standards in 8 out of 27 samples often during high flows, indicating moderately impaired conditions (Maguire 2001a). Phosphate levels exceeded the water quality standards 4 out of 28 samples (14.3 percent) during high flow events. All of these data (Maguire 2001a, USFS 1998a) are at least ten years old and so should not be considered a definitive description of current conditions. Effects of pesticides and herbicides on salmon are harmful (Ewing 1999), but there are no pesticide studies in the Elk River, nor any regional data available (Riley, S., pers. comm. 2009).

Degraded Riparian Forest Conditions

ODFW (2008b) noted problems with high water temperatures due to riparian shade loss and competition from non-native shrubs. Elk River riparian zones were once dominated by large conifers, but today are dominated by hardwoods and invasive non-native species including gorse and Himalayan blackberry (USFS 1998a, Maguire 2001a). In steeper channels of headwater streams, riparian trees may be removed by rapidly moving landslides known as debris torrents that move down channels (USFS 1998a).

Impaired Estuary/Mainstem Function

The main issues for coho salmon in the estuary are insufficient holding habitat for smolts and the barriers described below. Based on aerial photos, most of the land adjacent to the Elk River estuary has been converted to agricultural land, with associated channelization and diking that has disconnected small tributaries. A small amount of off-channel habitat remains near the mouth.

Altered Hydrologic Function

Diversion dams block water movement and restrict flows in a few lower river tributaries. Flow to the estuary from tributaries is completely disconnected. Wells for domestic and agricultural water supply in the lower Elk River and its tributaries have the potential to reduce surface water availability, which could substantially diminish coho salmon habitat in the smaller streams. Water diversions or surface water supply reductions both can directly reduce the amount of habitat available to coho salmon by drying up smaller streams and can increase water temperatures, making habitat unsuitable for coho salmon. The Elk River Watershed Assessment (Maguire 2001a) found that the minimum Oregon Water Rights Division instream-flow right of 45 cubic feet per second in the mainstem Elk River is usually met at the USGS gage at the Elk

River Hatchery. However, almost all of the water diversion is below the hatchery and no measurements are taken downstream or in tributaries with high IP. Therefore, compliance with the instream flow downstream of the hatchery has not been established. The significant number of cranberry bogs (Figure 7-2) alters hydrologic function by converting some tributaries to ponds and diverting many others. A golf course has been proposed on a terrace above Elk River. The proposal includes use of irrigation water from a tributary of lower Elk River. Increased peak flows in the watershed (USFS 1998a) can negatively affect redd stability and over-winter survival of fry and juveniles.

Altered Sediment Supply

Altered sediment supply poses an overall medium stress to coho salmon in the Elk River. Sediment contribution from landslides and erosion occurs naturally in the Elk River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. High sediment yield is of particular concern in those areas of the basin with decomposing diorite-type soil, such as at Bald Mountain Creek and Purple Mountain Creek (Maguire 2001a). Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. Poor pool frequency and depth throughout the Elk River basin (Maguire 2001a) are likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and, in some reaches, diminished scour due to channel widening.

Barriers

The most important barriers in the Elk River are three agricultural dams that block migration of coho salmon and contribute to excessively high water temperature. Two of the dams disrupt Swamp Creek, a tributary to the estuary. The Curry County Soil and Water Conservation District recently improved fish passage at these barriers by installing baffled culverts. They documented coho salmon smolts above the first dam, but fully unimpeded passage has not been confirmed (Swanson, M., pers. comm. 2013).

The third dam affects the small unnamed creek immediately upstream of Highway 101. In addition, diking and filling of river and estuarine tributaries constitute a great impediment to fish movement that is addressed as part of the channelization and diking stress. A few culverts are in need of modification to improve fish passage, as described in the “road-stream crossing barriers” threat description.

Adverse Hatchery Effects

The Elk River Hatchery releases approximately 295,000 Chinook salmon juveniles into Elk River each September and an additional 10,000 yearling Chinook in April (ODFW 2008c). The risk of competition between wild coho salmon and hatchery-produced steelhead and Chinook salmon is minimized by rearing fish to a sufficient size that smoltification occurs quickly and the stocked fish quickly leave the river for the ocean (ODFW 2008c). Due to temperature impairment below the hatchery, juvenile coho salmon rear mostly upstream of the hatchery. Due to these factors, the potential for competition between hatchery-released Chinook salmon and wild coho salmon is expected to be reduced. Adverse hatchery-related effects pose a medium risk to all life stages of coho salmon in the Elk River because of the ongoing in-basin stocking with Chinook salmon (Appendix B).

Disease/Predation/Competition

Water temperatures that are too high could elevate disease risk, although there are no recognized fish disease problems in the basin. Elk River Hatchery proactively manages disease risk and minimizes the risk of exposure of coho salmon to hatchery-related disease (ODFW 2008c).

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

7.6 Threats

Table 7-4. Severity of threats affecting each life stage of coho salmon in the Elk River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Agricultural Practices[1]	High	Very High	Very High[1]	Very High	Very High	Very High
3	Channelization/Diking[1]	High	High	High[1]	Medium	Medium	High
2	Dams/Diversions	Low	Medium	High	High	Medium	High
4	Road/Stream Crossing Barriers	-	Low	High	Medium	High	High
5	Roads	Low	Medium	Medium	Medium	Medium	Medium
6	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
7	Invasive/Non-Native Alien Species	-	Medium	Medium	Medium	Medium	Medium
8	Climate Change	-	-	Medium	Medium	Medium	Medium
9	High Severity Fire	Low	Low	Low	Low	Low	Low
10	Hatcheries	Low	Low	Low	Low	Low	Low
11	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
12	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
13	Fishing and Collecting	-	-	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are agricultural practices and channelization/diking.

Agricultural Practices

Agricultural practices are the top threat for coho salmon because their impacts are concentrated in the lower basin, where the highest IP habitat exists and where all fish from the upper basin must pass. Agricultural impacts include the loss and filling of wetlands, water diversion, riparian alteration, polluted stormwater runoff, and blocked access to formerly productive tributaries. Areas of bare soil on terraces adjacent to the lower river and estuary, and newly cleared riparian forests, which are apparent in recent aerial photo images, suggest that agricultural activities may be expanding. The ODFW (2008b) expert panel found agricultural activities to be the causal mechanism for a number of factors limiting Elk River coho salmon production. Removal of riparian trees, particularly conifers, associated with agricultural activities decreases shade and promotes increased water temperature. Cattle grazing can degrade bank structure, initiate erosion, and lead to increases in nutrients and pollutants. Non-point source pollution from cranberry cultivation has not been assessed, but the South Coast Watershed Council is working with growers to consider value-added organic options.

Channelization and Diking

The ODFW (2008b) expert panel found that habitat simplification, resulting from straightening, channelizing, revetting, filling, and/or stream channel dredging, was the most limiting stress upon coho salmon in the Elk River. One entire fork of Swamp Creek has been filled. Much of the lower Elk River channel has been diked since the major floods of 1955 and 1964 (USFS 1998a). Channel confinement causes bed load mobility that disrupts redds which results in high stress to eggs. Fry and juveniles have difficulty over-wintering in confined channels because of elevated water velocities and a lack of off-channel refugia. The Lower Elk River lacks large wood jams that formerly provided shelter from winter high flows and complex summer rearing habitat. Streamside roads in the basin may also confine the channel, creating higher velocities.

Dams/Diversions

There are two main effects of diversions on coho salmon: passage impairment and reduced water in the river. The most problematic diversions are those to cranberry bogs and the small unnamed creek just upstream of Highway 101. These and other diversions facilitate movement of water away from juvenile rearing habitat. The USGS stream flow gage is upstream of the Elk River hatchery and flow data for the lower river are not available. This reach may be at risk from over-diversion, but there are insufficient data to evaluate.

Road-Stream Crossing Barriers

Road crossings on Bagley and Blackberry Creeks are high priority barriers (ODFW 2008b). Additional barriers are listed in Table 7-5.

Table 7-5. List of prioritized road-stream crossing barriers in the range of Elk River coho salmon.

Priority	Stream Name	Road Name	County	Miles of upstream habitat
High	Bagley Creek	N/A	Curry	N/A
High	Blackberry Creek	N/A	Curry	1.25
N/A	Chapman Creek	At intersection with Elk River	Curry	N/A

Roads

Some areas have road densities exceeding levels known to increase risk of fine sediment yield and altered hydrology. There are far more un-surfaced roads than paved roads in the Elk River basin, which can increase surface erosion. Road densities are highest in the lower Elk River, Panther Creek and Bald Mountain Creek watersheds. The number of road failures and landslides caused by roads is far greater on roads constructed before 1980 than more recently built roads (USFS 1998a). In 2009, the USFS designated the Copper Salmon Wilderness. Most of the USFS lands north of the mainstem Elk River were included. The USFS designated approximately 60 miles of road within this area to be decommissioned, thus reducing the future threat of roads.

Timber Harvest

Timber harvest poses a medium threat in the Elk River basin because of high rates of timber harvest on private lands. Private timberlands are located in the lower Elk River, in tributaries such as Indian and Bagley creeks, as well as in-holdings in the Bald Mountain and Panther Creek drainages. Harvest practices on private lands have been shown to increase movement of fine sediment to the Elk River, where the percentage of fine sediment from landslides delivered to streams was higher where trees had been harvested from riparian areas (USFS 1998a). High rates of timber harvest and high road densities in the lower Elk River are a concern because the tributary streams found there are important for coho salmon recovery.

Invasive Non-Native Species

Gorse, Himalayan blackberry, and scotch broom pose serious problems for agricultural land in the lower river. These species have colonized riparian zones and are inhibiting regeneration of native hardwoods and conifers that provide shade and channel stability and allow for long-term large wood recruitment. Japanese knotweed (*Polygonum cuspidatum*) has spread into areas near Port Orford and may be present in the Elk River (Oregon Department of Agriculture 2010). Japanese knotweed is aggressive, fast growing, and out-competes native vegetation in riparian areas. Scotch broom and gorse are also locally common and similarly invasive. If these plants replace conifers or hardwoods in riparian zones, coho salmon habitat will be substantially impacted.

Climate Change

Air temperatures during July are expected to increase by 0.0 – 0.5 °C at the coast and 1.5 to 2.0 °C in the eastern portion of the basin. January temperature rise is expected to be similar with an increase of 0.5 to 1.0 °C at the coast and 1.0 to 1.5 °C in the interior portion of the basin. The latter trend could reduce snow pack in higher elevations, diminishing this source of cold water for coho salmon juvenile rearing. Sea level rise could expand the estuary and the footprint of tidal wetlands, which could potentially benefit coho salmon.

High Severity Fire

The large amount of land owned by the USFS and managed as Wilderness and Late Successional Reserves means that the Elk River basin has more old growth coniferous forest and maturing stands than any other southwest Oregon coastal basin. Stands of this type have a low risk of stand-replacing fires, particularly in a coastal basin.

Hatcheries

Hatcheries pose a medium threat to all life stages of coho salmon in the Elk River. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Mining/Gravel Extraction

There are 534 historic gold mining claims in the Elk River basin (Bredensteiner et al. 2001), and eight are active. There is currently no industrial scale gravel extraction. Minor amounts of aggregate are extracted for local use.

Urban/Residential/Industrial Development

There is some rural residential development in the lower Elk River. Residential development is concentrated in the lower basin, where the highest value coho salmon habitat occurs. Rural residential development can cause a variety of negative effects upon coho salmon and their habitats. These potential effects include, but are not limited to: increased road densities, increased densities of impervious surfaces, channel modification, reductions in riparian vegetation, reductions in riparian function, increased pollution and runoff, and reductions in in-stream water availability.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

7.7 Recovery Strategy

Deficiencies in the amount of suitable, juvenile rearing habitat are the most important factors limiting Elk River coho salmon recovery. The processes that create and maintain such habitat must be restored by increasing channel complexity and restoring flow. Channel complexity should be improved by constructing off-channel ponds or backwater habitat, restoring wetlands, and limiting development and fill. To increase instream structure, LWD should be added to stable channels to provide structure until natural sources of LWD (mature coniferous forests) are re-established next to the stream. Areas adjacent to the stream should be replanted to re-establish mature streamside forest as a source for LWD recruitment.

The most immediate need for habitat restoration and threat reduction in the Elk River are in those areas currently occupied by coho salmon, which are identified in this profile. Unoccupied areas must also be restored to provide enough habitats to allow for coho salmon recovery. Those areas with high IP habitat such as the Lower Elk River, Bagley Creek, Panther Creek, and Sunshine Creek are optimum candidates for recovery actions. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 7-6 on the following page lists the recovery actions for the Elk River population.

Table 7-6. Recovery action implementation schedule for the Elk River population. Recovery actions for monitoring and research are listed in the tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkR.12.1.41	Agricultural Practices	Yes	Improve agricultural practices	Improve regulatory mechanisms	Population wide	1
SONCC-ElkR.12.1.41.1	*Determine the best way to revise the Agricultural Water Quality Management Act (AWQMAP) so that it does not limit recovery of SONCC coho salmon and recommend appropriate revisions*					
SONCC-ElkR.12.1.41.2	*Ensure basin rules are specific and linked to implementing AWQMAP recommendations, including developing specific standards for riparian buffers*					
SONCC-ElkR.12.1.41.3	*Ensure that AWQMA plans address both impaired areas and proactive prevention of water quality impairment*					
SONCC-ElkR.12.1.41.4	*Adopt interim buffers equal to the buffer standards NMFS is recommending in Washington state until the state establishes its own buffers*					
SONCC-ElkR.12.1.41.5	*Change the complaint-based compliance monitoring process to a focused compliance program*					
SONCC-ElkR.2.8.4	Floodplain and Channel Structure	Yes	Improve timber harvest practices	Improve regulatory mechanisms	Private timberlands that include: tributaries of the alluvial coastal plain downstream of North Fork Elk River, Rock, Indian, Bagley, Red Cedar, Panther, and Butler creeks	1
SONCC-ElkR.2.8.4.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-ElkR.2.8.4.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-ElkR.2.8.4.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-ElkR.2.8.4.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-ElkR.2.8.4.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams*					
SONCC-ElkR.2.7.3	Floodplain and Channel Structure	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Elk River, west of Indian Creek, between County Highway 207 and Elk River Road, and areas where coho would benefit immediately	2a
SONCC-ElkR.2.7.3.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-ElkR.2.7.3.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-ElkR.2.7.3.3	*Plant vegetation to stabilize stream bank*					
SONCC-ElkR.2.7.3.4	*Fence livestock out of riparian zones*					
SONCC-ElkR.2.7.3.5	*Remove instream livestock watering sources*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkR.2.1.6	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All tributaries of the alluvial coastal plain downstream of Rock Creek, as well as Indian Cree, Bagley, Sunshine creeks, North Fork Elk River, Red Cedar, Panther, and Butler creeks	2a
SONCC-ElkR.2.1.6.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-ElkR.2.1.6.2	*Place instream structures, guided by assessment results*					
SONCC-ElkR.2.1.51	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-ElkR.2.1.51.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-ElkR.2.1.51.2	*Place instream structures, guided by assessment results*					
SONCC-ElkR.2.2.5	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Private timberlands that include: Mainstem Elk River and tributaries of the alluvial coastal plain downstream of North Fork Elk River, Rock, Indian, Bagley, Red Cedar, Panther, and Butler creeks	2a
SONCC-ElkR.2.2.5.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-ElkR.2.2.5.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-ElkR.2.2.53	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-ElkR.2.2.53.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-ElkR.2.2.53.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-ElkR.10.2.15	Water Quality	Yes	Reduce pollutants	Set standard	Population wide	2a
SONCC-ElkR.10.2.15.1	*Develop TMDLs for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-ElkR.10.1.37	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase instream flows	All streams with ODFW water rights for fish	2a
SONCC-ElkR.10.1.37.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkR.2.2.49	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-ElkR.2.2.49.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-ElkR.2.2.49.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-ElkR.2.2.52	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-ElkR.2.2.52.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-ElkR.2.2.52.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-ElkR.2.7.1	Floodplain and Channel Structure	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Federal forest lands	2b
SONCC-ElkR.2.7.1.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-ElkR.2.7.1.2	*Plant conifers, guided by the plan*					
SONCC-ElkR.2.1.38	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve grazing practices	Private lands population wide	2b
SONCC-ElkR.2.1.38.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-ElkR.2.1.38.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-ElkR.2.1.38.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-ElkR.2.2.29	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2b
SONCC-ElkR.2.2.29.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for landowners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-ElkR.2.2.29.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-ElkR.2.2.29.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-ElkR.10.2.36	Water Quality	Yes	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-ElkR.10.2.36.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-ElkR.10.2.36.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkR.10.2.40	Water Quality	Yes	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-ElkR.10.2.40.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-ElkR.10.2.40.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-ElkR.10.2.40.3	*Develop local regulatory mechanisms that reduce amount of total impervious area through incentives*					
SONCC-ElkR.26.1.48	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-ElkR.26.1.48.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-ElkR.2.2.45	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2b
SONCC-ElkR.2.2.45.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-ElkR.2.4.8	Floodplain and Channel Structure	Yes	Improve estuarine habitat	Restore tidally influenced habitats	Estuary	3b
SONCC-ElkR.2.4.8.1	*Assess coho use of different estuarine habitats and develop a plan to enhance those habitats (i.e. brackish wetlands, tidal sloughs, salt marshes, and tidally influenced freshwater)*					
SONCC-ElkR.2.4.8.2	*Restore tidally influenced habitats, guided by the plan*					
SONCC-ElkR.10.4.13	Water Quality	Yes	Improve flow timing or volume	Educate stakeholders	Lower Elk River and tributaries downstream of confluence of Rock Creek	3b
SONCC-ElkR.10.4.13.1	*Provide incentives and education to landowners to reduce water consumption and reduce groundwater pumping and surface water diversion by utilizing conservation and storage*					
SONCC-ElkR.10.4.12	Water Quality	Yes	Improve flow timing or volume	Increase instream flows	Lower Elk River and tributaries downstream of confluence of Rock Creek	3b
SONCC-ElkR.10.4.12.1	*Determine instream flow needs for coho salmon, utilize existing USGS gauging station information*					
SONCC-ElkR.10.4.12.2	*Perform a groundwater study to determine the volume of aquifer storage and the role of aquifers in streamflow*					
SONCC-ElkR.10.4.50	Water Quality	Yes	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-ElkR.10.4.50.1	*Determine instream flow needs for coho salmon, utilize existing USGS gauging station information*					
SONCC-ElkR.10.4.50.2	*Perform a groundwater study to determine the volume of aquifer storage and the role of aquifers in streamflow*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkR.2.7.2	Floodplain and Channel Structure	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Private lands subject to development and Panther, Red Cedar, and Blackberry creeks, middle mainstem Elk River	3b
SONCC-ElkR.2.7.2.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-ElkR.2.7.2.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat*					
SONCC-ElkR.2.7.30	Floodplain and Channel Structure	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	BLM lands	3b
SONCC-ElkR.2.7.30.1	*Manage timber harvest (and associated activities) on Federal lands in accordance with the Aquatic Conservation Strategy of the NWFP to achieve riparian and stream channel improvements for coho salmon*					
SONCC-ElkR.2.2.28	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Assess estuary and tidal wetland habitat	Estuary	3b
SONCC-ElkR.2.2.28.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-ElkR.2.2.28.2	*Complete a full assessment of the estuary using identified parameters*					
SONCC-ElkR.2.2.28.3	*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*					
SONCC-ElkR.5.1.11	Passage	No	Improve access	Remove barriers	Swamp Creek, unnamed tributary above Highway 101, Bagely Creek, Chapman Creek, Blackberry Creek, and other streams downstream of confluence of Rock Creek and the mainstem Elk River.	3b
SONCC-ElkR.5.1.11.1	*Evaluate and prioritize barriers for removal*					
SONCC-ElkR.5.1.11.2	*Remove barriers, based on evaluation*					
SONCC-ElkR.5.1.54	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-ElkR.5.1.54.1	*Evaluate and prioritize barriers for removal*					
SONCC-ElkR.5.1.54.2	*Remove barriers, based on evaluation*					
SONCC-ElkR.7.1.39	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho salmon bearing streams	3b
SONCC-ElkR.7.1.39.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-ElkR.7.1.39.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkR.8.1.9	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All tributaries of the alluvial coastal plain downstream of Rock, Indian, and Bagley creeks. Priority is the Butler Creek watershed.	3b
SONCC-ElkR.8.1.9.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-ElkR.8.1.9.2	*Decommission roads, guided by assessment*					
SONCC-ElkR.8.1.9.3	*Upgrade roads, guided by assessment*					
SONCC-ElkR.8.1.9.4	*Maintain roads, guided by assessment*					
SONCC-ElkR.8.1.55	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-ElkR.8.1.55.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-ElkR.8.1.55.2	*Decommission roads, guided by assessment*					
SONCC-ElkR.8.1.55.3	*Upgrade roads, guided by assessment*					
SONCC-ElkR.8.1.55.4	*Maintain roads, guided by assessment*					
SONCC-ElkR.10.2.14	Water Quality	Yes	Reduce pollutants	Educate stakeholders	Lower Elk River and tributaries downstream of confluence of Rock Creek	3d
SONCC-ElkR.10.2.14.1	*Develop an educational program that promotes Salmon Safe methods for agricultural operations and Integrated Pest Management for rural residents*					
SONCC-ElkR.10.2.35	Water Quality	Yes	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-ElkR.10.2.35.1	*Develop a pesticide management plan*					
SONCC-ElkR.10.2.35.2	*Implement pesticide management plan and technical assistance program*					
SONCC-ElkR.16.1.16	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ElkR.16.1.16.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-ElkR.16.1.16.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ElkR.16.1.17	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ElkR.16.1.17.1		*Determine actual fishing impacts*				
SONCC-ElkR.16.1.17.2		*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*				
SONCC-ElkR.16.2.18	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ElkR.16.2.18.1		*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*				
SONCC-ElkR.16.2.18.2		*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*				
SONCC-ElkR.16.2.19	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ElkR.16.2.19.1		*Determine actual impacts of scientific collection*				
SONCC-ElkR.16.2.19.2		*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*				
SONCC-ElkR.1.4.7	Estuary	No	Protect estuarine habitat	Improve regulatory mechanisms	Estuary	3d
SONCC-ElkR.1.4.7.1		*Limit development and filling of estuarine habitat through the development of regulatory mechanisms such as county or city ordinances*				
SONCC-ElkR.1.4.7.2		*Maintain or strengthen current estuarine protection measures*				
SONCC-ElkR.10.7.47	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-ElkR.10.7.47.1		*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*				
SONCC-ElkR.10.7.47.2		*Supply marine-derived nutrients to streams guided by the plan*				

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8. Brush Creek Population

Northern Coastal Stratum

Dependent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

12 mi^2 watershed (35% Federal ownership)

6 IP-km (4 IP-mi) (18% High)

Dominant Land Uses are Recreation, Timber Harvest

Key Limiting Stresses are ‘Lack of Floodplain and Channel Structure’ and ‘Degraded Riparian Forest Conditions’

Key Limiting Threats are ‘Roads’ and ‘Timber Harvest’

Highest Priority Recovery Actions

• Improve timber harvest practices by revising Oregon Forest Practices Act • Reduce road-stream hydrologic connection • Reduce pollutants from runoff, minimize impervious surfaces	• Increase riparian vegetation • Reduce pollutants by increasing application of Low Impact Development (LID) techniques

8.1 History of Habitat and Land Use

Maguire (2001b) notes the Brush Creek watershed is poorly studied and the reported history of land use in the area is inconsistent. The creek bottom was the main trail north and south for Native Americans and then white settlers. A road was built through Brush Creek canyon just after 1920. The State of Oregon made its first purchase of land for Humbug Mountain State Park in 1926 and continued to expand the park to its current size (1800 acres) over the following 50 years. Maguire (2001b) could not substantiate whether there was a mill in middle Brush Creek reaches, but historic timber harvest was widespread. Although Maguire (2001b) did not mention recent timber harvest, it is evident in aerial photos because of the early seral conditions (Figure 8-1). The Highway 101 corridor confines the stream for long reaches and constitutes the most significant disturbance in the Brush Creek basin.

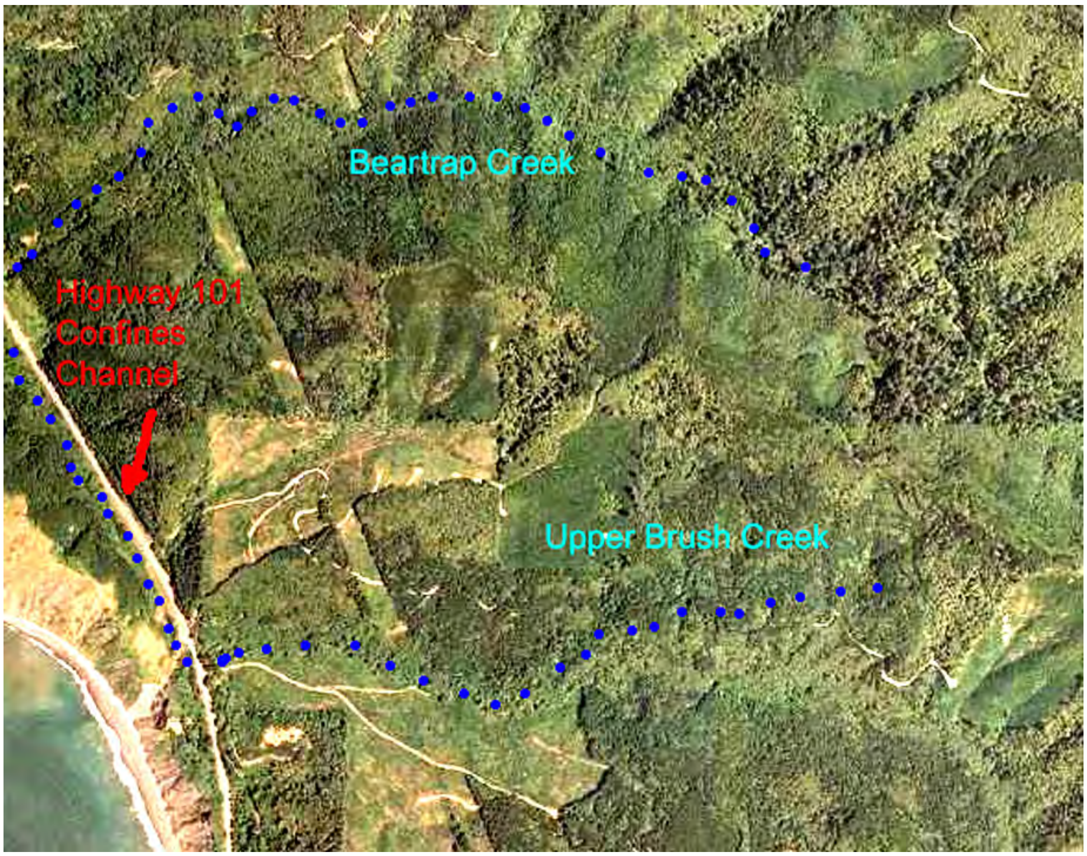

Figure 8-1. Upper Brush and tributary Beartrap Creek watersheds Photo shows power line corridor, extensive timber harvest and Highway 101 running right along the stream. Blue dots approximate USGS (1984) streams.

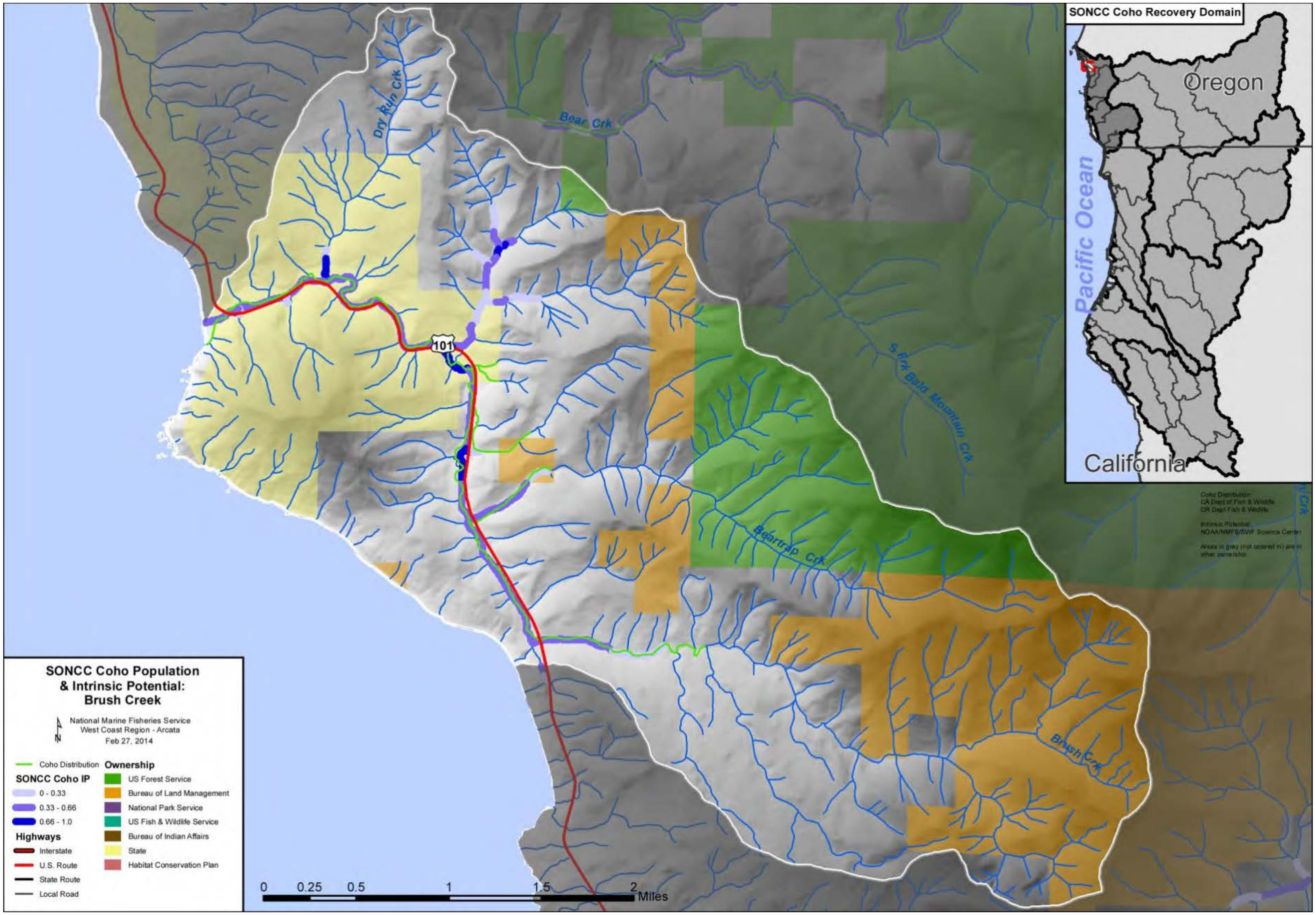

Figure 8-2. The geographic boundaries of the Brush Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

8.2 Historic Fish Distribution and Abundance

The Brush Creek basin is one of three coho salmon populations near Port Orford, Oregon (Maguire 2001b). Brush Creek has a higher gradient and greater natural valley confinement than its neighbor to the north, Hubbard Creek, with the bulk of high IP (>0.66) concentrated in the middle mainstem (Figure 8-2). Upper mainstem Brush Creek and the majority of Beartrap Creek are too steep for successful use by coho salmon. Table 8-1 lists the high intrinsic potential reaches and tributaries of Brush Creek.

Table 8-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Brush Creek mainstem	Dry Run Creek	Unnamed tributary (lower Brush)

8.3 Status of Brush Creek Coho Salmon

Spatial Structure and Diversity

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access have diverged from historical conditions, the greater the extinction risk. The confined mainstem channel conditions caused by Highway 101 restrict coho salmon use due to changes in stream velocity. ODFW (2005a) snorkeled two reaches, bracketing the area upstream and downstream of where Brush Creek first meets Highway 101, and found coho salmon in both reaches at very low densities (0.002 and 0.071 juveniles/m^2) in 2003 but did not find them in those same reaches in 2002. This suggests few adult spawners find suitable habitat in the Brush Creek basin, resulting in reduced diversity of the gene pool.

Population Size and Productivity

The very low density of coho salmon juveniles in Brush Creek found by ODFW in 2003 is likely associated with low adult population size caused by a reduction in the creek's carrying capacity due to channelization.

Extinction Risk

Not applicable because Brush Creek is not an independent population.

Role in SONCC Coho Salmon ESU Viability

The Brush Creek population is considered dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and would likely receive sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006). Although such populations are not viable on their own, they do increase connectivity by allowing dispersal among independent populations and provide areas of refugia for other populations, acting as a source of colonists in some cases. The Brush Creek population likely interacts with other Northern Coastal dependent populations of coho salmon, such as Mussel Creek, as well as larger independent populations such as those in the Elk and Rogue rivers. Any restored habitat in

Brush Creek provides potential connectivity that assists metapopulation function in the SONCC ESU.

8.4 Plans and Assessments

State of Oregon

Expert Panel Limiting Factors Report for Southwest Oregon

ODFW (2008b) convened a panel of fisheries and watershed science experts as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the concerns for the Brush Creek population as follows:

Key concerns in Brush Creek were primarily loss of over-winter tributary habitat complexity and floodplain connectivity for juveniles, especially in the lowlands which are naturally very limited in this system and have been impacted by past and current urban, rural residential, and forestry development and practices. A diversion that flows over a cliff and into the ocean is also a key concern. Secondary concerns were related to a loss of over-winter, lowland habitat complexity due to past and current agricultural practices. In addition, high water temperatures in the summer due to a loss of riparian function and channel straightening, stress coho salmon juveniles.

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The state of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is comprehensive and includes voluntary actions for all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary. The action plans, implementation, and annual reports can be found at the web site.

South Coast Watersheds Council

Port Orford Watershed Assessment

The Port Orford Watershed Assessment (Maguire 2001b) is a summary of conditions, historic changes, and restoration needs for Mill, Hubbard, and Brush creeks.

Port Orford Action Plan

The Port Orford Action Plan (Massingill 2001b) is a companion document to the Watershed Assessment. The action plan describes a restoration strategy with specific recommended actions.

8.5 Stresses

Table 8-2. Severity of stresses affecting each life stage of coho salmon in Brush Creek. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	High	High	Very High
3	Altered Hydrologic Function	Medium	High	High	High	High	High
4	Altered Sediment Supply	Low	Medium	High	Medium	Low	Medium
5	Impaired Estuary/Mainstem Function	-	Low	Low	Medium	Low	Low
6	Impaired Water Quality	Low	Low	Low	Low	Low	Low
7	Barriers	-	Low	Low	Low	Low	Low
8	Adverse Fishery- and Collection- Related Effects	-	-	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.
[2]Increased Disease/Predation/Competition is not a considered a stress for this population.

Key Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat is lacking. The key limiting stresses for this population are lack of floodplain and channel structure and degraded riparian forest conditions. Degraded riparian conditions eliminated the source of large wood recruitment. Most historically available habitat in the estuary has been altered by development, channelization, and diking. These findings are consistent with those of the Oregon Expert Panel (ODFW 2008b).

Lack of Floodplain and Channel Structure

Highway 101 has caused major alterations to the Brush Creek channel, including relocation and confinement. This channel confinement resulted in increased velocity, which compromises adult coho salmon passage and decreases the quality of summer and winter rearing habitat. These high velocities could also increase bedload movement in confined reaches, leading to bed scour and loss of eggs and alevins. Large wood supply in Brush Creek is limited according to ODFW habitat data, and pool frequency is low. Where large wood has been restored to the channel, it has increased pool depth and created more complex habitats.

Degraded Riparian Forest Conditions

There are few large conifers in the riparian zone of Brush Creek above Humbug Mountain State Park, except for large trees in the headwaters of Brush Creek which are well above the range of coho salmon. The remainder of Brush Creek's riparian zone is comprised of hardwoods, including willow and alder. These species do not provide long lasting large wood for channel forming processes (Cederholm et al. 1997). Riparian development is impeded by the highway in some channelized sections. ODFW found the lower mainstem of Brush Creek has poor riparian conditions (<75 conifers 36" diameter at breast height/1000 feet) due to development of campgrounds and recreational access.

Altered Sediment Supply

Altered sediment supply poses an overall medium stress to coho salmon in Brush Creek. Sediment contribution from landslides and erosion occurs naturally in the Brush Creek basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. Habitat surveys in the lower section of Brush Creek found poor (>17 percent fines) silt/sand surface conditions except in reaches confined by Highway 101, where scores rose to good levels (12 to 15 percent fines). Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. Poor pool frequency and depth throughout the Brush Creek basin is likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening.

Impaired Estuary/Mainstem Function

Estuary function is important to the population because of its unique role in the life history and survival of coho salmon (Miller and Sadro 2003, Koski 2009). Brush Creek meets the Pacific Ocean after passing through a narrow canyon opening spanned by Highway 101. The estuary is surrounded by very steep and unstable land at the base of Humbug Mountain and along the creek to the north. Although small, this estuary remains in good condition, with land being protected within Humbug Mountain State Park. The estuary/lagoon currently has little cover and complexity and has very little salmon rearing habitat. Because the estuary is naturally small, this lack of rearing habitat is not considered a threat for juveniles. However, lagoon breaching during the summer months may be affected by excess fine sediment and cause stress to outmigrating smolts.

Figure 8-3. Mouth of Brush Creek. Photo shows poorly developed estuary/lagoon, visible as a depression in the sandy beach that affords little opportunity for salmonid juvenile rearing.

Impaired Water Quality

Brush Creek's maximum floating weekly average water temperature (MWMT) value of less than 16 °C is well under the ODEQ criteria of 18.4 °C (64° F). Pesticide and herbicide use on both public and private lands contribute deleterious effects to water quality in Brush Creek. More significantly, Brush Creek's immediate adjacency to Highway 101 along most of its main stem makes it particularly vulnerable to herbicides from the Oregon Department of Transportation's vegetation management program for invasive weed control.

Barriers

Maguire (2001b) reports only one potential barrier to juvenile salmonids in the Brush Creek basin, which is at the mouth of Dry Run Creek.

Altered Hydrologic Function

There are no dams or low-flow diversions in Brush Creek other than for use at Humbug Mountain State Park. However, timber harvest and associated roads may result in altered peak flows (Grant et al. 2008). In addition, to prevent flooding of Highway 101 high flows greater than a 15 year event are diverted off a cliff into the ocean through an overflow channel about 3 miles upstream of the mouth (NMFS 2005a) (see Dams/Diversions section below). Runoff from Highway 101 enters Brush Creek directly and significantly adds to storm flow intensities.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Brush Creek population area. Hatchery-origin adults may stray into the population area; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

8.6 Threats

Table 8-3. Severity of threats affecting each life stage of coho salmon in Brush Creek. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Channelization/Diking	High	High	High	High	High	High
3	Timber Harvest[1]	High	High	High[1]	High	Medium	High
4	Climate Change	Low	Low	Medium	Medium	Medium	Medium
5	High Severity Fire	Low	Low	Low	Low	Low	Low
6	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
7	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
8	Dams/Diversions	Low	Medium	Medium	Medium	Low	Medium
9	Fishing and Collecting	-	-	Low	Low	Low	Low
10	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.
[2]Agricultural Practices, Mining/Gravel Extraction, and Invasive and Non-Native/Alien Species are not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and timber harvest.

Roads

A greater problem than high overall road densities is the fact that Highway 101 follows and confines almost the entire mainstem of Brush Creek.

Channelization/Diking

Channelization and diking pose a high threat to Brush Creek coho salmon because of the effects of Highway 101, which runs adjacent to most of the creek's mainstem. The highway causes confinement, accelerated currents and channel simplification, all of which adversely affect coho salmon. Development of campgrounds and day use recreation areas on the former flood terrace of the stream also confine the channel.

Timber Harvest

Timber harvesting in Brush Creek between 1972 and 1992 was less than 10 percent, except for patches of more intense activity where elevated road densities are also apparent (Bredensteiner et al. 2003). Maguire (2001b) produced a timber harvest map (Figure 8-4) that shows outlines of logged areas but does not provide information on when harvests took place or the harvest methods. Timber harvests in riparian zones and in headwater areas are likely to have played a role in decreased large wood supply. Forestry practices, past and present, in rain-dominated watersheds may combine to increase hydrologic risk as past practices may still be influencing the routing of water and causing channel modifications or increased fine sediment routing and turbidity (Maguire 2001b).

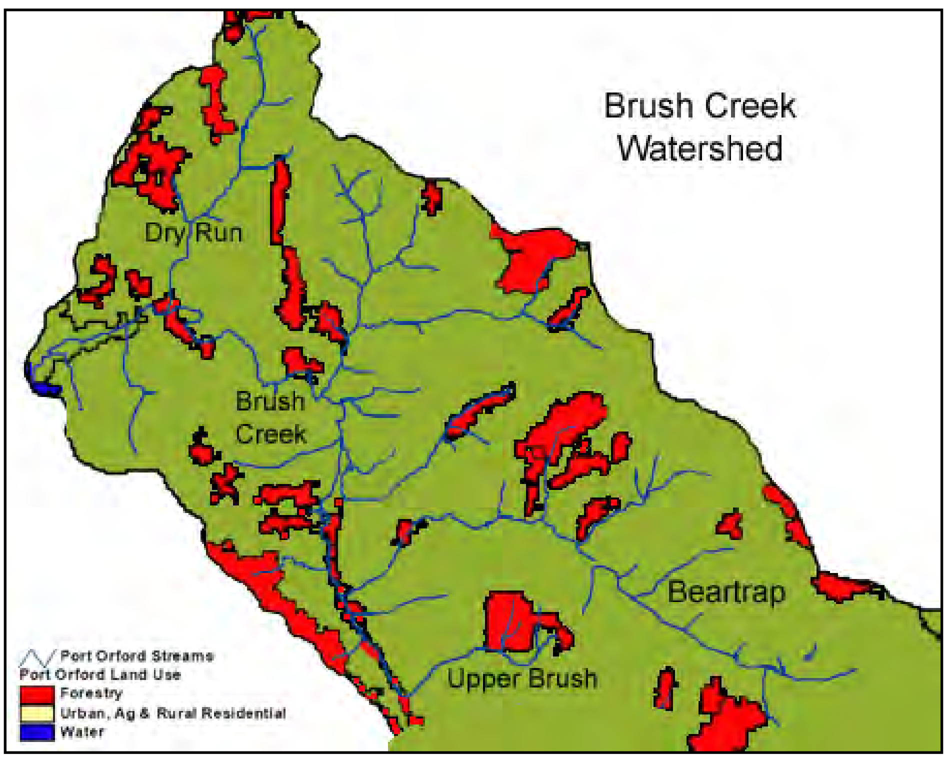

Figure 8-4. Map of timber harvest. This map was adapted from the Port Orford Watershed Assessment (Maguire 2001b) with polygons of timber harvests filled in with red. No metadata are available to understand harvest methods or dates.

Climate Change

There is low risk of change in average precipitation over the next 50 years (Appendix B). Modeled regional average temperature shows a moderate increase over the next 50 years (Appendix B). Average temperature could increase by up to 1^{o} C in the summer and by a similar amount in the winter. The risk of sea level rise is high (Thieler and Hammer-Klose 2000), which may impact the quality and extent of wetland juvenile and smolt habitat. Adults may be negatively impacted by climate-related ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

High Severity Fire

Brush Creek lies within the immediate coastal strip of southern Oregon and is subject to marine temperature mediation resulting in moist cool summers and high rainfall during fall, winter and spring. These attributes combine for a generally wet environment year-round and as a result a low threat score for fire.

Urbanization/Residential/Industrial Development

There is a relatively low level of urban and rural residential development in the Brush Creek basin.

Road-stream Crossing Barriers

A potential road-stream crossing barrier for juvenile coho salmon and other salmonids has been identified at the mouth of Dry Run Creek (Maguire 2001b).

Dams/Diversions

Near where Brush Creek first meets Highway 101, an overflow channel diverts peak flows from Brush Creek off a steep cliff into the ocean (NMFS 2005a). The overflow reduces roadway flooding downstream, but is unscreened and any coho entrained are killed. The overflow is now triggered during flows greater than 700 cubic feet per second (cfs), which are expected to occur on average once every 15 years.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Brush Creek population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

8.7 Recovery Strategy

The most immediate need for habitat restoration and threat reduction in Brush Creek is in those areas currently occupied by coho salmon, which according to the limited available data is the mainstem of Brush Creek. Unoccupied areas must also be restored to provide enough habitat for coho salmon to complete their life cycle.

The Brush Creek population is considered dependent and therefore cannot be viable on its own; however, restoring habitat within the basin is necessary so that the basin can support all life stages of coho salmon and provide connectivity between other populations in the ESU. The recovery criterion for this population is that 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival. Despite impaired habitat conditions, Brush Creek has maintained use by coho salmon, possibly through straying from larger independent populations like the Elk River and Rogue River nearby. Highway 101, which is not likely to be relocated, is the major impediment to achieving full coho salmon potential in Brush Creek.

The most important factor limiting recovery of coho salmon in Brush Creek is a deficiency in the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by increasing habitat complexity within the channel, re-establishing off-channel rearing areas, restoring riparian forests, and reducing threats to instream habitat. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 8-4 on the following page lists the recovery actions for the Brush Creek population.

Table 8-4. Recovery action implementation schedule for the Brush Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID / *Step ID*	Target	KLS/T	Strategy / *Step Description*	Action Description	Area	Priority
SONCC-BruC.2.1.29	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2c
SONCC-BruC.2.1.29.1			*Assess habitat to determine beneficial location and amount of instream structure needed*			
SONCC-BruC.2.1.29.2			*Place instream structures, guided by assessment results*			
SONCC-BruC.19.1.2	Timber Harvest	Yes	Improve timber harvest practices	Improve regulatory mechanisms	Population wide	2b
SONCC-BruC.19.1.2.1			*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*			
SONCC-BruC.19.1.2.2			*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*			
SONCC-BruC.19.1.2.3			*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*			
SONCC-BruC.19.1.2.4			*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*			
SONCC-BruC.19.1.2.5			*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams.*			
SONCC-BruC.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Mainstem within Humbug Mountain State Park, and all streams where coho salmon would benefit immediately	2b
SONCC-BruC.2.1.1.1			*Assess habitat to determine beneficial location and amount of instream structure needed*			
SONCC-BruC.2.1.1.2			*Place instream structures, guided by assessment results*			
SONCC-BruC.28.2.11	Roads	Yes	Reduce pollutants and stormflow	Educate stakeholders	Highway 101 and campgrounds	2b
SONCC-BruC.28.2.11.1			*Develop stormwater management plan, consistent with ODEQ specifications, to minimize non-point source pollution from entering Brush Creek from HWY 101 and campgrounds*			
SONCC-BruC.2.1.18	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve regulatory mechanisms	Population wide	2c
SONCC-BruC.2.1.18.1			*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*			
SONCC-BruC.2.2.9	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2c
SONCC-BruC.2.2.9.1			*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*			
SONCC-BruC.2.2.9.2			*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*			

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-BruC.2.2.31	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-BruC.2.2.31.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-BruC.2.2.31.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-BruC.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Lower mainstem	2c
SONCC-BruC.2.2.3.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for landowners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-BruC.2.2.3.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-BruC.2.2.3.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-BruC.2.2.30	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2d
SONCC-BruC.2.2.30.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for landowners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-BruC.2.2.30.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-BruC.2.2.30.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-BruC.28.2.20	Roads	Yes	Reduce pollutants and stormflow	Increase regulatory oversight	Population wide	2c
SONCC-BruC.28.2.20.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-BruC.28.2.20.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-BruC.28.2.20.3	*Develop local regulatory mechanisms that limits development and reduces amount of total impervious area through incentives*					
SONCC-BruC.8.1.10	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	2c
SONCC-BruC.8.1.10.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-BruC.8.1.10.2	*Decommission roads, guided by assessment*					
SONCC-BruC.8.1.10.3	*Upgrade roads, guided by assessment*					
SONCC-BruC.8.1.10.4	*Maintain roads, guided by assessment*					
SONCC-BruC.8.1.33	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2d
SONCC-BruC.8.1.33.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-BruC.8.1.33.2	*Decommission roads, guided by assessment*					
SONCC-BruC.8.1.33.3	*Upgrade roads, guided by assessment*					
SONCC-BruC.8.1.33.4	*Maintain roads, guided by assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-BruC.7.1.6	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Lower mainstem, estuary/lagoon	3c
SONCC-BruC.7.1.6.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-BruC.7.1.6.2	*Thin, or release conifers, guided by the plan*					
SONCC-BruC.7.1.6.3	*Plant conifers, guided by the plan*					
SONCC-BruC.7.1.19	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho bearing streams	3c
SONCC-BruC.7.1.19.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-BruC.7.1.19.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					
SONCC-BruC.5.1.7	Passage	No	Improve access	Remove barriers	Mouth of Dry Run Creek	3c
SONCC-BruC.5.1.7.1	*Assess and prioritize barrier*					
SONCC-BruC.5.1.7.2	*Remove barrier, based on evaluation*					
SONCC-BruC.5.1.32	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-BruC.5.1.32.1	*Assess and prioritize barriers using the ODFW fish passage barrier database*					
SONCC-BruC.5.1.32.2	*Remove barriers, based on evaluation*					
SONCC-BruC.10.7.27	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-BruC.10.7.27.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-BruC.10.7.27.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-BruC.10.7.28	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-BruC.10.7.28.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-BruC.10.7.28.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-BruC.10.2.17	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	3d
SONCC-BruC.10.2.17.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-BruC.10.2.17.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					

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9. Mussel Creek Population

Northern Coastal Stratum

Dependent Population

Recovery criteria: 80% of IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

14 mi^2 watershed (2% Federal ownership)

6 IP-km (4 IP-mi) (50% High)

Dominant Land Uses are Timber Harvest and Recreation

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Degraded Riparian Forest Conditions'

Key Limiting Threats are 'Timber Harvest' and 'Channelization/Diking'

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, or other instream structure • Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows • Improve timber harvest practices by revising Oregon Forest Practices Act	• Increase beaver abundance • Improve grazing practices • Reduce pollutants, minimize impervious surfaces

9.1 History of Habitat and Land Use

Mussel Creek empties into the Pacific Ocean just south of Port Orford between Brush and Euchre creeks. Historically, a trail likely passed through the lower basin, and became a road for automobiles in the 1920s prior to eventually becoming Highway 101 (Maguire 2001b). The roadway has caused the South Fork of Mussel Creek to be realigned, which resulted in a loss of habitat suitability for coho salmon. Tourist attractions, such as the Prehistoric Gardens and the Arizona Beach campground, are in the floodplain of lower Mussel Creek and Myrtle Creek.

Data for timber harvest on private lands are not available for the Mussel Creek basin, but aerial photos indicate timber has been harvested from most of the basin except for a small patch below Highway 101, adjacent to Prehistoric Gardens. Active timber harvest continues and road densities are high in this basin. In addition, Mussel Creek has very steep slopes, which likely facilitated sediment transport to the creeks during and after land disturbing activities. Myrtle Creek serves as an example of these channel changes; it loses surface flow in late summer and early fall possibly due to excessive fine sediment loads from steep, managed land near the headwaters. Additionally, the stream channel has been straightened and channelized to maximize space for camping and recreation. These impacts have made approximately 50 percent of the area with high intrinsic potential for coho salmon habitat currently uninhabitable and difficult to restore.

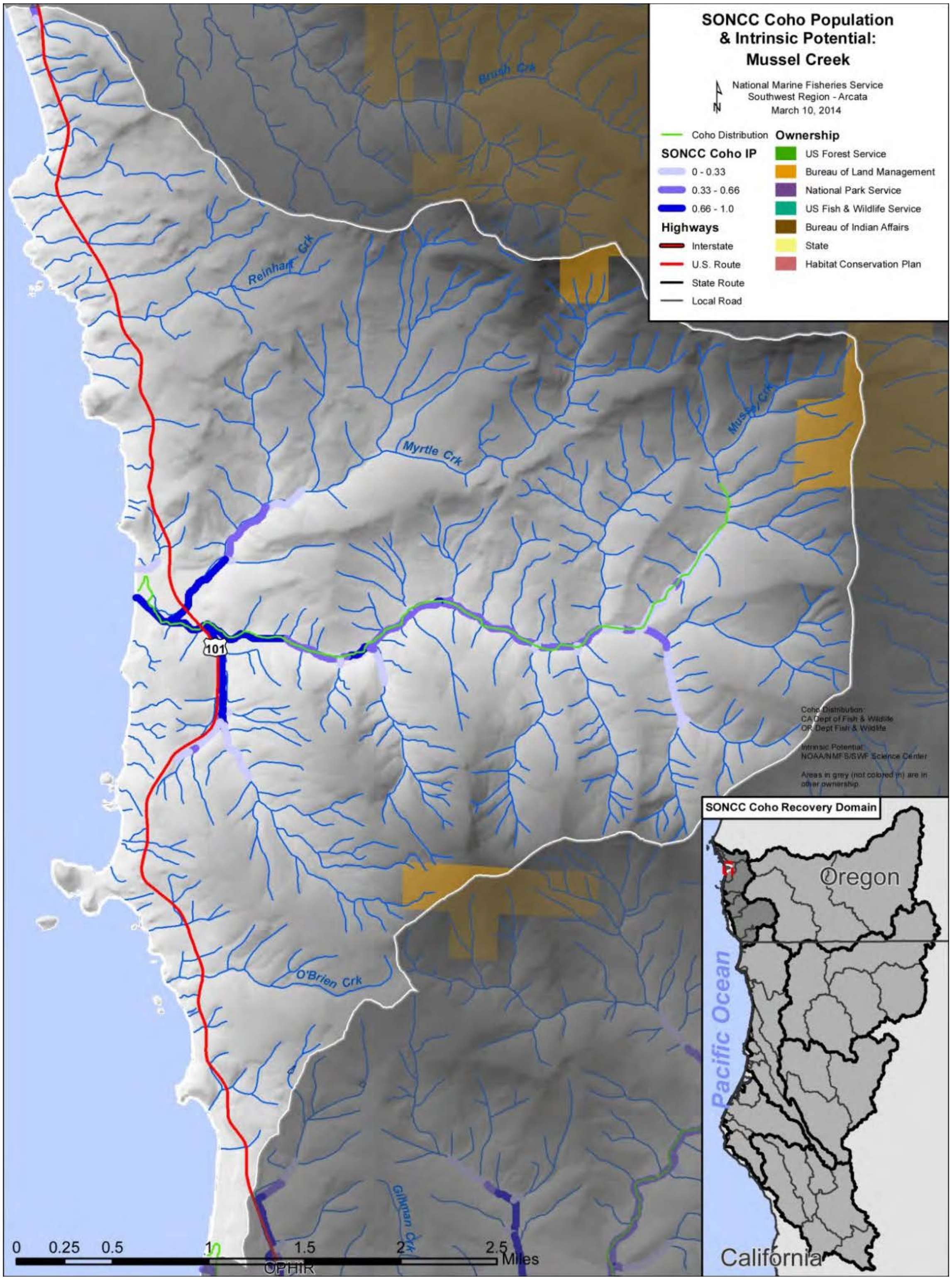

Figure 9-1. The geographic boundaries of the Mussel Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

9.2 Historic Fish Distribution and Abundance

No information is available about the historic distribution and abundance of coho salmon in Mussel Creek.

Table 9-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Lower Mussel Creek	Myrtle Creek	South Fork Mussel Creek

9.3 Status of Mussel Creek Coho Salmon

Spatial Structure and Diversity

Much of the high IP in Mussel Creek is not currently suitable because the South Fork is channelized and re-routed by Highway 101. The major tributary, Myrtle Creek, is also channelized and loses surface flows during the summer and fall. Approximately 50 percent of high IP in the basin has been degraded due to channelization and straightening. Additionally, mainstem Mussel Creek lacks sufficient depth and other channel features necessary to be fully functional for coho salmon rearing. Available data show coho salmon are restricted to mainstem Mussel Creek when present, and that no coho salmon were observed during recent juvenile surveys in 2002 and 2003 (Oregon Department of Fish and Wildlife [ODFW] 2005a). The small population size in Mussel Creek suggests restricted genetic diversity.

Population Size and Productivity

The Mussel Creek population is presumed to be nearly extirpated based on recent juvenile surveys, impaired habitat conditions, and the lack of any other information to indicate that coho salmon currently spawn or rear in the basin. The productivity and size of this population is driven not only by the dynamics of the Mussel Creek population, but by those of nearby populations as well, which contribute spawners as strays. However, the supply of strays to Mussel Creek is not expected to be substantial or consistent in the near term because most adjacent populations in the SONCC coho salmon ESU are at low levels.

Extinction Risk

Not applicable because Mussel Creek is not an independent population.

Role in SONCC Coho Salmon ESU Viability

The Mussel Creek population is considered dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and would likely receive sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006). Although such populations are not viable on their own, they do increase connectivity by allowing dispersal among independent populations and provide areas of refugia for other populations, acting as a source of colonists in some cases. Historically the Mussel Creek population would have interacted with other Northern Coastal dependent populations of coho salmon, such as those in

Brush Creek, as well as larger independent populations such as those in the Elk and Rogue Rivers. Any restored habitat in Mussel Creek provides potential connectivity that assists metapopulation function in the ESU.

9.4 Plans and Assessments

State of Oregon

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The State of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is a comprehensive plan that includes voluntary actions to address all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs described in the Oregon Plan were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary.

Report of the Oregon Expert Panel on Limiting Factors

ODFW (2008b) convened a panel of fisheries and watershed science experts as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the concerns for the Mussel Creek population as follows:

> Key concerns in Mussel Creek were primarily loss of over-winter tributary habitat complexity and floodplain connectivity for juveniles, especially in the lowlands which are naturally very limited in these systems and have been impacted by past and current urban, rural residential, and forestry development and practices. Secondary concerns were related to a loss of over-winter, lowland habitat complexity due to past and current agricultural practices. In addition, high water temperatures exist for summer parr due to a loss of riparian function and channel straightening.

Cumulative Effects of Southwest Oregon Coastal Land Use on Salmon Habitat

Oregon State University (OSU) Oak Creek Labs conducted a study funded by ODFW and the Oregon Department of Forestry (ODF) to determine relationships between forest harvest and Pacific salmon productivity (Frissell 1992). The study assessed basins along the Oregon coast extending from the Sixes River to the southern border during the period from 1986 to 1992.

9.5 Stresses

Table 9-2. Severity of stresses affecting each life stage of coho salmon in Mussel Creek. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	Low	Very High	Very High[1]	Very High	Very High	Very High
2	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	Very High	Very High	Very High
3	Altered Sediment Supply	High	High	High	High	High	High
4	Impaired Estuary/Mainstem Function	-	Medium	High	High	Medium	High
5	Impaired Water Quality	Medium	Medium	Medium	Low	Low	Medium
6	Barriers	-	Low	Low	Low	Low	Low
7	Altered Hydrologic Function	Low	Medium	High	High	Low	High
8	Adverse Fishery- and Collection- Related Effects	-	-	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.
[2] Increased Disease/Predation/Competition is not considered a stress for this population.

Key Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking as vital habitat for the population. The key limiting stresses for this population are lack of floodplain and channel structure and degraded riparian forest condition. Winter rearing habitat is often formed by instream large wood, but is also found in estuaries and floodplain wetlands. Timber removal has decreased the source of large wood, and much of the historically available habitat in the estuary and floodplain wetlands has been altered by development and channelization. The IP habitat in the Mussel Creek basin is concentrated in the flattest parts of the basin, near the ocean, which is where the development occurs. Off-channel juvenile rearing habitat with suitable temperature is vital to coho salmon recovery in this creek, but is very impaired. These findings are consistent with those of the Oregon Expert Panel (Section 9.4).

Lack of Floodplain and Channel Structure

In many areas, the creek and its tributaries are disconnected from the floodplain. Channelization of Myrtle Creek and the South Fork Mussel Creek eliminated meanders and side channels that would have provided summer and winter coho salmon rearing habitat. Coho salmon juveniles prefer pools formed by large wood, but habitat surveys show less than one key piece per 100 meters in the middle reach of Mussel Creek upstream of the highest IP habitat, which rates as poor according to ODFW standards. The upper reach of Mussel Creek had 1 to 2 key pieces of large wood per 1000 feet, which rates as fair.

Figure 9-2. Photo of the Myrtle Creek channel. View is looking downstream just above its convergence with Mussel Creek. Surface flow has been lost, and the stream has been channelized. Photo taken on 9/18/2008.

Pool frequency in the upper reach of Mussel Creek was rated as (10 to 20 percent) according to ODFW standards. The good rating (20 to 35 percent) in the middle reach of Mussel Creek likely represents a substantial reduction in pool frequency from historic conditions, given the level of disturbance in the basin. Pool depth is poor (average less than 2 feet) in the entire sampled area.

Degraded Riparian Forest Conditions

Without proper riparian forests, Mussel Creek has no mechanism for recruitment of large wood, which would trap fine sediment and enhance habitat complexity (Chapter 3). Lack of riparian cover also decreases shade and thermal buffering, and reduces formation of undercut banks. Habitat surveys of riparian conditions in the middle reaches of Mussel Creek found the area to be devoid of large conifers (>36" diameter at breast height), which translates to a poor riparian condition score using the ODFW criteria (<75 large conifers per 1000 feet of stream). Lack of large conifers in the riparian zone of much of the lower creek is also apparent. One short reach of Mussel Creek downstream Highway 101 contains a patch of late seral forest with a mature riparian canopy (Figure 9-3).

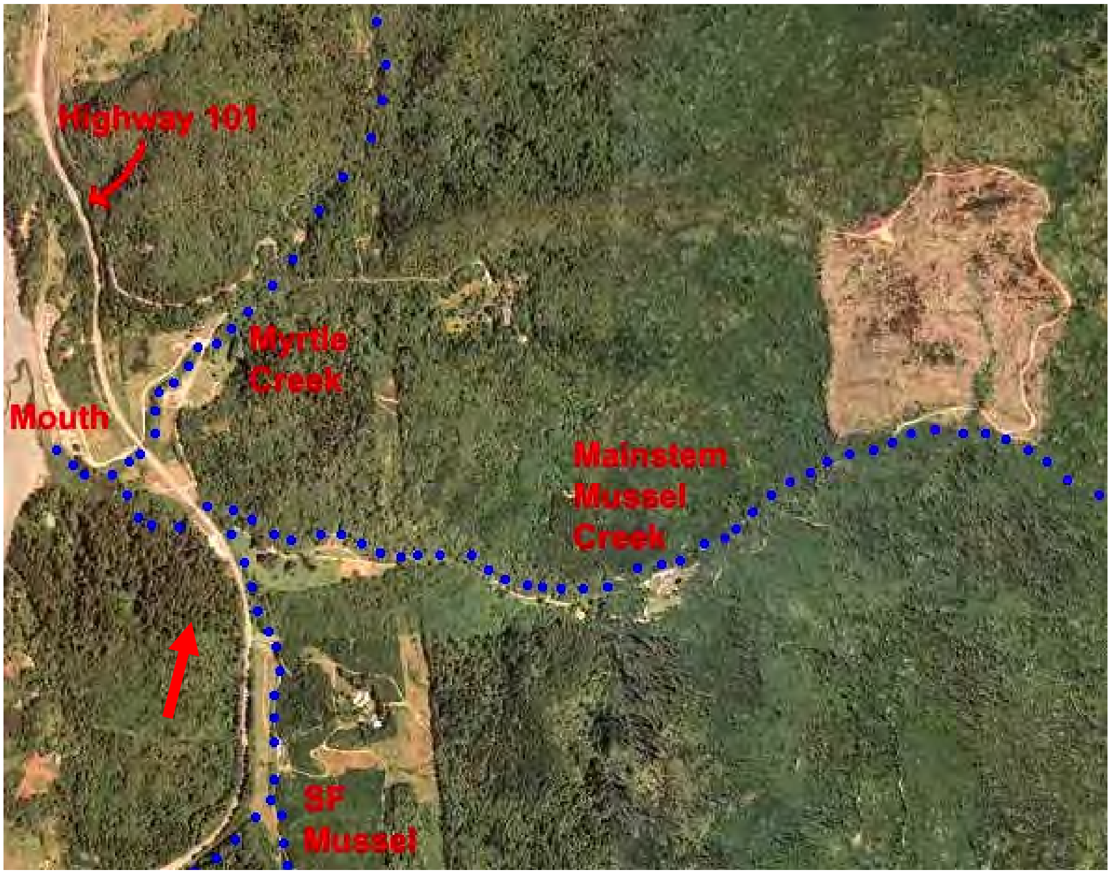

Figure 9-3. The lower reaches of Mussel, South Fork Mussel and Myrtle creeks in June 2005. Note the power line corridor in upper Myrtle riparian, Highway 101 confining South Fork, and a clearcut upper mainstem Mussel Creek. Arrow at lower-left points to patch of large trees, possibly old growth.

Altered Sediment Supply

Sediment contribution from landslides and erosion occurs naturally in the Mussel Creek basin. However, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. While the steeper reach further upstream rated good for surface fines (<12 percent), habitat surveys in the middle reaches of Mussel Creek found poor (>17 percent surface fines) silt/sand surface conditions. These middle reaches are where the high IP is located. The high percentage of industrial timberlands, high harvest rates and associated roads has increased the amount of fine sediment delivered to the streams. Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. Poor pool frequency and depth throughout the Mussel Creek basin is likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening.

Impaired Estuary/Mainstem Function

Little is known about the historic extent of estuarine area in Mussel Creek, but it is likely that development adjacent to the current estuary has reduced habitat. Currently the estuarine portion of Mussel Creek is confined to less than 10 acres of tidal sand and mudflat, and a few acres of tidal wetland habitat west of Highway 101 (Figure 9-4). Based on the natural drainage pattern and elevations in the area, much of the historical estuarine tidal area that once existed has likely been diked and filled to accommodate the highway, other small roads, and residential and agricultural development. Remaining habitat is largely degraded and provides little cover and foraging habitat.

Figure 9-4. Lagoon at the mouth of Mussel Creek. View is looking north. A sand bar blocks exchange of salt and fresh waters during periods of low flow. The lagoon is shallow, lacks cover, and likely provides limited habitat for juvenile salmonid rearing. (9/18/2008).

Impaired Water Quality

There are no water quality data available for Mussel Creek. Temperature problems are unlikely in Mussel Creek due to the proximity to the coast, topographic shading, short transit time, and likely contributions of groundwater from hollows throughout this steep basin. Turbidity is likely high during winter due to high road density and timber harvest in the basin. Potential sources of chemical water pollutants would be use of herbicides on industrial timberlands and leakage from septic systems at the campground, resorts, or the small number of rural residences in the basin.

Barriers

There are no known structural barriers to coho salmon passage in Mussel Creek. The dry reach of lower Myrtle Creek poses a potential seasonal impediment to passage.

Altered Hydrologic Function

The complex hydrology of Mussel Creek has been severely disrupted by Highway 101, debris torrents down Myrtle Creek, and development on the floodplain. Increased peak discharge is likely in the Mussel Creek basin, due to high road densities and widespread timber harvest. These peak flows can scour eggs and flush fry, juveniles, and smolts from the river system.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into Mussel Creek; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

9.6 Threats

Table 9-3. Severity of threats affecting each life stage of coho salmon in Mussel Creek. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Timber Harvest[1]	Very High	Very High	Very High[1]	Very High	Medium	Very High
2	Channelization/Diking[1]	High	Very High	Very High[1]	Very High	Very High	Very High
3	Roads	High	Very High	Very High	Very High	Very High	Very High
4	Urban/Residential/Industrial Dev.	High	High	High	High	High	High
5	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
6	Dams/Diversion	Low	Low	Medium	Low	Low	Low
7	Climate Change	Low	Low	Low	Low	Medium	Low
8	High Severity Fire	Low	Low	Low	Low	Low	Low
9	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
10	Fishing and Collecting	-	-	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.
[2]Invasive Non Native/Alien Species and Mining/Gravel Extraction are not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are timber harvest and channelization/diking.

Timber Harvest

Recent private timber harvest data are not readily available. However, Mussel Creek has the highest percentage of industrial timberlands managed under the Oregon Forest Practices Act. Active timber harvest on private lands within the Mussel Creek basin is widespread and occurring rapidly with the expectation it will continue. The high harvest rates and associated roads impact multiple aspects of coho salmon habitat. Studies of adjacent southwest Oregon basins found that "downstream, cumulative impacts of human activity are pervasive in southwest Oregon, wherever logging has occurred over an extensive portion of a drainage basin or has involved operations on steep, unstable slopes. The downstream effects of channel sedimentation and aggradation can severely damage streams even where buffer zones of riparian vegetation have been retained, and such effects persist more than 20-30 years after logging activities have ceased (Frissell 1992)."

Channelization/Diking

Highway 101 caused the relocation and straightening of most of the South Fork Mussel Creek channel, which altered more than 20 percent of the high IP in the Mussel Creek basin. The highway is not likely to be relocated and is a major impediment to restoring habitat in South Fork Mussel Creek; however, there is a meadow east of the creek that could potentially provide space for creation of a more complex channel. Myrtle Creek has also been channelized through the lower reach near the campground. A parking lot for beach access was constructed by rearranging deposited materials, which created a functional dike along the eastern lagoon border and reduced the lagoon area. While the number of developed properties is low (Prehistoric Gardens and a few rural residences), they overlap with the highest IP habitat. These most important reaches of Myrtle Creek, Mussel Creek and South Fork Mussel Creek have been pushed to the sides of their floodplains, channelized and diked.

Roads

Road densities in the Mussel Creek basin are over thresholds recognized as contributing to increased fine sediment yield and elevated peak flows. Roads are expected to cause fine sediment delivery into Mussel Creek because the basin is very steep and the geology is relatively unstable. The construction of Highway 101 has resulted in the channelization and realignment of the South Fork Mussel Creek, as well as parts of the mainstem Mussel Creek and Myrtle Creek. These impacts, along with excessive sedimentation from upslope activities, have altered the hydrology of these creeks and made them less suitable for coho salmon spawning and rearing. In addition, because of the small size of the Mussel Creek basin and the significant impacts of Highway 101 to high IP habitat in the basin, the highway continues to be a major threat to coho salmon in this basin.

Urban/Residential/Industrial Development

A resort (Prehistoric Gardens), a campground, and a day use recreation area (Arizona Beach) are operated in the floodplain of Mussel Creek. Additionally, an electrical power transmission line runs north-south across the South Fork and lower mainstem Mussel Creek and parallels the riparian zone of upper Myrtle Creek (Figure 9-3). Periodically, along this corridor all vegetation is removed. Other than the power lines, the existing developments are relatively small and are not expected to expand significantly. The recent acquisition and conversion of Arizona Beach from a privately operated campground facility to a state park should improve conditions in the basin.

Agricultural Practices

Cattle grazing occurs in the lower Mussel Creek floodplain adjacent to high IP. In the rest of the basin, agriculture is not a significant activity.

Dams/Diversions

No dams are known to exist in the valley and few water diversions are presently active.

Climate Change

There is low risk of average temperature increase, or change in average precipitation, over the next 50 years (Appendix B). The risk of sea level rise is moderate (Appendix B, Thieler and Hammer-Klose 2000). Adults may be negatively impacted by climate-related ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

High Severity Fire

The proximity of the Mussel Creek basin to the coast is a strong moderating factor on fire risk.

Road-Stream Crossing Barriers

Road-stream crossing barriers are not a significant threat to coho salmon in Mussel Creek based on the lack of known barriers that exist in the basin. Given the amount of timber harvest that has occurred in the basin and the density of roads in the lower basin, there are likely many partial or total barriers that have yet to be identified on private land. Based on the projected population growth in this area, an increase in road-stream crossings is not likely unless significant timber harvest resumes in roadless areas.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Mussel Creek population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

9.7 Recovery Strategy

Restoration efforts should be focused on lower Mussel Creek, South Fork Mussel Creek, and Myrtle Creek, which all have high IP (Figure 9-1).

The Mussel Creek population is considered dependent and therefore cannot be viable on its own; however, restoring habitat within the basin is necessary so that the basin can support all life stages of coho salmon and provide connectivity between other populations in the ESU. The recovery criterion for this population is that 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival. The most important factor limiting recovery of coho salmon in Mussel Creek is a deficiency in the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by increasing habitat complexity within the channel, re-establishing off-channel rearing areas, restoring riparian forests, increasing summer flow, and reducing threats to instream habitat. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 9-4 on the following page lists the recovery actions for the Mussel Creek population.

Table 9-4. Recovery action implementation schedule for the Mussel Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MusC.19.3.3	Timber Harvest	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2b
SONCC-MusC.19.3.3.2	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-MusC.19.3.3.3	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-MusC.19.3.3.4	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-MusC.19.3.3.5	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-MusC.19.3.3.6	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams.*					
SONCC-MusC.2.1.6	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	State park in lower mainstem and streams where coho salmon would benefit immediately	2b
SONCC-MusC.2.1.6.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MusC.2.1.6.2	*Place instream structures, guided by assessment results*					
SONCC-MusC.2.1.35	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2c
SONCC-MusC.2.1.35.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MusC.2.1.35.2	*Place instream structures, guided by assessment results*					
SONCC-MusC.2.2.4	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Lower mainstem and estuary, and streams where coho salmon would benefit immediately	2b
SONCC-MusC.2.2.4.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MusC.2.2.4.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MusC.2.2.36	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2c
SONCC-MusC.2.2.36.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MusC.2.2.36.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MusC.2.2.5	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Lower Mainstem and streams where coho salmon would benefit immediately	2b
SONCC-MusC.2.2.5.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-MusC.2.2.5.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-MusC.2.2.5.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-MusC.2.2.37	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2c
SONCC-MusC.2.2.37.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-MusC.2.2.37.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-MusC.2.2.37.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-MusC.7.1.1	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Lower mainstem and estuary	2c
SONCC-MusC.7.1.1.1	*Review General Plan or County Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-MusC.7.1.1.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat*					
SONCC-MusC.2.2.31	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2c
SONCC-MusC.2.2.31.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-MusC.7.1.19	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands and all areas where coho salmon would benefit immediately	3b
SONCC-MusC.7.1.19.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-MusC.7.1.19.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MusC.7.1.19.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MusC.7.1.40	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-MusC.7.1.40.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-MusC.7.1.40.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MusC.7.1.40.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-MusC.7.1.20	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho salmon bearing streams	3b
SONCC-MusC.7.1.20.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-MusC.7.1.20.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					
SONCC-MusC.22.1.21	Urban, Residential, Industrial Development	No	Reduce pollutants	Increase regulatory oversight	Population wide	3b
SONCC-MusC.22.1.21.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-MusC.22.1.21.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-MusC.22.1.21.3	*Develop local regulatory mechanisms that limits development and reduces amount of total impervious area through incentives*					
SONCC-MusC.5.1.8	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	3c
SONCC-MusC.5.1.8.1	*Use ODFW and SCWC fish passage barrier database to remove barriers based on known coho use or data identifying suitable habitat conditions above barriers*					
SONCC-MusC.5.1.39	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-MusC.5.1.39.1	*Use ODFW and SCWC fish passage barrier database to remove barriers based on known coho use or data identifying suitable habitat conditions above barriers*					
SONCC-MusC.3.1.18	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams with ODFW water rights for fish, and all streams where coho salmon would benefit immediately	3c
SONCC-MusC.3.1.18.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-MusC.3.1.38	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-MusC.3.1.38.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MusC.8.1.11	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	3c
SONCC-MusC.8.1.11.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MusC.8.1.11.2	*Decommission roads, guided by assessment*					
SONCC-MusC.8.1.11.3	*Upgrade roads, guided by assessment*					
SONCC-MusC.8.1.11.4	*Maintain roads, guided by assessment*					
SONCC-MusC.8.1.41	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MusC.8.1.41.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MusC.8.1.41.2	*Decommission roads, guided by assessment*					
SONCC-MusC.8.1.41.3	*Upgrade roads, guided by assessment*					
SONCC-MusC.8.1.41.4	*Maintain roads, guided by assessment*					
SONCC-MusC.10.7.33	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-MusC.10.7.33.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MusC.10.7.33.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MusC.10.7.34	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MusC.10.7.34.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MusC.10.7.34.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MusC.22.1.7	Urban, Residential, Industrial Development	No	Reduce pollutants	Educate stakeholders	Population wide	3d
SONCC-MusC.22.1.7.1	*Develop an educational program that teaches landowners about avoiding pollution from septic systems, backyard pesticides, fuels, and nutrients*					
SONCC-MusC.22.1.17	Urban, Residential, Industrial Development	No	Reduce pollutants	Increase regulatory oversight	Population wide	3d
SONCC-MusC.22.1.17.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-MusC.22.1.17.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					

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10. Lower Rogue River Population

Northern Coastal Stratum

Non-Core 1, Potentially Independent Population

High Extinction Risk

Population likely below depensation threshold

320 Spawners Required for ESU Viability

198 mi^2 watershed (58% Federal ownership)

81 IP-km (50 IP-mi) (24% High)

Dominant Land Uses are Timber Harvest and Agriculture

Key Limiting Stresses are ‘Lack of Floodplain and Channel Structure’ and ‘Impaired Water Quality’

Key Limiting Threats are ‘Roads’ and ‘Urban/Residential/Industrial Development’

Highest Priority Recovery Actions

• Improve timber harvest practices by revising Oregon Forest Practices Act	• Increase large woody debris (LWD), boulders, or other instream structure
• Reduce road-stream hydrologic connection	• Increase instream flows
• Re-connect and restore estuarine habitat	• Reduce impacts of mining

10.1 History of Habitat and Land Use

Historically, beaver ponds created ideal habitat for coho salmon and likely existed in side channels of the valley floor and in the lowlands of tributaries all the way to the estuary [Oregon Department of Fish and Wildlife (ODFW) 2005b]. Timber near the coast was in stands separated by large meadows, which were regularly burned by Native Americans (Hicks 2005). Anglo-American settlement began with the gold rush in 1853. Canneries were established as early as 1861 (Hicks 2005) on the shores of the estuary and thrived until salmon stocks were depleted around 1930. Around the same time, larger wood jams which interfered with net fishing or shipping were removed (Hicks 2005). Grazing was once widespread in the Lower Rogue River watershed (Hicks 2005), with tens of thousands of sheep and cattle feeding in upland prairies. In the early to mid-1900s, agricultural use shifted to development of dairies, which led to the clearing of riparian vegetation from river terraces for conversion to pasture (Hicks 2005). Streams with mild gradient and broad valleys (ideal coho salmon habitat) were ideal pasture land, so forests were cleared to accommodate grazing which led to simplified channels.

The most profound change to the Lower Rogue River resulted from timber harvest after World War II (U.S. Forest Service (USFS) 2000a). Most old growth timber in the Lower Rogue River sub-basin has been logged (USFS 1996b,USFS 1996a and 2000a; Hicks 2005), with remnant patches scattered on federal lands in basins like Quosatana, Silver, and Lobster creeks as well as in inner gorge tributaries of the mainstem Rogue River below Agness. The flood of 1964 devastated Lower Rogue River tributary channels and a wave of sediment swept through the lower mainstem (USFS 2000a). Low gradient streams (formerly the best sites for coho salmon spawning and rearing) were the most impacted by sediment depositions. Timber harvest on public lands resumed after 1970 and another wave of sediment was unleashed (USFS 1996b). The Lower Rogue continues to be impacted by the timber harvest that occurred on National Forest land during the 1970s and 1980s. During this period, harvests and expanding road networks were increasingly located on steep ground, and subsequent landslides during storm events contributed massive inputs of fine sediments into streams (USFS 2000a). Aquatic habitat remains compromised by elevated water temperatures and sediment levels decades after the initial impacts.

Mainstem Rogue River flow was diminished due to construction of Lost Creek Dam in the Upper Rogue in the 1970s (Figure 10-1), but flows from the dam were later increased to prevent the loss of spring-run Chinook salmon and are now thought to be adequate for mainstem ecosystem function of the Lower Rogue (Hicks 2005). Before disturbance, the estuary occasionally barred up and formed a lagoon (Hicks 2005). The Rogue River mouth now remains open due to the construction of jetties in 1960 to maintain navigability, which changed the estuary circulation and accelerated currents (Hicks 2005). Marina development eliminated the largest track of saltwater wetlands, and levees further upstream cut off access to tributaries and sloughs. The human population of Gold Beach is modest (1,847) and not believed to be increasing. Effects of urbanization and residential development in the Lower Rogue River sub-basin are moderate (Hicks 2005), but domestic water use and wastewater treatment related to rural development are regional concerns (Southwest Oregon Resource Conservation and Development Council (SO RC&D) 2003).

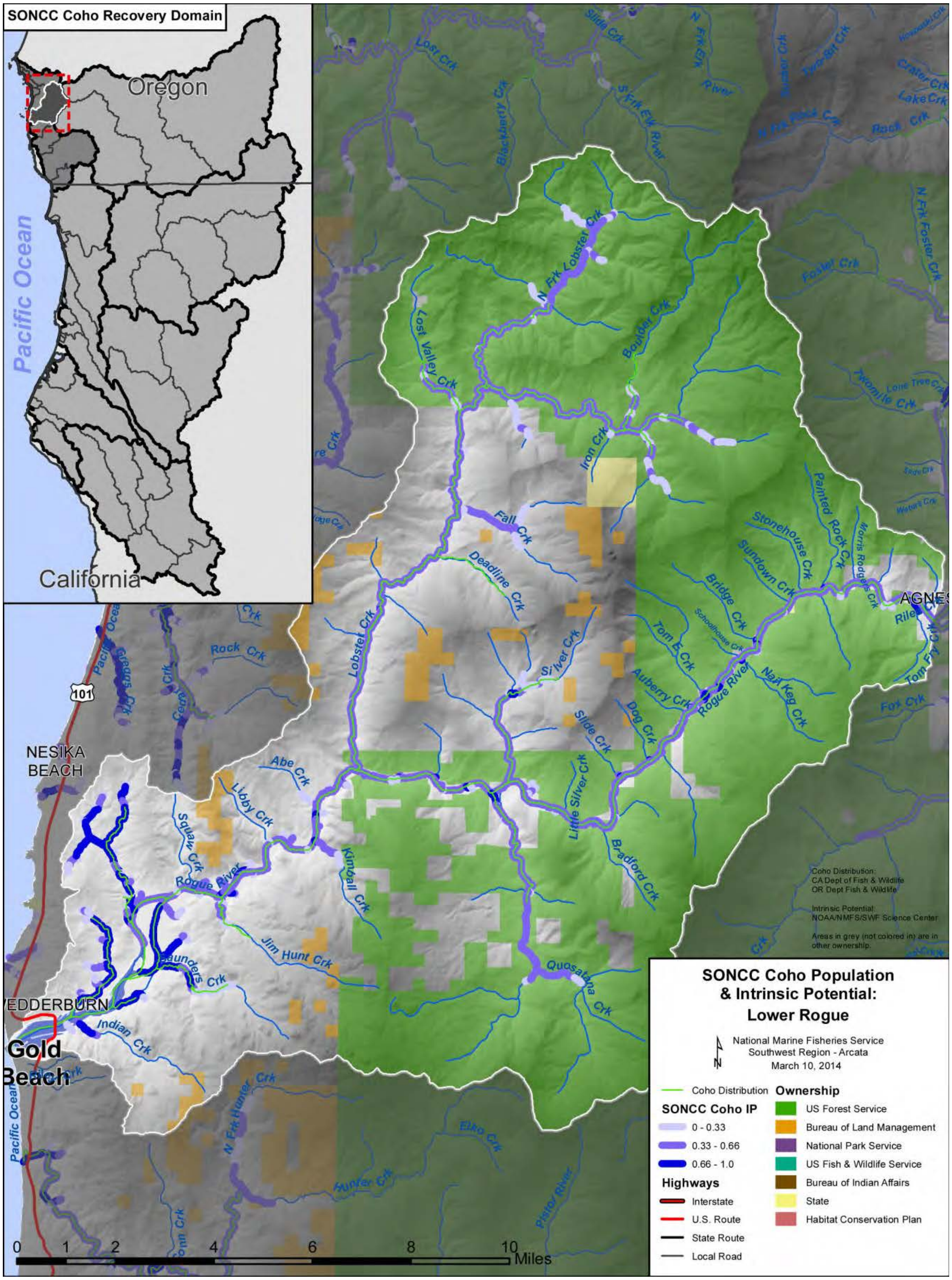

Figure 10-1. The boundaries of the Lower Rogue River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

10.2 Historic Fish Distribution and Abundance

While the Rogue River basin still produces many coho salmon, the indigenous stock adapted to the Lower Rogue River sub-basin is diminished in range and abundance (USFS 2000a). Meengs and Lackey (2005) used the cannery data from near the mouth of the Rogue River in the late 1880s to estimate annual catches of 114,000 adult coho salmon; however, there is no way to know how many of these fish were returning specifically to the lower Rogue River area. Because this sub-basin constitutes about 6 percent of the entire Rogue watershed area, approximately 7,000 coho salmon could have spawned in the Lower Rogue River. Williams et al. (2006) used models to estimate that the Lower Rogue had 80.9 intrinsic-potential kilometers (IP-km) of coho salmon habitat, with the highest IP habitats concentrated mostly in tributaries near the estuary (Figure 10-1). An estimated 37 coho salmon spawners would be needed to fully utilize each IP-km, and would have produced an annual coho salmon population of 3,000 adults (Williams et al. 2008).

The highest IP (IP >0.66) habitat for coho salmon in the Lower Rogue River is in Indian, Saunders, God Wants You, Jerrys Draw, Ranch and Edson creeks (Figure 10-1). Jim Hunt Creek has a small patch of high IP at its confluence with the mainstem Rogue River. Steep tributaries upstream of Lobster Creek, such as Silver, Quosatana and Tom Fry creeks also have high IP reaches just above their confluence with the mainstem Rogue River. Table 10-1 lists all tributaries with the highest IP coho salmon habitat. Alluvial flats of the Lower Rogue mainstem also have segments of high IP habitat all the way up to Agnes, especially downstream of tributaries that add coarse sediment for spawning and flatten stream gradient locally.

Table 10-1. Tributaries with high IP reaches (IP > 0.66) Williams et al. (2006).

Stream Name	Stream Name	Stream Name
Edson Creek	Kimball	Rogue River- Lower Mainstem
God Wants You Creek	Ranch Creek	Saunders Creek
Indian Creek	Quosatana Creek	Silver Creek
Jerrys Draw	Rogue River- Estuary	Tom Fry Creek
Jim Hunt		

10.3 Status of Lower Rogue River Coho Salmon

Spatial Structure and Diversity

Although they contain high IP (>0.66) habitat, Jim Hunt Creek, Kimball Creek, Ranch Creek and Indian Creek are not known to currently support coho salmon. Monitoring reports for the years 1998 through 2004 indicated that coho salmon are well distributed but at low levels in Lobster Creek, Quosatana Creek, Silver Creek, and Tom Fry Creek (ODFW 2005a). The Lower Rogue Watershed Council (2010) also found coho salmon in Edson Creek, Ranch Creek, and Saunders Creek. However, coho salmon spawners have not been seen in Ranch Creek since 2002, which indicates the potential presence of a new barrier (Lower Rogue Watershed Council 2010). Many reaches in these streams are not prime coho salmon habitat due to the steep gradient (USFS

2000a). Genetic diversity has likely diminished as coho salmon have disappeared from productive tributaries and the population has declined.

Population Size and Productivity

In 2001, there were an estimated 32,962 adult coho salmon in the Rogue Basin (Oregon State University [OSU] 2009, ODFW 2009b). Using a different methodology, ODFW (2013b) estimated a maximum of 235 spawners in the Lower Rogue River during the period 2000 to 2008 (Table 10-2). These escapement estimates suggest one year class may be weaker than the others – that observed in 2000, 2003, and 2006. The highest three year running average in the period 2000-2008 was 172 (from 2001 to 2003).

Table 10-2. Estimates of coho salmon escapement for the Lower Rogue River (ODFW 2013b)

. Year	Population Estimate	Year	Population Estimate	Year	Population Estimate
1998	0	2003	75	2008	184
1999	0	2004	127	2009	193
2000	59	2005	127	2010	0
2001	235	2006	35	2011	44
2002	205	2007	193	2012	0

Surveys completed from 1998 to 2003 (Hicks 2005) in the Lower Rogue River sub-basin found coho salmon spawners in lower Lobster Creek (19 individuals), South Fork Lobster Creek (46 individuals), Silver Creek (18 individuals), and Quosatana Creek (5 individuals). During juvenile coho salmon surveys (ODFW 2005a) in the Lobster Creek watershed from 1998 to 2004, fish were present in zero of four years in Boulder Creek, one of two years in Deadline Creek, one of seven years in North Fork Lobster Creek, and four of six years in lower Lobster Creek. South Fork Lobster Creek, on National Forest land, is the only site with observed annual juvenile coho salmon presence, but juvenile density there is very low (0.000 to 0.110 coho salmon per m^2) (ODFW 2005a). The growth rate of the Lower Rogue River coho salmon population is unknown but likely negative, given that successful recruitment is consistent only in the South Fork Lobster Creek.

The number of adult coho salmon is estimated using a seine-recapture method at Huntley Park in the Lower Rogue River (river mile 8). These data provide the most robust and precise estimates of adult coho salmon abundance in the Rogue River (ODFW 2013b). It is impossible to determine, with existing information, how many of the estimated coho salmon at Huntley Park are returning to the Lower Rogue River as opposed to other sub-basins in the Rogue River basin. However, the trend in abundance at Huntley Park can inform whether the population is at high risk of extinction according to the population decline criterion (Williams et al. 2008). The number of adults estimated at Huntley Park has declined at an annual rate of 11% over the last 12 years (Figure 10-2), greater than the 10% decline associated with a high risk of extinction (Williams et al. 2008). Therefore, the population is at high risk of extinction due to its sharply declining productivity.

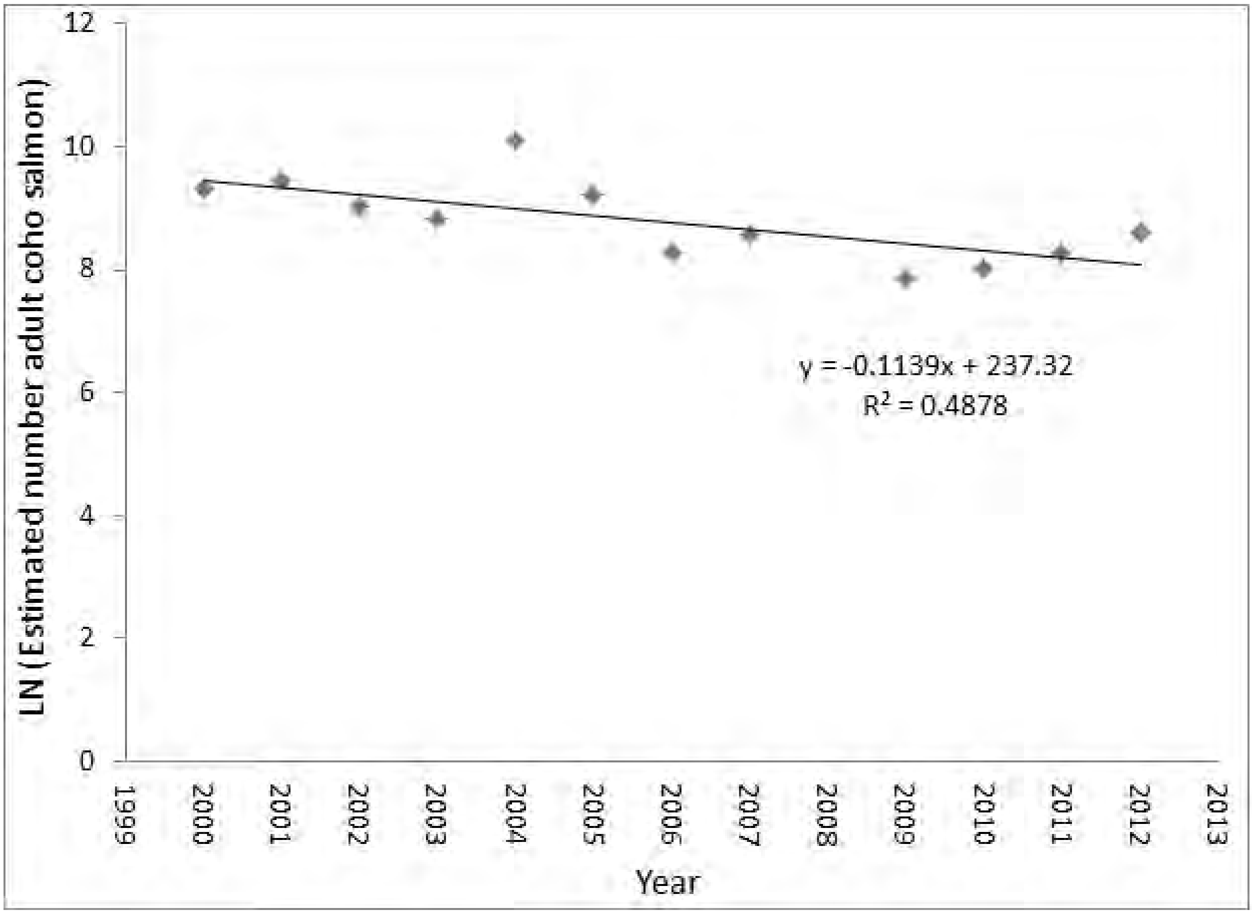

Figure 10-2. Rate of decline of estimated population abundance at Huntley Park. Data source: ODFW 2013b.

Extinction Risk

The Lower Rogue River population is at high risk of extinction because the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Lower Rogue River population is a non-core, Potentially Independent population within the Northern Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, but strongly influenced by immigration from other populations such that they did not exhibit independent dynamics (Williams et al. 2006). The Lower Rogue River population is strongly influenced by upstream populations in the Rogue River basin, as well as coastal populations such as the Chetco River. Adult strays from these populations spawn and interact with coho salmon in the Lower Rogue River. To contribute to stratum and ESU viability, the Lower Rogue River non-core population needs to have at least 320 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Furthermore, the Lower Rogue River population will contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to other nearby populations.

10.4 Plans and Assessments

State of Oregon

Expert Panel on Limiting Factors for Oregon's SONCC coho salmon populations

ODFW (2008b) convened a panel of fisheries and watershed scientists as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, concerns for the Lower Rogue River are as follows:

> Key concerns for the Lower Rogue River were primarily loss of over-winter tributary habitat for juveniles, especially in the lowlands which are naturally very limited in this system and have been impacted by past and current forestry practices and rural residential development. Another key concern is limited habitat complexity for pre-smolts due to a loss of large wood transport into the freshwater portions of the estuary. Secondary concerns were related to high water temperatures in tributaries for summer parr (excluding the mainstem, where rearing is not expected) due to land management and reduced estuarine habitat for pre-smolts and smolts due to past and current forestry practices and rural residential development.

Rogue River TMDL

The Rogue River TMDL (Oregon Department of Environmental Quality 2008) includes an extensive treatise on the water quality impairment of the Upper Rogue River and its tributaries and describes mechanisms that drive pollution of different types, including bacteria, temperature, sedimentation, pH, and dissolved oxygen.

Lobster Creek TMDL and Water Quality Management Plan

The Lobster Creek TMDL and Water Quality Management Plan (ODEQ 2002b) were developed to abate temperature problems in this major Lower Rogue River tributary. A shade model was used in the TMDL process to gauge needs for recovery of riparian zones. ODEQ (2002b) also acknowledged that sediment contributions play a role in channel changes and increased water temperature.

Cumulative Effects of Southwest Oregon Coastal Land Use on Salmon Habitat

OSU Oak Creek Labs conducted a study funded by ODFW and the Oregon Department of Forestry (ODF) to determine relationships between forest harvest and Pacific salmon productivity (Frissell 1992). The study evaluated watersheds along the Oregon coast extending from the Sixes River to the California-Oregon border from 1986 to 1992. The principal findings were as follows: (1) Compared to streams draining mature old growth forests, streams in heavily logged basins had one third less pool area, supported a reduced diversity of Pacific salmon species, and were more likely to have actively eroding banks; (2) Channel instability in heavily logged basins coincided with high failure rates for in-stream structures; (3) Erosion rates have increased basin wide, contributing to chronic habitat damage in downstream alluvial valleys leading to depression or elimination of mainstem spawning populations of Pacific salmon; and (4) With timber harvest rotations of 30 to 50 years, large portions of drainage basins are deforested and made vulnerable to increased erosion before aquatic habitat and fish populations have recovered from the previous episode of disturbance.

Southwest Oregon Salmon Restoration Initiative

The Southwest Oregon Salmon Restoration Initiative provides the framework for coho salmon recovery in southwest Oregon (Prevost et al. 1997) and helped foster formation of watershed councils. This document was prepared as part of a Memorandum of Understanding between ODFW and the National Marine Fisheries Service (NMFS). Many of the recommended restoration measures have been carried out, but others are pending. Prevost et al. (1997) also identified ‘core areas’ for coho salmon recovery that overlap with areas of high coho salmon density and habitat quality. Streams with this designation include the upper South Fork of Lobster Creek, Quosatana Creek, and Silver Creek.

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The state of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is comprehensive and includes voluntary actions for all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary. The action plans, implementation, and annual reports can be found at the web site.

Lower Rogue Watershed Council

Lower Rogue Watershed Assessment

This extensive assessment on the Lower Rogue River sub-basin (Hicks 2005) includes historical accounts, descriptions of land use and aquatic habitat, and a wealth of information on factors that might limit coho salmon and restoration opportunities.

10.5 Stresses

Table 10-3. Severity of stresses affecting each life stage of coho salmon in the Lower Rogue River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	Medium	Very High	Very High[1]	Very High	High	Very High
2	Impaired Water Quality[1]	Medium	Very High	Very High[1]	Very High	Medium	Very High
3	Impaired Estuary/Mainstem Function	-	High	High[1]	Very High	High	Very High
4	Altered Sediment Supply	High	High	High	High	High	Very High
5	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
6	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
7	Altered Hydrologic Function	Medium	Medium	Medium	Low	Low	Medium
8	Increased Disease/Predation/Competition	Low	Low	Low	Low	Low	Low
9	Barriers	Low	Medium	Medium	Medium	Medium	Medium
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low

[1]Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The primary stresses to SONCC coho salmon in the Lower Rogue River are the lack of floodplain and channel structure, degraded water quality resulting from high water temperature, and impaired estuarine function. Juveniles are the most limited life stage, due to insufficient summer and winter rearing habitat. Recovery is extremely unlikely without additional summer and winter rearing habitat. Overall, these findings are consistent with those of the Oregon Expert Panel (ODFW 2008b), but the expert panel considered water temperature to be only a secondary, not primary, concern. The highest historic IP coho salmon habitat is in the western part of the watershed (Williams et al. 2008), where the land is privately owned and land management is likely to be more intensive. The greatest effects of this management are the loss of rearing habitat when wetlands were filled, and degradation of the remaining habitat by high water temperatures resulting from the lack of mature trees in the riparian zone and the reduction of the amount of water in the river by diversions.

Lack of Floodplain and Channel Structure

The floodplain and channel structure of the Lower Rogue River is highly impaired and constitutes a major limiting stress for coho salmon. Edson Creek has been channelized in many reaches and lacks large wood and pool-riffle structure necessary to support juvenile coho salmon.

Libby Creek is one of the most altered Lower Rogue River tributaries due to the dam constructed above its confluence with the Lower Rogue River to create a recreational fishing pond. Channel structure and transport capacity has been completely disrupted in lower Jim Hunt Creek and Kimball Creek.

ODFW habitat surveys show poor pool frequency for the upper South Fork Lobster Creek (<10 percent) and fair (10 to 20 percent) conditions in the upper-most reach of the North Fork and one of its tributaries. Pool frequencies increase to good (20 to 35 percent) in the lower reaches of the North Fork (NF) and South Fork (SF) Lobster Creek. The average maximum pool depths ranged from less than 2 feet deep to 3.3 feet deep, with the deepest pools located in lower Lobster and Quosatana creeks. Quosatana Creek has re-developed pool depths of up to 10 feet (USFS 1996a).

Impaired Water Quality

Water quality in the Lower Rogue River is very poor and constitutes a major limiting stress for coho salmon (USFS 1996b, 2000a; ODEQ 2002b, 2008; Hicks 2005). Coho salmon have a low tolerance for elevated water temperatures (McCullough 1999) and this factor consequently poses a very high level of stress for Lower Rogue coho salmon fry, juveniles and smolts. The ODEQ (2002b, 2008) limit for maximum weekly maximum water temperature (MWMT) is 64° Fahrenheit, which is compatible with coho salmon recovery. Only 36 percent of Lower Rogue locations surveyed met this standard (SO RC&D 2003), and cooler locations were in headwater areas that are too steep for coho salmon to access (USFS 2000a). Inner gorge tributaries of the mainstem Rogue River below Agness have recovered to optimal salmonid rearing temperatures (e.g., Bradford Creek at 59.5 to 61.7° F), providing critical summer refugia. Tom Fry Creek also has a half-mile reach above the mouth that is suitable for coho salmon rearing (USFS 2000a). The Quosatana Creek MWMT from 1991 to 1999 ranged from a low of 66.4° F to a high of 70.9° F (USFS 2000a). Recovery of pool depth in Quosatana Creek (USFS 1996a) may help re-establish cool water temperatures, due to seepage of groundwater from adjacent alluvial deposits, which have been shown to create a deep layer of cold water in healthy streams (U.S. Environmental Protection Agency (USEPA) 2003a, ODEQ 2008).

The Lower Rogue River is recognized as having elevated nutrient levels (i.e., phosphorous; ODEQ 2010), but because the source of these nutrients is upstream, solutions to the problem are described in other Rogue River basin profiles. Libby Pond in the Lower Rogue sub-basin appears highly enriched with nutrients and has substantial algae blooms. Conditions are conducive to the proliferation of toxic algae, a recognized problem in other Oregon lakes (Jones et al. 2008).

The Oregon Department of Agriculture (Riley, S., pers. comm. 2009) currently has no pesticide data for the south coast Oregon, yet this may be a significant but little recognized region-wide problem for salmonids (Ewing 1999, Laetz et al. 2009).

Impaired Estuary/Mainstem Function

The Rogue River estuary is highly altered and retains little of its historic function downstream of Highway 101 (Figure 10-3; Hicks et al. 2008). Studies elsewhere in Oregon show estuarine tributaries and sloughs can be some of the most important habitat types for rearing coho salmon juveniles (Koehler and Miller 2003, Miller and Sadro 2003, Koski 2009). The lack of habitat in the Rogue River estuary that can be used for refugia likely results in high rates of predation from birds, fish, and pinnipeds. Numerous barriers in tributaries flowing into the estuary prevent use of these important rearing habitats and inhibit proper tidal exchange and greatly diminish opportunities for non-natal rearing in cooler coastal climates. The tributary on the north side of the estuary has been completely channelized and all of the wetlands near its mouth have been filled. Fine sediment from Saunders Creek has also partially filled Snag Patch Slough at its mouth (Hicks 2005).

Figure 10-3. Aerial photo of the Rogue River estuary. Photo shows the boat basin (right), jetties, levees and shoreline development. Photo from Hicks (2005).

Altered Sediment Supply

Altered sediment supply poses an overall high stress to coho salmon in the Lower Rogue River. Sediment contribution from landslides and erosion occurs naturally in the Lower Rogue River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. Excess fine sediment reduces coho salmon egg viability and may reduce food for fry, juveniles and smolts. Accumulation of excess fine sediment has caused several creeks in the Lower Rogue River sub-basin (Quosatana Creek, Jim Hunt Creek, and Kimball Creek) to flow subsurface. Low pool frequency and depth throughout the Lower Rogue River basin are likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening. The USFS (1996b, 2000a) and Hicks (2005) recognize elevated fine sediment transport as a major Lower Rogue River limiting stress for salmonids.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions are recognized as the major driving force of water temperature problems in the Rogue River basin (ODEQ 2002b, 2008). These conditions also contribute to the lack of large wood in stream channels in the Lower Rogue (USFS 1996a, 2000a; Hicks 2005). The lack of large woody debris and high water temperatures contribute to the limiting stresses for this population – lack of floodplain and channel structure and impaired water quality. Past land use has led to replacement of riparian conifers with hardwoods on both public and private forest lands in the Lower Rogue River sub-basin (USFS 1996a, 2000a; Hicks 2005). Additionally, one of the more important riparian species (Port Orford Cedar) is experiencing a disease epidemic causing loss of this important riparian species in Quosatana Creek (USFS 1996a), and Frissell (1992) recognized the loss of this species as regionally significant.

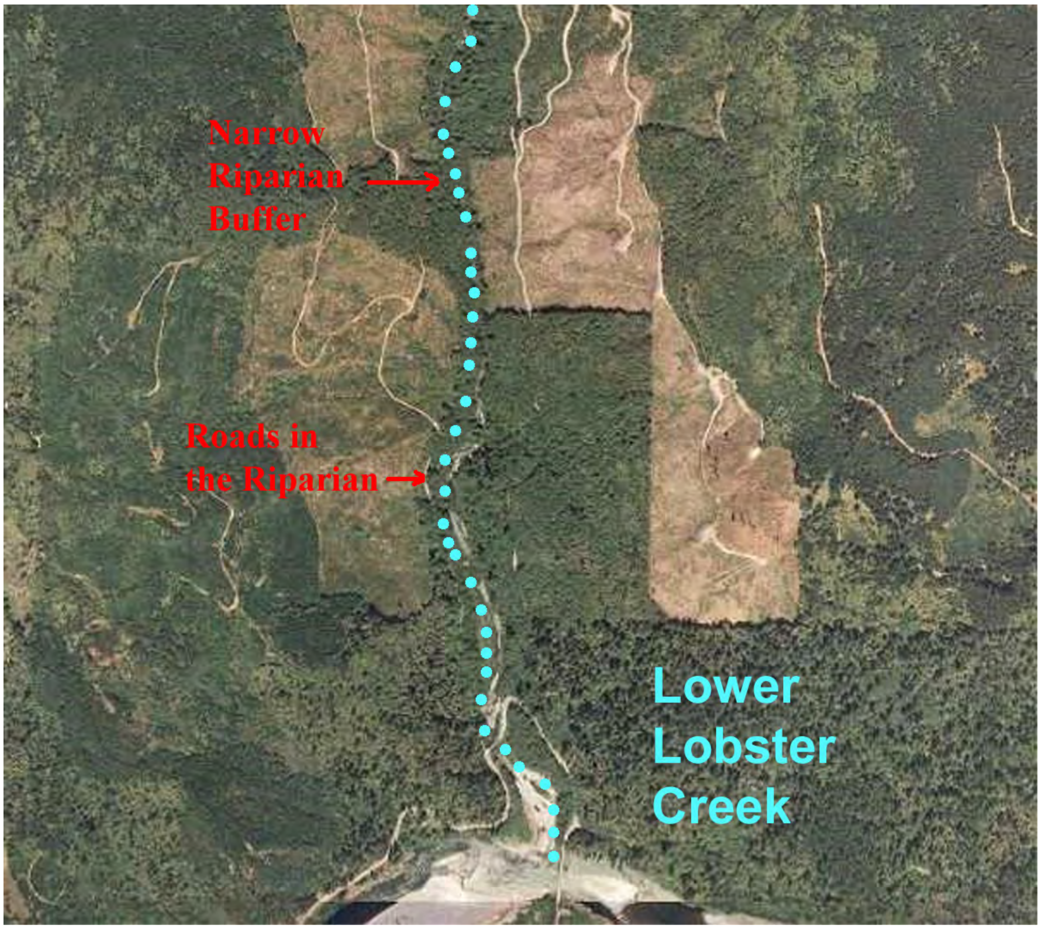

Figure 10-4. Aerial photo of Lower Lobster Creek at its convergence with the mainstem Rogue River. Convergence is at bottom of photo, which shows clear cuts, insufficient buffer widths, high road density and near stream roads. The stream course is shown in blue dots. (Terra Server, www.terraserver.com).

Adverse Hatchery-Related Effects

No hatcheries or artificial propagation occur in the Lower Rogue population area, but there is an active hatchery in the Rogue River basin. Cole Rivers Hatchery is downstream of William L. Jess Dam (RM 157) in the Upper Rogue River sub-basin. Genetic stress due to introduction of out-of-basin genetic material is not a current concern, because broodstock are currently selected from those fish which return to the hatchery (ODFW 2008d). Hatchery fish are stocked under conditions designed to make them leave the system quickly (ODFW 2008d), but are nonetheless expected to influence wild smolts to some degree. Eighty-two percent of coho spawners observed in Lower Rogue River tributaries in 2001 were of hatchery origin (Jacobs et al. 2002).

Adverse hatchery-related effects pose a medium risk to all life stages, due to the presence of Cole Rivers Hatchery in the Rogue River basin (Appendix B).

Altered Hydrologic Function

Water used for agriculture and residential developments in the Lower Rogue River sub-basin is modest relative to mainstem flows. The USFS (2000a) rated hydrologic risk as moderate due to timber harvest and road construction, particularly in the transient snow zone. Extensive timber harvest and road building have been hypothesized to diminish summer base flows (Montgomery and Buffington 1993) and likely contributed to increased peak flows. The loss of surface flow in creeks like Jim Hall and Kimball creeks may be due to aggradation, changes in net water yield, or a combination of the two. There is a side channel in the main river at the confluence with Edson Creek, which is the upper extent of the estuary, and cool flows from the tributary may create important refugia that could be diminishing with increasing residential water use.

Increased Disease/Predation/Competition

Although above-optimal water temperatures can elevate disease risk for coho salmon (McCullough 1999), there are currently no documented problems in the Lower Rogue River. Hicks (2005) raised questions about predation in the simplified estuary, because the lack of cover reduces their ability to avoid predators. Port Orford Cedar root-rot is a disease which is negatively impacting this important riparian species region-wide (Frissell 1992).

Barriers

High road densities on private lands in the Lower Rogue River sub-basin result in a high number of road-stream crossings that are potential juvenile and adult migration barriers. However, surveys have already identified most of the problems in potential coho salmon streams and many of these passage issues have been addressed or have plans in place to be addressed in the near future (Prevost et al. 1997, Hicks 2005). The USFS (2000a) addressed all fish passage problems related to culverts in the NF and SF Lobster Creek and will continue to improve fish passage at road-stream crossings as funds become available. Myers (2001) reported successful fish passage projects on private land in Lobster and Silver creeks. There is likely a barrier issue on Ranch Creek, which contains a substantial amount of high IP coho salmon habitat in a strategic location low in the basin. After implementing passage projects in upper Ranch Creek, the Lower Rogue Watershed Council found coho salmon spawning in 2001 and 2002 (Lower Rogue Watershed Council 2010). But the council did not find spawners from 2003 through 2012 and attribute it likely to presence of a barrier downstream (Lower Rogue Watershed Council 2010).

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

10.6 Threats

Table 10-4. Severity of threats affecting each life stage of coho salmon in the Lower Rogue River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

Threats		Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	Medium	Very High	Very High[1]	Very High	Medium	Very High
2	Timber Harvest	High	High	High	High	Medium	High
3	Urban/Residential/Industrial Dev.[1]	Medium	High	High[1]	High	Medium	High
4	Channelization/Diking	Low	High	High	High	Low	High
5	Mining/Gravel Extraction	Low	Low	Medium	Medium	Medium	Medium
6	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
7	Agricultural Practices	Low	Medium	Medium	Medium	Low	Medium
8	Dams/Diversion	Low	Medium	Medium	Medium	Low	Medium
9	Climate Change	Low	Low	Medium	Medium	Medium	Medium
10	High Severity Fire	Low	Low	Low	Low	Low	Low
11	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
12	Invasive Non-Native/Alien Species	-	Low	Medium	Medium	-	Medium
13	Fishing and Collecting	-	-	Low	Low	Medium	Low

[1]Key limiting threats

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and urban/residential/industrial development.

Roads

High road densities, numerous road-stream crossings, and roads on steep slopes combine to pose a critical threat to most coho salmon life history phases in the Lower Rogue River sub-basin. The road density in the Lower Rogue River exceeds 2.5 miles of road per square mile (mi/mi^2) of watershed. NMFS (1995) set a limit for road density of 2 mi/mi^2 to protect anadromous salmonids in the interior Columbia River basin to limit sources of fine sediment mobilization. Roads have contributed substantially to increased landsliding and fine sediment yield, including failures at stream crossings (USFS 1996a, 2000a). The most severe erosion potential is when multiple road-stream crossings fail in a single tributary. This occurs when a crossing washes out and creates a slug of debris and fine sediments that wash out crossings further downstream. Miles of Lower Rogue channels have been scoured by these debris torrents, resulting in flattened stream profiles that may require decades to recover. The loss of riparian conifers will require even more time to replace. Private lands feature large numbers of near-stream roads and roads on slopes of greater than 50 percent (Hicks 2005). Most timber haul roads are not surfaced, and chronically contribute fine sediment to streams, although measures are being taken to remedy the problem in Lobster Creek (ODEQ 2002b).

Timber Harvest

Sixty percent of the Lower Rogue River watershed is in federal ownership, and this land currently has low levels of timber harvest. Reeves et al. (1993) found that the rate of timber harvest in Oregon coastal watersheds should not exceed 25 percent of a watershed to minimize risks and disturbances to aquatic resources. The study covered a period of 30 years (Reeves, G., pers. comm. 2003) and watersheds exceeding that level of harvest did not maintain channel integrity or Pacific salmon species diversity. Timber harvest on public land is now largely restricted to selective harvests in previously logged areas in order to improve forest health. The greatest risk from timber harvest is on private industrial timberlands that are managed under the Oregon Forest Practices Act. Intense harvest rates on private lands in Lobster Creek (see Figure 10-4) and Silver Creek are double or triple the rates recommended by Reeves et al. (1993). It is likely the effects from these harvest practices are why juveniles were not present in Lobster Creek 4 of 6 years in the ODFW juvenile sampling (ODFW 2005a).

Urban/Residential/Industrial Development

The city of Gold Beach encroaches on the estuary of the Rogue River. Impervious surfaces related to development contribute stormwater runoff and non-point source pollution, as observed elsewhere in the Rogue River basin (ODEQ 2008). Commercial development along the north bank confines the lower estuary. Residential development also occurs in the Lower Rogue River riparian zone upstream to Lobster Creek and likely contributes pollutants from leaking septic systems. The high severity of this threat is due to concentrated impacts in areas of the highest IP coho salmon habitat, specifically in Edson Creek, Indian Creek, Saunders Creek, and in the estuary.

Channelization and Diking

Channelization and diking has greatly altered low gradient Lower Rogue River tributaries, the lower mainstem, and the estuary. Channel alteration of Edson Creek and Ranch Creek have had the greatest impact on coho salmon production in the Lower Rogue River sub-basin because of the extent of high potential coho salmon habitat occurring there. Levees and dikes have been constructed to protect residential or commercial property in the lower seven miles of the Rogue River, decreasing summer and winter coho salmon juvenile rearing habitat and disconnecting the river from its floodplain. Some remaining side channels located in the lower portions of the population area maintain some rearing habitat capacity (Hicks 2005). Side channels cannot reform on the north side of the upper estuary, because of the levees that protect grazing land and a gravel mining operation. Nearly all of the tidal wetlands have been channelized or diked and are no longer available to coho salmon. Development of the boat basin and marina along the south side of the river eliminated valuable tidal wetlands that provided off-channel habitat for coho salmon rearing and holding.

Mining/Gravel Extraction

Gravel mining is ongoing on the terrace of the Lower Rogue River estuary. There is a gravel operation on the south bank of the estuary. There was an operation of the north bank, but it has not removed from the river for several years. These areas have some of the best restoration opportunities for creating mainstem rearing refugia for coho salmon. The USFS has 9 gold mining claims on their land in Lobster Creek.

Hatcheries

Hatcheries pose a medium threat to all life stages in the Lower Rogue River sub-basin. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Agricultural Practices

Livestock have been eliminated from prairies on public land (USFS 2000a), but on private land grazing may have significant effects on coho salmon. Pasture in the historic estuarine floodplain restricts side channel development that could provide refugia for rearing coho salmon. Across the sub-basin, channel changes caused by conversion of forest to pasture in the highest IP coho salmon habitat are a major inhibitor of coho salmon recovery. Ongoing livestock grazing only contributes to the threat. The primary stream reaches impacted are Ranch Creek and Edson Creek. The Oregon Department of Agriculture currently has no means of tracking pesticide use near the Lower Rogue River (Riley, S., pers. comm. 2009), but agricultural use of these substances could be affecting coho salmon (see Water Quality).

Dams/Diversions

Libby Pond on Libby Creek is the only known impoundment within the Lower Rogue River sub-basin that prevents access to historical coho salmon habitat. Concerns related to diversions, water use, and stream flows are restricted to Edson and Indian creeks. Problems with the base flow of Edson Creek are likely a combination of surface flow and groundwater extraction for agricultural and residential water use. The City of Gold Beach has a 0.77 cfs water right on Indian Creek (USFS 2000a). Flow depletion is a factor known to contribute to stream warming (Poole and Berman 2001), resulting in loss of potential coho salmon habitat.

Climate Change

Climate change in this region will have the greatest impact on juveniles, smolts, and adults. Although the current climate is generally cool, modeled regional average temperature shows a moderate increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 1.5 °C in the summer and by 1 °C in the winter. Annual precipitation in this area is predicted to stay within the natural range of current variability however seasonal patterns in precipitation likely will occur (Mote and Salathe 2010). Overall, the range and degree of variability in temperature and precipitation are likely to increase in all populations. The vulnerability of the estuary and coast to sea level rise is moderate to high in this population. Juvenile and smolt rearing and migratory habitat are most at risk to climate change. Rising sea level may impact the quality and extent of wetland rearing habitat by inundating freshwater marshes or wetlands with saltwater.

High Severity Fire

Proximity to the coast and high rainfall make fire risk less of an issue in the Lower Rogue River than in watersheds like the Applegate or Illinois in the interior of the Rogue River basin. Crowded stands of small-diameter trees have increased fire danger (SO RC&D 2003), and such stands are common on private timber lands.

Road-Stream Crossing Barriers

Coho salmon can access most of the Lower Rogue River watershed. Surveys of barriers have been conducted in all lower tributaries and in Lobster and Silver creeks (Hicks 2005) and most issues with fish passage at road-stream crossings have been resolved (Myers 2001). The Libby Pond is a current barrier although it is not a road-stream crossing.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Invasive Non-Native/Alien Species

New Zealand mud snails are known to be present in the Lower Rogue River population area. The mud snail is a parthenogenic (i.e., asexual) livebearer with high reproductive potential, often reaching densities greater than 100,000/m² in suitable habitat (Portland State University (PSU) 2011). Due to the rapid population growth rates, New Zealand mud snails may account for the majority of the invertebrate biomass in colonized areas. This species is known to out-compete native invertebrates and contributes little food value to salmonids.

10.7 Recovery Strategy

The most important factor limiting recovery of coho salmon in the Lower Rogue River is the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored. Channel complexity should be improved by constructing off-channel ponds or backwater habitat, reconnecting the wetlands and estuary to the river, restoring wetlands, and limiting development and fill. To increase instream structure, large wood should be added where the channel is stable, to provide structure until natural sources of large wood (mature coniferous and hardwood forests) are re-established next to the stream. Areas adjacent to the stream should be replanted and subsequently thinned to re-establish mature streamside forest as a source of large wood recruitment.

The most immediate need for habitat restoration and threat reduction in the Lower Rogue River is in those areas currently occupied by coho salmon, such as Snag Patch Slough in the estuary, the oxbow at the mouth of Edson Creek, and upper Lobster Creek. The least disturbed aquatic habitat would be a good place to start for restoring vital rearing habitat. Unoccupied areas must also be restored to provide habitat for coho salmon recovery, and the least disturbed areas with IP should be considered first for restoration: South Fork Lobster Creek, North Fork Lobster Creek, Indian Creek, and Saunders Creek (Reeves et al. 1995). The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 10-5 on the following page lists the recovery actions for the Lower Rogue River population.

Table 10-5. Recovery action implementation schedule for the Lower Rogue River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	***Step Description***					
SONCC-LRR.7.1.4	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide, primarily Lobster Creek	1
SONCC-LRR.7.1.4.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-LRR.7.1.4.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-LRR.7.1.4.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-LRR.7.1.4.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-LRR.7.1.4.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams*					
SONCC-LRR.2.1.9	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2a
SONCC-LRR.2.1.9.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LRR.2.1.9.2	*Place instream structures, guided by assessment results*					
SONCC-LRR.2.1.50	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-LRR.2.1.50.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LRR.2.1.50.2	*Place instream structures, guided by assessment results*					
SONCC-LRR.2.2.10	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	All streams where coho salmon would benefit immediately	2a
SONCC-LRR.2.2.10.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-LRR.2.2.10.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-LRR.2.2.10.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LRR.2.2.51	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2b
SONCC-LRR.2.2.51.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-LRR.2.2.51.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-LRR.2.2.51.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-LRR.10.2.26	Water Quality	Yes	Reduce pollutants	Reduce point- and non-point source pollution	All streams where coho salmon would benefit immediately	2a
SONCC-LRR.10.2.26.1	*Identify pollution sources, and develop a strategy to minimize input to stream channels*					
SONCC-LRR.10.2.26.2	*Implement strategy to minimize pollution*					
SONCC-LRR.10.2.49	Water Quality	Yes	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	2b
SONCC-LRR.10.2.49.1	*Identify pollution sources, and develop a strategy to minimize input to stream channels*					
SONCC-LRR.10.2.49.2	*Implement strategy to minimize pollution*					
SONCC-LRR.28.1.1	Roads	Yes	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	SF and NF Lobster, Silver, Saunders, Indian creeks, and all areas where coho salmon would benefit immediately	2a
SONCC-LRR.28.1.1.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-LRR.28.1.1.2	*Decommission roads, guided by assessment*					
SONCC-LRR.28.1.1.3	*Upgrade roads, guided by assessment*					
SONCC-LRR.28.1.1.4	*Maintain roads, guided by assessment*					
SONCC-LRR.28.1.57	Roads	Yes	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	Population wide	2b
SONCC-LRR.28.1.57.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-LRR.28.1.57.2	*Decommission roads, guided by assessment*					
SONCC-LRR.28.1.57.3	*Upgrade roads, guided by assessment*					
SONCC-LRR.28.1.57.4	*Maintain roads, guided by assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LRR.2.4.8	Floodplain and Channel Structure	No	Improve estuarine habitat	Restore estuarine habitat	Areas of the estuary where coho salmon would benefit immediately	2a
SONCC-LRR.2.4.8.1	*Assess coho use of different estuarine habitats and develop a plan to enhance those habitats (i.e. brackish wetlands, tidal sloughs, salt marshes, and tidally influenced freshwater)*					
SONCC-LRR.2.4.8.2	*Restore tidally influenced habitats, guided by the plan*					
SONCC-LRR.2.4.53	Floodplain and Channel Structure	No	Improve estuarine habitat	Restore estuarine habitat	Population wide	2b
SONCC-LRR.2.4.53.1	*Assess coho use of different estuarine habitats and develop a plan to enhance those habitats (i.e. brackish wetlands, tidal sloughs, salt marshes, and tidally influenced freshwater)*					
SONCC-LRR.2.4.53.2	*Restore tidally influenced habitats, guided by the plan*					
SONCC-LRR.2.5.6	Floodplain and Channel Structure	No	Improve tidal exchange of water	Reconnect estuarine habitat	Mouth of Ranch Creek and areas of the estuary where coho salmon would benefit immediately	2a
SONCC-LRR.2.5.6.1	*Assess the tidal wetland habitat and develop a plan to reconnect the tributary*					
SONCC-LRR.2.5.6.2	*Reconnect tidal wetlands, guided by the plan*					
SONCC-LRR.2.5.54	Floodplain and Channel Structure	No	Improve tidal exchange of water	Reconnect estuarine habitat	Population wide	2b
SONCC-LRR.2.5.54.1	*Assess the tidal wetland habitat and develop a plan to reconnect the tributary*					
SONCC-LRR.2.5.54.2	*Reconnect tidal wetlands, guided by the plan*					
SONCC-LRR.2.7.33	Floodplain and Channel Structure	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	All streams on private lands where coho salmon would benefit immediately	2a
SONCC-LRR.2.7.33.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-LRR.2.7.33.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-LRR.2.7.33.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LRR.2.7.55	Floodplain and Channel Structure	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	2b
SONCC-LRR.2.7.55.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-LRR.2.7.55.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-LRR.2.7.55.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-LRR.2.2.48	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-LRR.2.2.48.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LRR.2.2.48.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-LRR.2.2.52	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-LRR.2.2.52.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LRR.2.2.52.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-LRR.22.3.36	Urban, Residential, Industrial Development	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho salmon bearing streams	2b
SONCC-LRR.22.3.36.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-LRR.22.3.36.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					
SONCC-LRR.28.1.2	Roads	Yes	Reduce sediment delivery to streams	Improve regulatory mechanisms	Population wide	2b
SONCC-LRR.28.1.2.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-LRR.2.4.7	Floodplain and Channel Structure	No	Improve estuarine habitat	Increase regulatory oversight that protects existing estuarine habitat	Undisturbed intertidal and shallow subtidal habitats in the lower estuary, such as the spit forming inside the jetties and the shore near the Coast Guard station.	2b
SONCC-LRR.2.4.7.1	*Strengthen city and county ordinances to limit development near tidally influenced habitat, and maintain or strengthen current protection measures*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LRR.2.7.5	Floodplain and Channel Structure	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Lower Lobster Creek and Federal lands	2b
SONCC-LRR.2.7.5.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-LRR.2.7.5.3	*Plant conifers, guided by the plan*					
SONCC-LRR.2.7.56	Floodplain and Channel Structure	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	2d
SONCC-LRR.2.7.56.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-LRR.2.7.56.3	*Plant conifers, guided by the plan*					
SONCC-LRR.26.1.47	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-LRR.26.1.47.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-LRR.2.2.44	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2b
SONCC-LRR.2.2.44.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-LRR.10.2.37	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-LRR.10.2.37.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-LRR.10.2.37.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-LRR.10.2.37.3	*Develop local regulatory mechanisms that limits development and reduces amount of total impervious area through incentives*					
SONCC-LRR.2.7.34	Floodplain and Channel Structure	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Federal lands	3b
SONCC-LRR.2.7.34.1	*Monitor effects of livestock grazing on coho salmon habitat and adjust or discontinue grazing if effects of livestock grazing on salmon habitat are limiting coho recovery*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LRR.7.1.27	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	BLM lands	3b
SONCC-LRR.7.1.27.1		*Manage timber harvest (and associated activities) on Federal lands in accordance with the Aquatic Conservation Strategy of the NWFP, or with the updated ACS guidance contained in newly revised Resource Management Plans or Land and Resource Management Plans, in order to achieve riparian and stream channel improvements for coho salmon*				
SONCC-LRR.5.1.35	Passage	No	Improve access	Remove barrier	Ranch Creek	3c
SONCC-LRR.5.1.35.1		*Identify barrier(s) preventing fish passage into Ranch Creek*				
SONCC-LRR.5.1.35.2		*Remove barrier(s) preventing passage into Ranch Creek*				
SONCC-LRR.10.2.32	Water Quality	Yes	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-LRR.10.2.32.1		*Develop a pesticide management plan*				
SONCC-LRR.10.2.32.2		*Implement pesticide management plan and technical assistance program*				
SONCC-LRR.1.2.25	Estuary	No	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	3d
SONCC-LRR.1.2.25.1		*Identify parameters to assess condition of estuary and tidal wetland habitat*				
SONCC-LRR.1.2.25.2		*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*				
SONCC-LRR.16.1.12	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LRR.16.1.12.1		*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*				
SONCC-LRR.16.1.12.2		*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*				
SONCC-LRR.16.1.13	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LRR.16.1.13.1		*Determine actual fishing impacts*				
SONCC-LRR.16.1.13.2		*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LRR.16.2.14	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LRR.16.2.14.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-LRR.16.2.14.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-LRR.16.2.15	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LRR.16.2.15.1	*Determine actual impacts of scientific collection*					
SONCC-LRR.16.2.15.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-LRR.10.7.46	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-LRR.10.7.46.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LRR.10.7.46.2	*Supply marine-derived nutrients to streams guided by the plan*					

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11. Hunter Creek Population

Northern Coastal Stratum

Dependent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

44.5 mi^2 watershed (38% Federal ownership)

15 IP-km (9 IP-mi) (13% High)

Dominant Land Uses are Timber Harvest and Urban/Rural Development

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Degraded Riparian Forest Conditions'

Key Limiting Threats are 'Roads' and 'Timber Harvest'

Highest Priority Recovery Actions

• Increase streamflows • Reconnect estuarine habitat by installing new bridge at Highway 101 • Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows	• Remove, setback, or reconfigure levees and dikes • Increase large woody debris (LWD), boulders or other instream structure • Improve timber harvest practices by revising Oregon Forest Practices Act

11.1 History of Habitat and Land Use

Hunter Creek enters the Pacific Ocean just south of the town of Gold Beach, which is located at the mouth of the Rogue River. Farming and ranching on the lower terraces began in the 1850s. Some coho salmon habitat was likely impacted, although basin-wide productivity remained high. Only about 20 people lived in lower Hunter Creek through the 1930s (Massingill 2001d), but today there are hundreds of residents as rural development has spread outward from Gold Beach.

Forestry is the dominant land use in the Hunter Creek basin. Like most southwest Oregon river basins, Hunter Creek was extensively logged after World War II (EA Engineering, Science, and Technology 1998). In the 1950s, there were as many as 17 active mills in the Gold Beach/Hunter Creek area (Massingill 2001d). Private timber land was substantially logged by 1960, and reforestation was limited (Maguire 2001d). U.S. Forest Service (USFS) and Bureau of Land Management (BLM) lands in the headwaters of the upper mainstem and North Fork of Hunter Creek were logged from the 1950s to the 1980s (EA Engineering, Science, and Technology 1998). Damage in Hunter Creek from the floods of 1955 and 1964 was extensive.

In 1995, an area of lower Hunter Creek with a human population of about 414 people was annexed to the City of Gold Beach (Maguire 2001d). Residential development is concentrated in the lower basin. Residential, commercial, and industrial development in lower Hunter Creek and the estuary have also contributed to coho salmon habitat degradation.

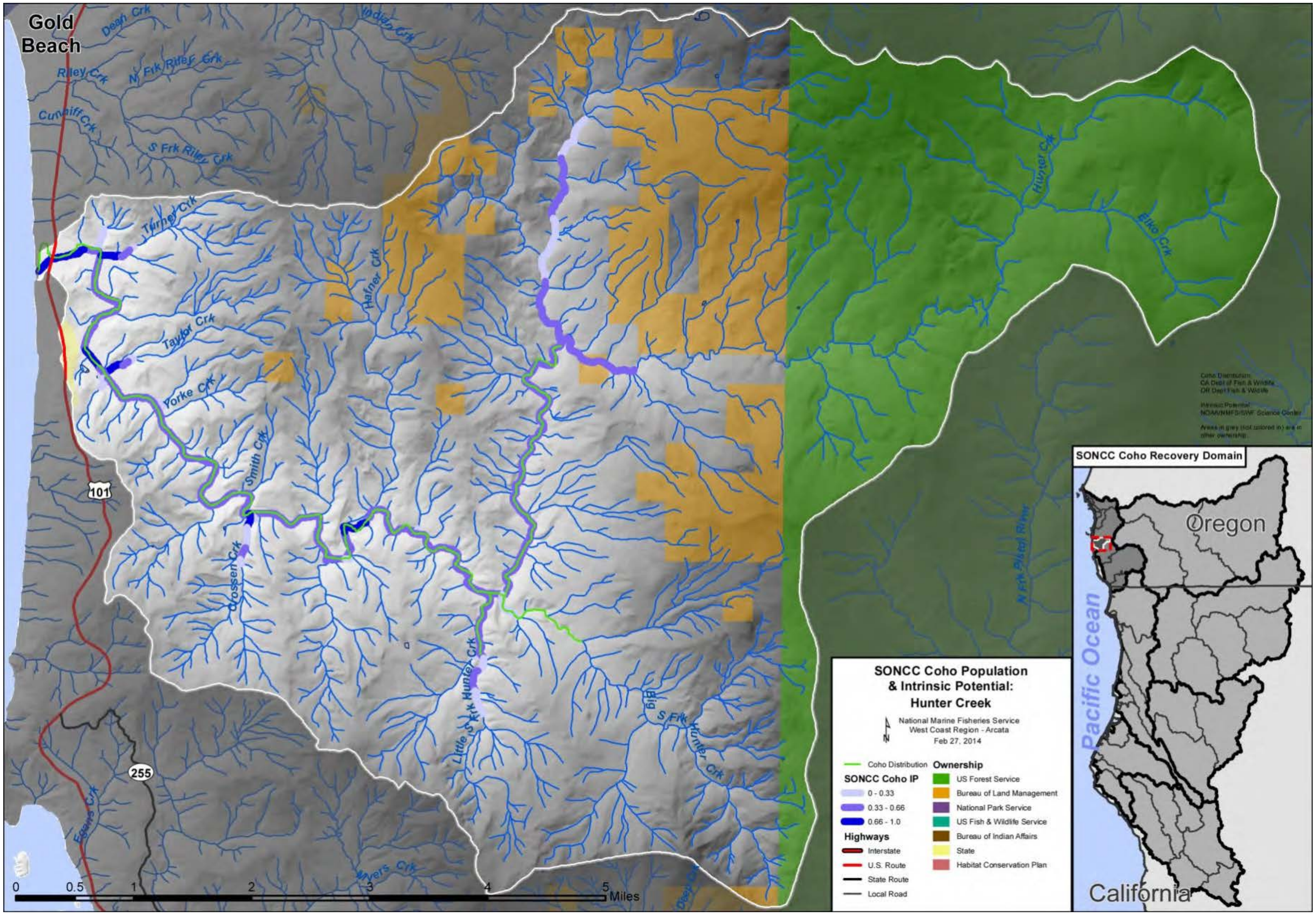

Figure 11-1. The geographic boundaries of the Hunter Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

11.2 Historic Fish Distribution and Abundance

Historic data on the distribution and abundance of coho salmon in Hunter Creek is limited. Annual estimates of coho salmon adults in Hunter Creek were 136 in 2001, 52 in 2002, 17 in 2004, 22 in 2005 and 35 in 2008 (ODFW 2009a). Williams et al. (2006) identified the estuary, lower mainstem, and tributaries below Conn Creek as having the highest coho salmon intrinsic potential habitat (IP > 0.66) in the basin. Hunter Creek has a total of 14.63 IP-km of coho salmon rearing habitat. Table 11-1 lists streams with high IP coho salmon habitat in the Hunter Creek population area.

Table 11-1 Tributaries with high IP reaches (IP > 0.66). (Williams et al. 2006).

Stream Name	Stream Name
Crossen Creek	Taylor Creek
Hunter Creek Estuary	Turner Creek
Lower Mainstem Hunter Creek	

11.3 Status of Hunter Creek Coho Salmon

Spatial Structure and Diversity

Coho salmon still inhabit their historic range in Hunter Creek from the Big South Fork Hunter Creek downstream, including the lowest extent of the Big South Fork Hunter Creek and Little South Fork Hunter Creek (Maguire 2001d). However, in dive surveys of three reaches of Hunter Creek (upstream of Yorke Creek, downstream of Little South Fork Hunter Creek, and upstream of North Fork Hunter Creek) in 2002-2004, coho salmon were only found at the reach downstream of Little South Fork Hunter Creek and were at very low densities (0.038 and 0.063/sq. meter) (ODFW 2005a). This indicates patchy distribution and likely a small population, which would generally have less genetic diversity than larger ones. Thus, spatial structure and diversity is likely low.

Population Size and Productivity

The Oregon Department of Fish and Wildlife (ODFW 2009a) estimated coho salmon populations for the period 1998 to 2008 for south coast Oregon, including Hunter Creek. Coho salmon adults were found in 5 of 11 years, with annual estimates of 136 in 2001, 52 in 2002, 17 in 2004, 22 in 2005 and 35 in 2008. One year class appears to be completely missing and the lack of consistent returns in other brood years indicates very low productivity in the Hunter Creek. There is no information regarding consistency of ODFW survey effort across years, so some qualification of these results is required. Also, in high flow years, surveys can be difficult or impossible. Consequently, the population may be somewhat larger than estimated and there may have been some coho salmon adults in years when the population estimate was zero. The productivity and size of this population is driven not only by the dynamics of the Hunter Creek population, but by those of nearby populations as well, which contribute spawners as strays. However, the supply of strays to Hunter Creek is not expected to be substantial or consistent in the near term because most adjacent populations in the SONCC coho salmon ESU are at low levels.

Extinction Risk

Not applicable because Hunter Creek is not an independent population.

Role in SONCC Coho Salmon ESU Viability

The Hunter Creek population is considered dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and likely received sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006). Although such populations cannot be viable on their own, they increase connectivity by allowing dispersal among independent populations, acting as a source of colonists in some cases. Historically, the Hunter Creek population would have interacted with the Northern Coastal independent populations such as the lower Rogue River to the north, and with other dependent populations such as the Pistol River to the south. Any restored habitat in Hunter Creek provides potential connectivity that could assist with metapopulation function in the SONCC coho salmon ESU.

11.4 Plans and Assessments

State of Oregon

Expert Panel Limiting Factors Report for Southwest Oregon

ODFW (2008b) convened a panel of fisheries and watershed science experts as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the concerns for the Hunter Creek population as follows:

> Key concerns were a loss of over-winter tributary habitat complexity and floodplain connectivity for juveniles, especially in the lowlands which are naturally very limited in these systems and have been impacted by past and current urban, rural residential, and forestry development and practices. High water temperatures for summer parr due to a loss of riparian function and channel straightening is also a key concern in this stream. The secondary concern was related to a loss of over-winter, lowland habitat complexity due to past and current agricultural practices.

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The State of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is a comprehensive plan that includes voluntary actions for all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary. The action plans, implementation success, and annual reports can be found at http://www.oregon.gov/OPSW/.

South Coast Watersheds Council (SCWC)

Hunter Creek Watershed Assessment

The Hunter Creek Watershed Assessment (Maguire 2001d) was prepared for the Hunter Creek Watershed Council by the SCWC. The purpose of the assessment was to compile, summarize, and synthesize existing data and information pertaining to the Hunter Creek basin's condition. This information is the foundation for the prioritization of projects outlined in the Hunter Creek Watershed Action Plan.

Hunter Creek Watershed Action Plan

The Hunter Creek Watershed Action Plan (Massingill 2001d) lays out a restoration strategy with specific recommended actions for Hunter Creek. These actions include: increasing the size and complexity of the estuary, identifying and restoring wetlands, identifying current and potential sediment sources in the basin, protecting existing riparian vegetation and planting new riparian vegetation, converting alder-dominated stands to conifer, and assessing the risk of failure of road crossings in earthflow areas."

11.5 Stresses

Table 11-2. Severity of stresses affecting each life stage of coho salmon in Hunter Creek. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses [2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	Medium	Very High	Very High[1]	Very High	High	Very High
2	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	High	Medium	Very High
3	Altered Sediment Supply	High	Medium	High	High	Medium	High
4	Impaired Water Quality	Low	High	Very High	High	Low	High
5	Impaired Estuary/Mainstem Function	-	Low	Very High	High	Medium	High
6	Altered Hydrologic Function	Medium	Medium	Medium	Medium	Low	Medium
7	Barriers	-	Low	Low	Low	Low	Low
8	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low
9	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.
[2]Increased Disease/Predation/Competition is not considered a stress for this population.

Key Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat is lacking as vital habitat for the population. Degraded riparian conditions eliminated the source of large wood recruitment. The complexity of the channel has been significantly reduced by the combined effect of excess fine sediment that fills pools and the lack of structure to meter out sediment or provide scour mechanisms which create and maintain pools. These findings are consistent with those of the Oregon Expert Panel (Section 11.4).

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure is the most limiting stress to coho salmon. Channelization of lower Hunter Creek has disconnected the stream from its riparian zone and wetlands and has likely disrupted surface water-groundwater interactions. Large fallen conifers and root masses that formerly forced the scour of pools are now scarce or absent, depriving coho salmon of necessary cover in their summer and winter habitats (Appendix B). ODFW and USFS conducted large wood surveys and found poor levels of large wood (<1 key piece per 100m). Wood has been removed from stream channels (EA Engineering, Science, and Technology 1998).

ODFW and USFS habitat surveys of the Hunter Creek basin found that pool frequency varied from fair (10 to 20 percent) in lower Big South Fork and upper mainstem Hunter to good (20 to 35 percent) in the mainstem above the North Fork and the lower North Fork (Appendix B). Surveys of lower Hunter Creek found pool frequencies greater than 35 percent and pool depths greater than three feet, which ODFW rates as very good (Appendix B). However, pool frequencies and depths are probably substantially reduced from historic conditions. For example, nearby Quosatana Creek in the Lower Rogue River sub-basin has a watershed with similar size to Hunter Creek but has mainstem pool depths of 10 feet (USFS 1996a). Hunter Creek pools historically may have approached or exceeded this depth.

Degraded Riparian Forest Conditions

There are few large trees capable of providing large wood in the riparian zone of Hunter Creek. Specifically, ODFW found there were fewer than 75 conifers greater than 36” in diameter per 1000 ft. in all reaches of Hunter Creek (Appendix B). Large conifers stabilize bank structure, maintain shade, and improve both thermal and nutrient buffering. The riparian zone of Hunter Creek is significantly altered, and hardwood trees like alder and willow are now the most abundant species in alluvial valleys. These species do not provide long lasting large wood for channel forming processes (Cederholm et al. 1997). Serpentine soils naturally limit the presence of large-diameter conifer forests in much of the east side of the Hunter Creek basin. In serpentine areas, Port Orford cedar is an important riparian tree that has suffered high mortality due to the spread of introduced Port-Orford cedar root rot (EA Engineering, Science, and Technology 1998). Sediment deposition and shifting bedload may cause mortality of streamside hardwoods and conifers, inhibiting riparian recovery and succession.

Altered Sediment Supply

Sediment contribution from landslides and erosion occurs naturally in the Hunter Creek basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. In lower Hunter Creek, where coho salmon are known to occur, sand and fine sediment has degraded (Appendix B). Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. Poor pool frequency and depth throughout the Hunter Creek basin (Maguire 2001d) is likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening.

Impaired Water Quality

Hunter Creek is recognized as temperature impaired from its mouth to 18.4 miles upstream (Oregon Department of Environmental Quality (ODEQ) 2002a). This is the area that contains some of the highest IP coho salmon habitat in the basin. North Fork Hunter Creek is also listed by ODEQ (2002a) as temperature impaired in the lower 4.8 miles. Upper mainstem temperatures are naturally warm (72 to 75 °F) because the headwaters have serpentine soils where vegetation is naturally sparse and stream shade low (Massingill 2001d). The Little South Fork is currently too warm during the summer, as is lower Hunter Creek which has temperatures as high as 74 to 75 °F. Only the lower Big South Fork is currently cool enough for rearing coho salmon. Aquatic insect samples on federal lands in the South Fork show that communities are diverse and very good in headwaters, but decline to fair or poor in lower reaches.

Lower Hunter Creek is pH-impaired during the summer. Septic systems could be a source of pollution (Massingill 2001d). Reduced flow levels combined with increased nutrients contribute to nuisance algae blooms that can elevate pH during the day and depress dissolved oxygen levels at night.

Impaired Estuary/Mainstem Function

The lack of estuary function is a high stress to juveniles and smolts. The Hunter Creek estuary has occasional nuisance algae blooms (Figure 11-2) and has lost both depth and complexity due to excess fine sediment deposition. Almost all former estuarine habitat has been altered. Highway 101 bisects the estuary just upstream of the mouth and acts as a dike along most of its length. There are also dikes along the south side of the estuary in front of a large commercial development. Further upstream, former estuarine habitat has been diked and filled for other commercial and agricultural use. One large side channel remains, but this channel, along with most of the estuary, shows signs of fine sediment accretion and lacks complex features such as large wood and deep pools. There appear to be no remaining tidal wetlands in the Hunter Creek estuary. Water quality is poor in the estuary during the low-flow season due to high water temperatures and the presence of algae blooms.

Figure 11-2. Algal bloom in the Hunter Creek estuary.

Altered Hydrologic Function

Altered hydrologic function is a low stress to Hunter Creek coho salmon. Maguire (2001d) notes that residential development and increased water demand have the potential to compromise flows. Timber harvest and roads have likely increased peak flows in the Hunter Creek basin (EA Engineering, Science, and Technology 1998). Such peak flows are known to cause channel scour, loss of large wood and pool filling. Disconnection of the channel and floodplain also may disrupt surface and groundwater connections that can provide a cooling influence that benefits coho salmon and other salmonids.

Barriers

Barriers to coho salmon migration exist in Hunter Creek, including several in the Lower Hunter Creek mainstem watershed (Maguire 2001d). Because coho salmon have access to most of the Hunter Creek basin, barriers represent a low stress.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Hunter Creek population area. Hatchery-origin coho salmon may stray into Hunter Creek; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages. (Appendix B).

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

11.6 Threats

Table 11-3. Severity of threats affecting each life stage of coho salmon in Hunter Creek. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	Medium	Very High	Very High[1]	Very High	Very High	Very High
2	Timber Harvest[1]	Very High	Very High	Very High[1]	Very High	Medium	Very High
3	Channelization/Diking	Low	Very High	Very High	Very High	Very High	Very High
4	Agricultural Practices	Low	High	High	High	High	High
5	Urban/Residential/Industrial Dev.	Low	Medium	High	High	High	High
6	Dams/Diversion	Low	Medium	Medium	Medium	Low	Medium
7	High Severity Fire	Low	Medium	Medium	Medium	Medium	Medium
8	Road-Stream Crossing Barriers	-	Low	Medium	Medium	Medium	Medium
9	Climate Change	Low	Low	Medium	Medium	Medium	Medium
10	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low
12	Invasive and Non-Native/Alien Species	-	Low	Low	Low	Low	Low
13	Fishing and Collecting	-	-	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and timber harvest.

Roads

Roads have been identified as a major source of sediment in the Hunter Creek watershed (EA Engineering, Science, and Technology 1998). Lower Hunter Creek, the Little Fork Hunter Creek, and Big South Fork Hunter Creek all have densities of over 3 miles of road per square mile of basin (mi/mi^2). USFS and BLM lands in the headwaters of the North Fork and mainstem Hunter Creek have road densities of 1.6 to 2.5 mi/mi^2. Unpaved roads often concentrate surface runoff and deliver sediment to stream channels. They also can initiate slope failures and landslides. Paved roads increase runoff and peak flows.

Channelization/Diking

Almost all high IP (>0.66) habitat areas in Hunter Creek have been altered by channelization and diking. Constriction of the channel by dikes and levees increases current velocity, making it unsuitable for winter rearing, and increases bedload mobility that scours redds and causes mortality of eggs. Road berms that parallel streams confine the channel, cutting it off from its floodplain and adjacent wetlands (Figure 11-3). Filling of the Hunter Creek estuary to enable commercial development has isolated formerly productive wetlands and decreased coho salmon rearing habitat. Channel migration in the estuary is also constrained by the Highway 101 bridge.

Figure 11-3. Lower Hunter Creek flows adjacent to residential development. Creek is closely confined by a berm for Hunter Creek Road. Some houses encroach closely upon the creek and fully occupy the riparian floodplain.

Timber Harvest

Private industrial timber lands cover much of the middle and lower Hunter Creek basin, including tributaries occupied by coho salmon habitat in their lowest reaches. Harvest cycles are on 30 to 50 year rotations. A high percentage (over 50%) of Hunter Creek is industrial timberlands managed under the Oregon Forest Practices Act. The high harvest rates and associated roads negatively impact multiple aspects of coho salmon habitat. In addition, nearly all intrinsic potential streams are surrounded by private industrial forestlands. Active timber harvest on private lands within the Hunter Creek basin is widespread and occurring rapidly with the expectation it will continue. Use of herbicides for site preparation after clear cutting to prevent growth of hardwoods or shrubs may also pose a risk to salmonids (Ewing 1999).

Agricultural Practices

Most of the upper Hunter Creek basin is unsuitable for agriculture. Agricultural practices occur in much of the high IP area in the lower basin, and pose a high threat to coho salmon. River terraces were cleared for farming and channels moved to accommodate greater agricultural production. Although agriculture may have been responsible for original changes to aquatic habitat, much of what was formerly farm land has now been converted to residential or industrial use.

Urbanization/Residential Development

Development in the Hunter Creek basin poses an overall high threat to coho salmon. Most development has occurred on the floodplain of the lower and middle reaches of Hunter Creek and the estuary, where coho salmon habitat occurs. Rural residences use both surface water and groundwater, which can deplete streamflows. This diminishes habitat and contributes to stream warming. Rural residential septic systems may leach nutrients or pollutants into nearly streams, and pesticides and herbicides used on lawns can pollute nearby waterways. Commercial and industrial land use in lower Hunter Creek and the upper estuary may also contribute to non-point source pollution.

Dams/Diversions

There are no dams known to impede passage in Hunter Creek; however, diversions are a concern, particularly in lower Hunter Creek. Massingill (2001d) notes that Hunter Creek water rights are over-allocated from May through October, but approximately 25 percent of the water rights are junior to the in-stream rights held by ODFW which date from 1964.

High-Intensity Fire

The proximity of the Hunter Creek basin to the coast is a strong moderating factor on fire risk. However, serpentine terrain in the upper Hunter Creek basin has sparse vegetation and drier site conditions that make fires more frequent than in coastal rain forests. Early seral conditions with crowded trees elevate the risk of catastrophic fire regionally (Southwest Oregon Resource Conservation and Development Council 2003). If fire causes widespread loss of ground cover, substantial erosion may wash fine sediment into streams and degrade coho salmon habitat. Thus, fire poses an overall medium risk to coho salmon.

Road-stream Crossing Barriers

Road-stream crossings pose a low threat to coho salmon. The Big South Fork Hunter Creek has the highest density of stream crossings of any watershed in the basin, while the Lower and Middle Hunter Creek mainstem have moderate to high densities of road crossings (Maguire 2001d). Road crossing surveys were conducted to assess erosion potential; however, it is likely that some of these crossings impede fish migration.

Climate Change

There is low risk of change in average precipitation over the next 50 years (Appendix B). Modeled regional average temperature shows a moderate increase over the next 50 years (Appendix B). Average temperature could increase by up to 1^{o} C in the summer and by a similar amount in the winter. The risk of sea level rise is high (Thieler and Hammer-Klose 2000), which may impact the quality and extent of wetland juvenile and smolt habitat. Adults may be negatively impacted by climate-related ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Mining/Gravel Extraction

Sand and gravel have been extracted from gravel bars along the lower 10 km of Hunter Creek since at least the 1960s (Jones et al. 2011). Gravel mining at two sites is covered under a NMFS biological opinion until September 2016 (NMFS 2011b). Gravel mining can reduce instream habitat complexity, but it is unknown whether this has occurred in Hunter Creek. Air photo analysis indicates a decline in bar area from 1940-2009, but the reasons are unknown (Jones et al. 2011).

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Hunter Creek population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Invasive and Non-Native/Alien Species

Given the extent of residential development in the lower floodplain of Hunter Creek, it is likely that invasive plant species will spread from residential landscaping into riparian areas, particularly if there are pre-existing gaps in the riparian vegetation. Some of these species could impede restoration of riparian forests and wetlands. The extent to which this has already occurred is unknown.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

11.7 Recovery Strategy

The most immediate need for habitat restoration and threat reduction in Hunter Creek is in those areas currently occupied by coho salmon in mainstem Hunter Creek, Little South Fork Hunter Creek, and Big South Fork Hunter Creek. Unoccupied areas must also be restored to provide enough habitat for coho salmon recovery.

The Hunter Creek population is dependent and therefore cannot be viable on its own; however, it is necessary to restore habitat within the basin so that it can support all life stages of coho salmon and provide connectivity between other populations in the ESU. The recovery criterion for this population is that 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival. The most important factor limiting recovery of coho salmon in Hunter Creek is a deficiency in the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by increasing habitat complexity within the channel, re-establishing off-channel rearing areas, restoring riparian forests, and reducing threats to instream habitat. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 11-4 on the following page lists the recovery actions for the Hunter Creek population.

Table 11-4. Recovery action implementation schedule for the Hunter Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HunC.2.4.15	Floodplain and Channel Structure	Yes	Improve estuarine habitat	Reconnect estuarine habitat	Highway 101 bridge	2b
SONCC-HunC.2.4.15.1	*Develop plan to replace Highway 101 bridge that will allow Hunter Creek to meander across estuarine floodplain*					
SONCC-HunC.2.4.15.2	*Install new bridge, guided by plan*					
SONCC-HunC.2.4.17	Floodplain and Channel Structure	Yes	Improve estuarine habitat	Restore estuarine habitat	Hunter Creek Estuary, immediately upstream of Highway 101	2b
SONCC-HunC.2.4.17.1	*Assess tidally influenced habitat and develop a plan to restore tidal channels*					
SONCC-HunC.2.4.17.2	*Restore tidal wetlands and tidal channels in historic estuary, guided by the plan*					
SONCC-HunC.19.1.4	Timber Harvest	Yes	Improve timber harvest practices	Improve regulatory mechanisms	Population wide	2b
SONCC-HunC.19.1.4.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-HunC.19.1.4.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-HunC.19.1.4.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-HunC.19.1.4.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-HunC.19.1.4.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams*					
SONCC-HunC.7.1.1	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Private land	2b
SONCC-HunC.7.1.1.1	*Review General Plan or City/County Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-HunC.7.1.1.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat*					
SONCC-HunC.2.1.13	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2b
SONCC-HunC.2.1.13.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-HunC.2.1.13.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HunC.2.1.42	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2c
SONCC-HunC.2.1.42.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-HunC.2.1.42.2	*Place instream structures, guided by assessment results*					
SONCC-HunC.2.2.11	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Lower mainstem Hunter Creek, including estuary and tributaries within the floodplain, and all streams where coho salmon would benefit immediately	2b
SONCC-HunC.2.2.11.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-HunC.2.2.11.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-HunC.2.2.44	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2c
SONCC-HunC.2.2.44.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-HunC.2.2.44.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-HunC.2.2.10	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Lower mainstem Hunter Creek and tributaries within floodplain, and all streams where coho salmon would benefit immediately	2b
SONCC-HunC.2.2.10.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-HunC.2.2.10.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-HunC.2.2.10.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-HunC.2.2.43	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2c
SONCC-HunC.2.2.43.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-HunC.2.2.43.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-HunC.2.2.43.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HunC.2.2.16	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Lower Hunter Creek	2b
SONCC-HunC.2.2.16.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-HunC.2.2.16.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-HunC.28.2.27	Roads	Yes	Reduce pollutants and stormflow	Increase regulatory oversight	Population wide	2b
SONCC-HunC.28.2.27.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-HunC.28.2.27.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-HunC.28.2.27.3	*Develop local regulatory mechanisms that reduce amount of total impervious area through incentives*					
SONCC-HunC.28.1.12	Roads	Yes	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	Prioritize middle and lower reaches of basin, Big South Fork, and all streams where coho salmon would benefit immediately	2b
SONCC-HunC.28.1.12.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-HunC.28.1.12.2	*Decommission roads, guided by assessment*					
SONCC-HunC.28.1.12.3	*Upgrade roads, guided by assessment*					
SONCC-HunC.28.1.12.4	*Maintain roads, guided by assessment*					
SONCC-HunC.28.1.46	Roads	Yes	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	Population wide	2c
SONCC-HunC.28.1.46.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-HunC.28.1.46.2	*Decommission roads, guided by assessment*					
SONCC-HunC.28.1.46.3	*Upgrade roads, guided by assessment*					
SONCC-HunC.28.1.46.4	*Maintain roads, guided by assessment*					
SONCC-HunC.12.1.28	Agricultural Practices	No	Improve agricultural practices	Improve regulatory mechanisms	Population wide	2b
SONCC-HunC.12.1.28.1	*Determine the best way to revise the Agricultural Water Quality Management Act (AWQMAP) so that it does not limit recovery of SONCC coho salmon and recommend appropriate revisions*					
SONCC-HunC.12.1.28.2	*Ensure basin rules are specific and linked to implementing AWQMAP recommendations, including developing specific standards for riparian buffers*					
SONCC-HunC.12.1.28.3	*Ensure that AWQMA plans address both impaired areas and proactive prevention of water quality impairment*					
SONCC-HunC.12.1.28.4	*Adopt interim buffers equal to the buffer standards NMFS is recommending in Washington state until the state establishes its own buffers*					
SONCC-HunC.12.1.28.5	*Change the complaint-based compliance monitoring process to a focused compliance program*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HunC.2.2.38	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2c
SONCC-HunC.2.2.38.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-HunC.10.2.8	Water Quality	No	Reduce pollutants	Set standard	Population wide	2d
SONCC-HunC.10.2.8.1	*Develop TMDLs for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-HunC.7.1.26	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho salmon bearing streams	3b
SONCC-HunC.7.1.26.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-HunC.7.1.26.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					
SONCC-HunC.22.2.25	Urban, Residential, Industrial Development	No	Improve flow timing or volume	Increase instream flows	All streams with ODFW water rights for fish, and all streams where coho salmon would benefit immediately	3b
SONCC-HunC.22.2.25.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-HunC.22.2.45	Urban, Residential, Industrial Development	No	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-HunC.22.2.45.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-HunC.7.1.2	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Forest federal lands	3c
SONCC-HunC.7.1.2.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-HunC.7.1.2.2	*Plant conifers, guided by the plan*					
SONCC-HunC.10.7.40	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-HunC.10.7.40.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-HunC.10.7.40.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-HunC.10.7.41	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-HunC.10.7.41.1		*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*				
SONCC-HunC.10.7.41.2		*Supply marine-derived nutrients to streams guided by the plan*				
SONCC-HunC.7.1.3	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Remove invasive species	Lower mainstem	3d
SONCC-HunC.7.1.3.1		*Remove invasive species from lower river riparian zones and replace with conifers or native hardwood species, such as cottonwoods*				
SONCC-HunC.7.1.3.2		*Develop an educational program that teaches local landowners the methods and benefits of restoring riparian stand functions*				
SONCC-HunC.10.2.14	Water Quality	No	Reduce pollutants	Educate stakeholders	Population wide	3d
SONCC-HunC.10.2.14.1		*Develop an educational program that teaches landowners and businesses about avoiding pollution from septic systems, backyard pesticides, fuels, and nutrients*				
SONCC-HunC.10.2.24	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	3d
SONCC-HunC.10.2.24.1		*Increase application of Low Impact Development (LID) techniques through education and incentives*				
SONCC-HunC.10.2.24.2		*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*				
SONCC-HunC.10.2.23	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-HunC.10.2.23.1		*Develop a pesticide management plan*				
SONCC-HunC.10.2.23.2		*Implement pesticide management plan and technical assistance program*				
SONCC-HunC.3.1.5	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Lower mainstem	BR
SONCC-HunC.3.1.5.1		*Develop an educational program that teaches landowners to implement water conservation measures*				
SONCC-HunC.3.1.6	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Lower mainstem and tributaries	BR
SONCC-HunC.3.1.6.1		*Install additional flow gages in the lower river and tributaries to study surface and groundwater use*				

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12. Pistol River Population

Northern Coastal Stratum

Dependent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

93 mi^2 watershed (57% Federal ownership)

30 IP-km (19 IP-mi) (23% High)

Dominant Land Uses are 'Timber Harvest' and 'Agriculture'

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Degraded Riparian Forest Conditions'

Key Limiting Threats are 'Roads', and 'Timber Harvest'

Highest Priority Recovery Actions

• Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows • Improve timber harvest practices by revising Oregon Forest Practices Act • Reduce sediment delivery to streams from roads	• Improve grazing practices • Decommission, upgrade, or maintain roads • Increase beaver abundance

12.1 History of Habitat and Land Use

The relevant history of the Pistol River is described in the Pistol River Watershed Analysis (U.S Forest Service [USFS] 1998b) and the Pistol River Watershed Assessment (Maguire 2001e), which are the basis of this summary. Early settlers likely diminished the habitat capacity of the two lower river tributaries, which no longer have recognizable channels. Two ranches in the grassy meadows near the lower river have been in continuous grazing since that time.

Long-time residents remember a river too cold to swim in most of the summer, before intensive timber harvest began in the 1950s (Maguire 2001e). The 1955 flood carried sediment that filled the lower river, which had previously been the site of major salmon spawning. Where the lower Pistol River had been a sequence of riffles and deep corner pools, it became a series of long riffles with small, shallow pools. Tributaries like Deep Creek were changed by repeated debris torrents after timber harvest, but local residents report prior use by 300 to 400 spawning salmon (Maguire 2001e). These same observers note that the river's flood flows rise and fall much more quickly than before timber harvest and that base flow conditions appear greatly reduced. The mouth of the river now opens later in the fall than it used to. Local residents used to breach the sand berm at the mouth of the Pistol River, but that is no longer allowed (Maguire 2001e).

Private industrial timber land ownership covers 30 percent of the basin and lies between the federally managed land in the upper basin and the ranchland in the lower valley.

Since the Northwest Forest Plan (US Department of Agriculture [USDA] and US Department of the Interior [USDI] 1994) was adopted, there has been a very low level of timber harvest in the Pistol River basin on USFS and BLM lands. Streams in these upper tributaries have started to recover. Private industrial timber harvest is active in the western portion of the Pistol River basin, including much of the South Fork, where harvest rotations are 30 to 50 years.

The intensity of grazing in the lower Pistol River has undoubtedly decreased since a cheese factory located in the lower basin ceased operation in the 1960s, but fields still constrain the lower river channel and occupy its floodplain. Residential development has occurred in the lower Pistol River, but not to the same degree as other southwest Oregon streams like Hunter Creek and the lower Chetco River. Widespread restoration efforts over the last decade have had mixed success (Swanson 2005).

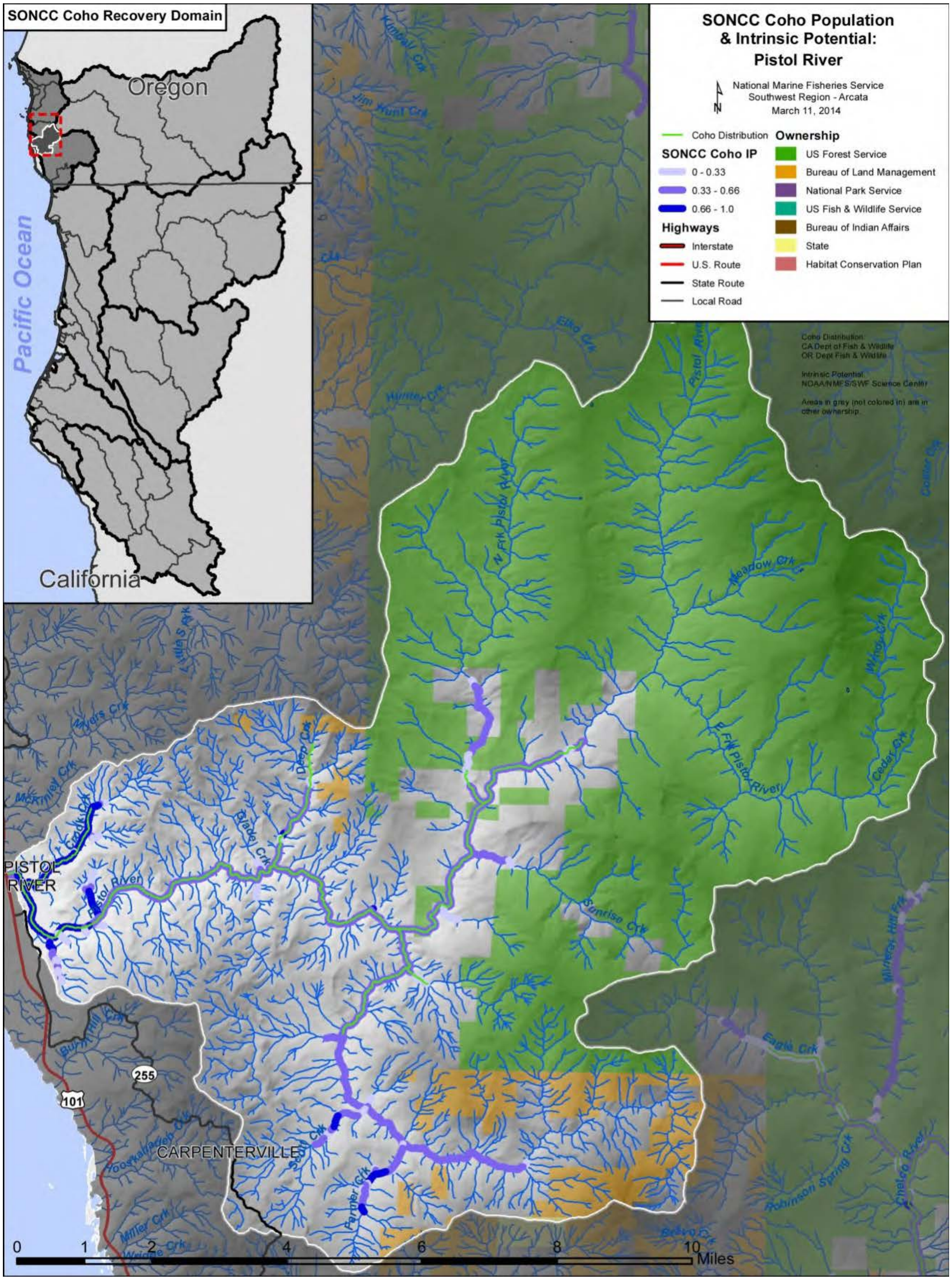

Figure 12-1. The geographic boundaries of the Pistol River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

12.2 Historic Fish Distribution and Abundance

The steep headwaters of the upper Pistol River prevent coho salmon access very far up major tributaries except in the South Fork (Maguire 2001e). Modeling by Williams et al. (2006) found high intrinsic potential (IP >0.66) habitat for coho salmon in the lower mainstem Pistol River, estuarine tributary Crook Creek and two unnamed tributaries of the lower river. Additionally, flat reaches in Deep Creek, and South Fork Pistol River tributaries, Farmer and Scott creeks, have patches of high IP (Table 12-1). The two unnamed tributaries of lower Pistol River are not found on U.S. Geological Survey (USGS) 1:24000 topographic map (USGS 1989) and no longer have recognizable stream channels when examined using aerial photos; therefore, they are not listed in Table 12-1. Pistol River had sufficient capacity before disturbance to provide possible refugia for smaller nearby populations and a modest source of colonists to adjacent smaller streams, such as Hunter Creek.

Table 12-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Crook Creek	Farmer Creek	Pistol River Estuary
Deep Creek	Lower Pistol River	Scott Creek

12.3 Status of Pistol River Coho Salmon

Spatial Structure and Diversity

Much of the high IP in the lower mainstem Pistol River and its tributaries is presently unsuitable for coho salmon spawning or rearing. Some low gradient tributaries of the lower river are only partially degraded, but others have been completely lost. Although coho salmon population levels are low, spawning still occurs in the mainstem Pistol River up to the East Fork Pistol, in Crook Creek and Deep Creek, in lower North Fork Pistol River, and in the lower South Fork Pistol River including its tributary Koontz and Davis Creek (Figure 12-1). The Oregon Department of Fish and Wildlife (ODFW; 2005a) conducted a total of 14 snorkel surveys at sites in the Pistol River basin from 2002 to 2004. They found juvenile coho salmon in 3 of 11 reaches (6 of 352 pools) sampled, all at very low levels of ≤0.001 coho/m^2, including in the lower South Fork and two mainstem Pistol River reaches upstream of the North Fork Pistol River. Pistol River coho salmon are still well distributed but persisting at low levels, which is likely diminishing genetic diversity.

Population Size and Productivity

Although ODFW (2005a) found coho salmon juveniles in each year of their surveys between 2002 and 2004, they were found only at extremely low levels. Coho salmon are only intermittently present in Crook Creek (Swanson 2005), a formerly productive tributary. Population estimates for 1998 to 2008 for south coast Oregon coho salmon were provided by ODFW (2009a). They estimated escapement in the Pistol River as 78 coho salmon in 1999, 155 in 2000, 118 in 2002, and zero in all the other years. The lack of consistent spawner returns within year classes and the absence of some year classes indicate very low productivity in the Pistol River. Because there is no information on ODFW survey effort, some qualification of these results is required. If surveys were only in lower river tributaries, then coho salmon that spawned in upper basin tributaries would not have been counted. Similarly, in high flow years, counts may be difficult or impossible. Consequently, the population may be somewhat larger than estimated and there may have been some coho salmon adults in years when the population estimate was zero. The productivity and size of this population is driven not only by the dynamics of the Pistol River population, but by those of nearby populations as well, which contribute spawners as strays. However, the supply of strays to Pistol River is not expected to be substantial or consistent in the near term because most adjacent populations in the SONCC coho salmon ESU are at low levels.

Extinction Risk

Not applicable because the Pistol River is not an independent population.

Role in SONCC Coho Salmon ESU Viability

Although dependent populations such as the Pistol River are not viable on their own, they do increase connectivity by allowing dispersal among independent populations and provide areas of refugia for other populations, acting as a source of colonists in some cases. The Pistol River may have been a source of colonists to nearby dependent populations, such as Hunter Creek. Any restored habitat in Pistol River provides potential connectivity that assists metapopulation function in the SONCC ESU.

12.4 Plans and Assessments

State of Oregon

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The State of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is a comprehensive plan that includes voluntary actions to address all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs described in the Oregon Plan were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary.

Report of the Oregon Expert Panel on Limiting Factors

ODFW (2008b) convened a panel of fisheries and watershed science experts as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the concerns for the Pistol River population as follows:

> Key concerns in the Pistol River were a loss of over-winter tributary habitat complexity and floodplain connectivity for juveniles, especially in the lowlands

which are naturally very limited in these systems and have been impacted by past and current urban, rural residential, and forestry development and practices. High water temperatures for summer parr due to a loss of riparian function and channel straightening is also a key concern in these streams. The secondary concern was related to a loss of over-winter, lowland habitat complexity due to past and current agricultural practices.

Cumulative Effects of Southwest Oregon Coastal Land Use on Salmon Habitat

Oregon State University (OSU) Oak Creek Labs conducted a study funded by ODFW and the Oregon Department of Forestry (ODF) to determine relationships between forest harvest and Pacific salmon productivity (Frissell 1992). The study assessed basins along the Oregon coast extending from the Sixes River to the southern border during the period from 1986 to 1992.

Curry County Soil and Water Conservation District

Pistol River Package Monitoring Report

The Pistol River Package Monitoring Report (Swanson 2005) describes conditions in the Pistol River after numerous basin enhancements were carried out, including large wood placement, fish passage improvements, riparian fencing and planting, rock weirs, and bio-engineered bank stabilization structures.

South Coast Watershed Council (Pistol River Watershed Council)

Pistol River Watershed Assessment

This assessment (Maguire 2001e) summarizes conditions, historic changes and restoration needs in the Pistol River basin. Community concerns, salmonid habitat, limiting factors, and prospects for recovery of fisheries and watershed health are included.

Pistol River Action Plan

The Pistol River Action Plan (Massingill 2001e) is a companion to Maguire (2001e), and proposes specific targets for restoration.

United States Forest Service

Pistol River Watershed Analysis

The Pistol River Watershed Analysis was written by the USFS (1998b) in accordance with the Northwest Forest Plan (USDA and USDI 1994) and sets a course of restoration for their ownership in the Pistol River. Planned activities include road decommissioning, hardwood thinning and conifer planting in riparian zones and combating the spread of Port Orford root disease in the watershed.

12.5 Stresses

Table 12-2. Severity of stresses affecting each life stage of coho salmon in the Pistol River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	High	Very High	Very High[1]	Very High	High	Very High
2	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	High	High	Very High
3	Altered Sediment Supply	Very High	Very High	Very High	High	High	Very High
4	Impaired Water Quality	Medium	High	Very High	High	Low	High
5	Altered Hydrologic Function	High	High	High	High	Low	High
6	Impaired Estuary/Mainstem Function	-	Low	Very High	High	Medium	High
7	Barriers	-	Low	Low	Low	Low	Low
8	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low
9	Adverse Fishery- and Collection- Related Effects	-	-	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.
[2]Increased Disease/Predation/Competition is not considered a stress to this population.

Key Limiting Stresses, Life Stages, and Habitat

The upper South Fork Pistol River above Farmer Creek may provide coho salmon refugia because it has suitable gradient, cool water temperatures, and pools greater than 1 meter deep; however, there are no data documenting coho presence in that reach. Otherwise there are currently no functioning coho salmon refugia in the Pistol River or its tributaries. Crook Creek is too warm at its convergence with the mainstem to support coho salmon (Maguire 2001e) and Deep Creek has excessive amounts of fine sediment (Swanson 2005).

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking as vital habitat for the population. Juvenile summer rearing habitat is impaired by an excess of fine sediment, which has filled in the mainstem, tributary channels, and the estuary, and contributes to high water temperature. Lack of floodplain and channel structure due to channelization and filling of the floodplain has eliminated much of the coho salmon rearing habitat in the basin. Winter rearing habitat is often formed by instream large wood, but is also found in estuaries and floodplain wetlands. Degraded riparian conditions have eliminated the source of large wood recruitment and floodplain wetlands have been filled or disconnected from the river. Overall, these findings are consistent with those of the Oregon Expert Panel (Section 12.4), except that the expert panel did not consider excess sediment to be a concern.

Lack of Floodplain and Channel Structure

Long-time lower Pistol River residents described the transformation of the channel from one with well-developed deep pools joined by short riffles to one dominated by riffles with few pools of limited depth (Maguire 2001e). High fine sediment load and bedload movement inhibit channel recovery and also creates adverse conditions for eggs because redds are scoured out or deposits smother eggs and prevent fry emergence.

Before disturbance, the Pistol River riparian zone was comprised of large conifers that lived hundreds of years and then fell into streams, forming pools and complex habitats with which coho salmon co-evolved. Large wood was swept from many mainstem and tributary channels in the 1955 and 1964 floods, which lead to a loss of habitat complexity. Current large wood recruitment is also low. Large wood surveys by ODFW show that all Pistol River reaches have poor levels of large wood (<1 key piece per 100m). USFS large wood surveys found very good levels of large wood in the upper East Fork Pistol River, North Fork Pistol River, and Sunrise Creek on USFS lands, but these streams are largely inaccessible to coho salmon.

Disconnection of the lower Pistol River and estuary from its floodplain and confinement of its channel (Figure 12-2) are major impediments to lower river recovery. Lower Crook Creek has high IP, but its lower reaches are channelized also.

ODFW and USFS habitat data indicate that in the mainstem Pistol River, pool frequencies are greater than 35 percent, which they rate as good. An upper East Fork Pistol River reach, lower Meadow Creek, and the South Fork tributary Koontz and Davis Creek all had poor ratings (<10 percent pools). Pool frequency is only fair (10 to 25 percent) in the lower North Fork, lower Sunrise Creek, Deep Creek, and South Fork tributaries including Scott Creek.

Pool depth of greater than one meter (3.3 ft.) is rated as good by ODFW, and on that basis the South Fork and mainstem Pistol River below the East Fork have good pool depth. However, the Pistol River formerly had pools that were up to 20 feet deep (Maguire 2001e).

Figure 12-2. Aerial photo of Pistol River showing confinement by a levee. The levee separates the active channel from adjacent farm and industrial gravel operation to the west (left). The levees also cut off the river from oxbows and meanders on the east bank (right), which would have formerly created ideal coho salmon rearing areas. Yellow arrows highlight pockets of residential development.

Degraded Riparian Forest Conditions

ODFW surveys found fewer than 75 conifers greater than 36” in diameter per 1000 ft. on the South Fork Pistol River, mainstem Pistol River downstream of the East Fork, Sunrise Creek, and Deep Creek. This low density of large trees in the riparian zone has led to poor bank structure, reduced shade, and reduced thermal and nutrient buffering. The riparian zone of the mainstem Pistol River is predominantly hardwood trees (Figure 12-3), with very few large conifers. Willow and alder are the most abundant species in the alluvial valleys, although cottonwoods were once a significant part of the riparian community (Maguire 2001e). High bedload transport in the lower Pistol River is likely causing high mortality of both conifers and alders, because these species die if their root systems are buried.

Figure 12-3. Photo of the lower mainstem Pistol River. The river has a willow and alder riparian zone. Note also excess sediment and lack of channel structure.

Altered Sediment Supply

Sediment contribution from landslides and erosion occurs naturally in the Pistol River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. For example, debris torrents in 2003 covered large wood restoration projects with approximately 100,000 to 200,000 cubic yards of sediment in lower Deep Creek (Swanson 2005). Debris flows significant enough to alter channel structure occurred in the South Fork Pistol River and upper mainstem Pistol River in 1996 (Maguire 2001e). Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. Poor pool frequency and depth throughout the Pistol River basin (Maguire 2001e) is likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening.

Figure 12-4. Photo of Pistol River estuary. View is looking downstream from the Pistol River Road bridge. The large gravel bars occupy a formerly deep channel here, suggesting excess fine sediment.

Impaired Water Quality

The mainstem Pistol River is listed under the Clean Water Act Section 303(d) for impaired temperature and dissolved oxygen from the mouth upstream to RM 19.8, and the lower half mile of the South Fork is also listed as temperature impaired. Maguire (2001e) reported that the ODEQ maximum floating weekly maximum temperature (MWMT) threshold for impairment of 64 °F was exceeded at all stations measured, indicating lack of suitability for coho salmon rearing; however, there are a few additional stations/years in the ODEQ LASAR database (see Appendix B) with temperatures below the 64 °F threshold: Glade Creek at mouth, upper Farmer Creek, South Fork Pistol River at upper crossing, Deep Creek at mouth (2 of 8 years), and North Fork Pistol River near mouth (1 of 6 years). Figure 12-5 shows water temperatures for the Pistol River from 1995 to 2000 as reported by Maguire (2001e). The lower East Fork Pistol River and Deep Creek are almost cool enough to provide suitable coho salmon habitat. Lower reaches of the North Fork and the upper mainstem Pistol River are showing improvement (65 °F to 69 °F), but the South Fork is much too warm to support coho salmon (71.4 °F to 72.8 °F). Lower mainstem Pistol River temperatures are also too warm (71.8 °F -75 °F). The Pistol River warms 2 to 4 °F between the East Fork Pistol and South Fork Pistol (Maguire 2001e).

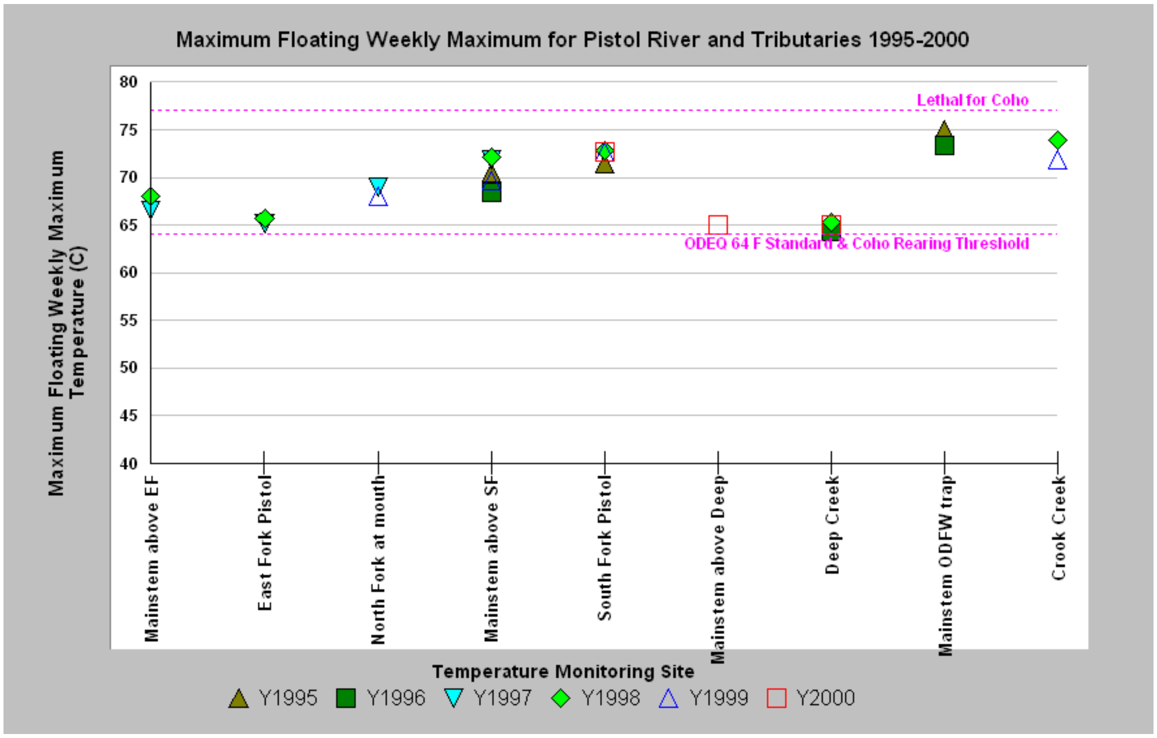

Figure 12-5. Maximum floating weekly maximum water temperatures for the Pistol River. Data includes tributaries and shows a pattern of exceeding coho salmon rearing requirements (McCullough 1999) and ODEQ standards (64 °F). The lethal temperature reference value of 77 °F is from Sullivan et al. (2000).

Water quality in the Pistol River is also compromised by low dissolved oxygen (DO) levels. The low DO levels are likely due to stagnation and to algal blooms, which are encouraged by excess nutrients and lack of shade. There are seasonal problems with elevated phosphorous, *E. coli* and biological oxygen demand (Maguire 2001e).

Altered Hydrologic Function

Changes in Pistol River basin hydrology have led to a substantial decrease in available habitat for coho salmon, resulting in a high level of stress for most life stages. Excess fine sediment blocks surface and groundwater interactions by clogging interstitial spaces of stream gravels that are known to help maintain cool temperatures. This type of connection likely created cold water strata at depth in the deeper pools that were formerly common, even when surface waters were warm. Some Pistol River Watershed Council members believe that the summer base flows have also diminished (Maguire 2001e). Studies elsewhere in the Pacific Northwest indicate that converting forest stands of fewer large trees to ones with many small trees can decrease base flows for several decades (Murphy 1995).

The hydrology of the lower basin has been substantially altered through disconnection of the floodplain and channelization. High road densities in some Pistol River watersheds are likely to lead to increased peak flows. These peak flows can scour eggs and flush fry, juveniles, and smolts from the river system.

Impaired Estuary/Mainstem Function

The Pistol River estuary retains little of its historic form or function and provides little opportunity for estuarine rearing. Studies elsewhere in Oregon found that estuarine tributaries and sloughs can be important habitat types for rearing coho salmon juveniles (Koehler and Miller 2003, Miller and Sadro 2003). The remnants of past estuarine habitat indicate the Pistol River estuary was formerly large with numerous tributaries, tidal channels, and likely tidal wetlands. The diking and filling for conversion to agricultural uses has completely eliminated these habitats. Lack of riparian vegetation in the estuary and the accretion of fine sediment have led to highly degraded water quality and habitat conditions. Long-time residents remember pools up to 20 feet deep, while ODFW 1991 habitat data indicated a mean pool depth of only 3.3 feet in the lowermost Pistol River reach (Maguire 2001e). Long-time residents noted a decrease in estuarine use by smelt, which is likely due to a change in seasonality of the opening of the mouth. Crook Creek, the largest estuary tributary, loses surface flow during the summer for its last 500 feet (Swanson 2005), seasonally preventing fish use of this important rearing stream. Highway 101 bisects the estuary near the mouth of the river, constraining the estuary and preventing full tidal inundation upstream. The estuary to the west of Highway 101 encompasses a fair amount of sand and mudflat habitat that could be used for rearing, but it lacks complex habitat features such as large wood or deep pools. Reduced estuarine function poses an overall high stress to Pistol River coho salmon.

Barriers

Although road densities in the Pistol River basin are high, which increases risk of passage problems, coho salmon still have access to most of the basin (Maguire 2001e). The dry reach at the mouth of Crook Creek (Swanson 2005) is a seasonal barrier to juveniles. A major passage problem into Deep Creek has been resolved by replacing a culvert with a bridge (Swanson 2005). Consequently, barriers represent a low stress.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into Pistol River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

12.6 Threats

Table 12-3. Severity of threats affecting each life stage of coho salmon in the Pistol River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	High	Very High	Very High[1]	Very High	Very High	Very High
2	Timber Harvest[1]	Very High	Very High	Very High[1]	Very High	Medium	Very High
3	Channelization/Diking	Medium	Very High	Very High	Very High	Very High	Very High
4	Agricultural Practices	Low	Medium	High	High	High	High
5	Dams/Diversion	Low	Medium	Medium	Medium	Low	Medium
6	Urban/Residential/Industrial Dev.	Low	Medium	Medium	Medium	Medium	Medium
7	High Severity Fire	Low	Medium	Medium	Medium	Medium	Medium
8	Climate Change	Low	Low	Medium	Medium	Medium	Medium
9	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
10	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low
12	Fishing and Collecting	-	-	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.
[2]Invasive and Non-Native/Alien Species is not considered a threat to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and timber harvest.

Roads

Roads pose an overall very high threat to the Pistol River coho salmon population. There are high road densities (2.5 to 3.0 mi/mi^2) in the South Fork Pistol River and very high densities (>3.0 mi/mi^2) in the Upper and Lower Pistol River. Road densities are medium (1.6-2.5 mi/mi^2) in the East Fork Pistol River, North Fork Pistol River, and in mainstem watersheds between the East Fork and South Fork Pistol River. Additionally there is a high number of road stream crossings, streamside roads, and many road segments that cross steep unstable slopes or erodible soils. These conditions all pose a risk of elevated fine sediment yield. Road density estimates are conservative because they do not include skid roads, landings, or temporary roads. The main timber harvest haul road along the Pistol River has initiated large landslides (Maguire 2001e). A main haul road also follows the South Fork Pistol River.

Timber Harvest

Timber harvest poses an overall very high threat to the coho salmon population. Private industrial timber lands managed under the Oregon Forest Practices Act occupy 30 percent of the landscape, but they coincide with nearly all the low gradient intrinsic potential streams. Therefore, these lands have a disproportionate effect on coho salmon. The high harvest rates and associated roads negatively impact multiple aspects of coho salmon habitat. Deep Creek is an example of where short timber harvest rotations are likely inhibiting channel and coho salmon recovery.

Studies of adjacent southwest Oregon basins found that "downstream, cumulative impacts of human activity are pervasive in southwest Oregon, wherever logging has occurred over an extensive portion of a drainage basin or has involved operations on steep, unstable slopes. The downstream effects of channel sedimentation and aggradation can severely damage streams even where buffer zones of riparian vegetation have been retained, and such effects persist more than 20-30 years after logging activities have ceased" (Frissell 1992).

Channelization/Diking

Channelization and diking have occurred in high IP reaches in the lower tributaries, along the lower mainstem, and in the estuary. Crook Creek had ideal gradient and valley width for coho salmon, but the channel has been straightened and greatly reduced in complexity (Figure 12-6). The lower mainstem and estuary have been similarly channelized and disconnected from the floodplain and adjacent wetlands. Roads that follow the river or tributaries may cut them off from their floodplains as well.

Agricultural Practices

The same farms and ranches have operated in the lower river for well over 100 years and levels of grazing are likely not as high as they were in the past. Nonetheless, long term activities have led to the disconnection of the lower Pistol River and estuary from floodplains (Figure 12-2). Lower Pistol River tributaries have also been profoundly altered; two unnamed tributaries with high IP now have unrecognizable channels. Crook Creek has also been straightened and disconnected from its floodplain (Figure 12-6), but landowners have been trying to restore it (Swanson 2005). The negative effects of pesticides and herbicides on Pacific salmon species and aquatic ecosystem function are becoming more well documented regionally (National Marine Fisheries Service (NMFS) 2008, Laetz et al. 2009), but the extent of use of these chemicals by Pistol River farms and ranches is unknown.

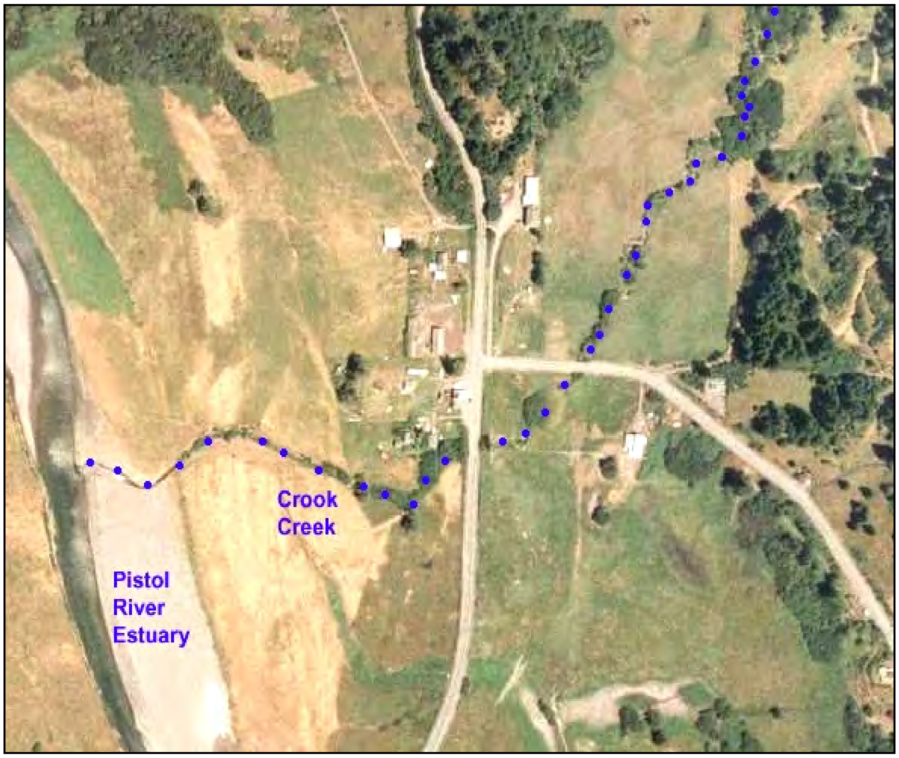

Figure 12-6. Photo of Crook Creek joining the Pistol River estuary. Convergence is at center left. The creek's channel is straightened and confined. It also lacks a functional riparian zone.

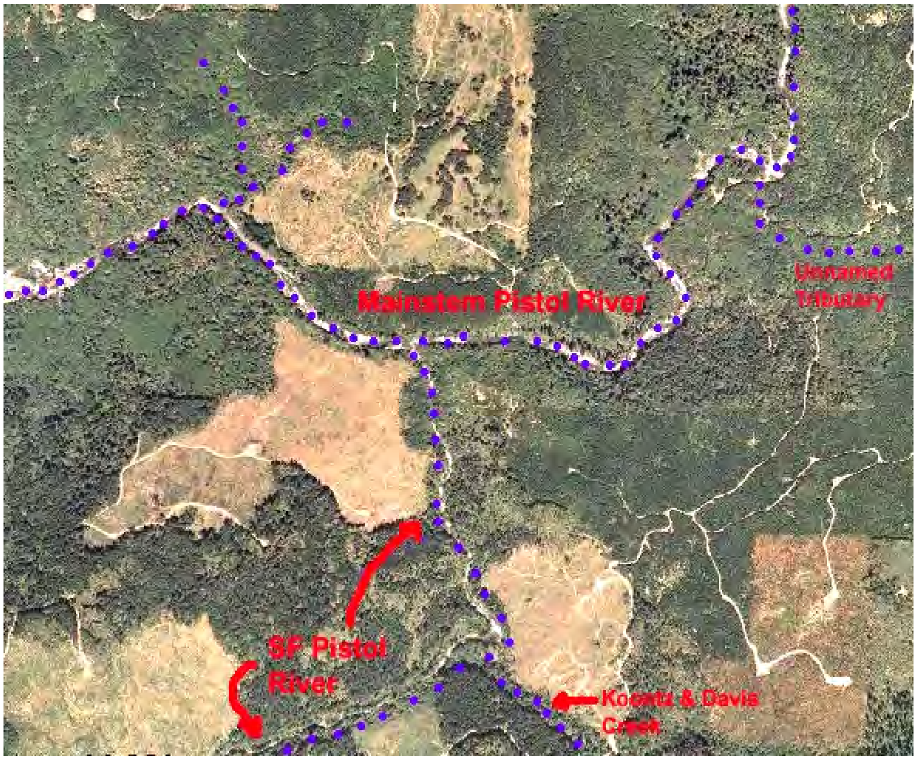

Figure 12-7. Photo of the mainstem Pistol River and the South Fork. Also shown is lower tributary Koontz and Davis Creek. Note extensive clear cuts and high road density.

Dams/Diversions

There are no known dams on the Pistol River. The Oregon Water Resources Department has a Pistol River instream water right of 15 cfs (Maguire 2001e). The sum of the diversion water rights in the Pistol River basin is 1.5 cfs, primarily for agricultural use, but only 0.1 cfs of this is senior to the instream right (Maguire 2001e). The effects of water diversions on coho salmon in the Pistol River basin are not well understood. Crook Creek, an important coho salmon tributary, loses surface flow at the downstream end of an agricultural area. However, the contribution of diversions to the dry creek condition is unknown A potentially significant contributor to the diminished flow in the Pistol River is the aggradation of the stream bed, with more flow now sub-surface.

Urbanization/Residential/Industrial Development

Both commercial and residential development is occurring in the sensitive lower river and estuary. This area once held some of the most productive coho salmon habitats.

High Severity Fire

High severity fires in this basin pose a medium threat to this coho salmon population. The Pistol River is very near the coast and has moderate air temperatures and high rainfall. Consequently, it should have naturally low fire risk; however, hot (100 °F) 35 mph east winds occur seasonally, which can cause extreme seasonal fire risk (Maguire 2001e). Large areas of the Pistol River basin are presently covered by even-aged plantations and hardwoods that elevate fire risk. Sudden oak death syndrome is known to occur in the adjacent North Fork Chetco basin (Oregon Department of Agriculture (ODA) 2008) and could become a significant contributor to increased fire risk if it causes mortality of tanoaks in the Pistol River basin.

Climate Change

There is low risk of average temperature increase over the next 50 years (Appendix B). Modeled regional average temperature shows a moderate increase over the next 50 years (Appendix B). Average temperature could increase by up to 1 °C in the summer and by a similar amount in the winter. The risk of sea level rise is also low (Appendix B, Thieler and Hammer-Klose 2000). Adults may be negatively impacted by climate-related ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007). Overall, climate change poses a medium threat to the population.

Mining/Gravel Extraction

Mining poses a low threat to the coho salmon population. Pistol River does not have geologic formations that bear gold and so was spared mining impacts that were experienced by interior basins of the Rogue River. Gravel mining can inhibit channel recovery by flattening the stream's profile upstream and downstream from the point of extraction. The Sixes River company gravel permit for operation in the Pistol River has expired and there is no prospect of gravel mining activity in the near future (Wheeler 2009).

Road-Stream Crossing Barriers

Road-stream crossing barriers pose a low threat to the coho salmon population. Although there are many road-stream crossings on private industrial timber lands in the western Pistol River basin, many are well above the range of coho salmon. Maguire (2001e) and the ODFW (2008e) fish passage database do not indicate that road-stream crossing barriers are a significant problem for coho salmon distribution in the Pistol River basin.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Pistol River population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

12.7 Recovery Strategy

The most immediate need for habitat restoration and threat reduction in the Pistol River is in those areas currently occupied by coho salmon in mainstem Pistol River, Crook Creek, Deep Creek, North Fork Pistol River, South Fork Pistol River, and Koontz and Davis Creek. Unoccupied areas must also be restored to provide enough habitat for coho salmon recovery, and the places with the greatest chance of success are those with high IP, such as the lower mainstem Pistol River, the estuary, Crook Creek, Deep Creek, Scott Creek, and Farmer Creek.

The Pistol River population is considered dependent and therefore cannot be viable on its own; however, it is necessary to restore habitat within the basin so that it can support all life stages of coho salmon and provide connectivity between other populations in the ESU. The recovery criterion for this population is that 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival.

The most important factor limiting recovery of coho salmon in the Pistol River is a deficiency in the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by increasing habitat complexity within the channel, re-establishing off-channel rearing areas, restoring riparian forests, and reducing threats to instream habitat. The effects of fishing on this population’s ability to meet its viability criteria should be evaluated.

Table 12-4 on the following page lists the recovery actions for the Pistol River population.

Table 12-4. Recovery action implementation schedule for the Pistol River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-PisR.19.3.3	Timber Harvest	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	All areas where coho salmon would benefit immediately	2b
SONCC-PisR.19.3.3.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-PisR.19.3.3.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-PisR.19.3.3.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-PisR.19.3.3.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-PisR.19.3.3.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams.*					
SONCC-PisR.19.3.40	Timber Harvest	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2c
SONCC-PisR.19.3.40.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-PisR.19.3.40.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-PisR.19.3.40.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-PisR.19.3.40.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-PisR.19.3.40.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams.*					
SONCC-PisR.2.2.6	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Lower mainstem, estuary, Crooks Creek, and all streams where coho salmon would benefit immediately	2b
SONCC-PisR.2.2.6.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-PisR.2.2.6.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-PisR.2.2.41	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2c
SONCC-PisR.2.2.41.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-PisR.2.2.41.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-PisR.2.2.7	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	All streams where coho salmon would benefit immediately	2b
SONCC-PisR.2.2.7.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-PisR.2.2.7.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-PisR.2.2.7.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-PisR.2.2.42	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2c
SONCC-PisR.2.2.42.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-PisR.2.2.42.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-PisR.2.2.42.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-PisR.28.1.4	Roads	Yes	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	Population wide; prioritize upper South Fork Pistol River and Crook, Deep, Farmer, and Scott creeks	2b
SONCC-PisR.28.1.4.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-PisR.28.1.4.2	*Decommission roads, guided by assessment*					
SONCC-PisR.28.1.4.3	*Upgrade roads, guided by assessment*					
SONCC-PisR.28.1.4.4	*Maintain roads, guided by assessment*					
SONCC-PisR.12.1.26	Agricultural Practices	No	Improve agricultural practices	Improve regulatory mechanisms	Population wide	2b
SONCC-PisR.12.1.26.1	*Determine the best way to revise the Agricultural Water Quality Management Act (AWQMAP) so that it does not limit recovery of SONCC coho salmon and recommend appropriate revisions*					
SONCC-PisR.12.1.26.2	*Ensure basin rules are specific and linked to implementing AWQMAP recommendations, including developing specific standards for riparian buffers*					
SONCC-PisR.12.1.26.3	*Ensure that AWQMA plans address both impaired areas and proactive prevention of water quality impairment*					
SONCC-PisR.12.1.26.4	*Adopt interim buffers equal to the buffer standards NMFS is recommending in Washington state until the state establishes its own buffers*					
SONCC-PisR.12.1.26.5	*Develop a process in the AWQMA Program that tracks and evaluates implementation*					
SONCC-PisR.12.1.26.6	*Change the complaint-based compliance monitoring process to a focused compliance program*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-PisR.7.1.22	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands and all areas where coho salmon would benefit immediately	2b
SONCC-PisR.7.1.22.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-PisR.7.1.22.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-PisR.7.1.22.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-PisR.7.1.45	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	2c
SONCC-PisR.7.1.45.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-PisR.7.1.45.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-PisR.7.1.45.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-PisR.28.2.25	Roads	No	Reduce pollutants and stormflow	Increase regulatory oversight	Population wide	2b
SONCC-PisR.28.2.25.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-PisR.28.2.25.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-PisR.28.2.25.3	*Develop local regulatory mechanisms that limits development and reduces amount of total impervious area through incentives*					
SONCC-PisR.7.1.2	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Private land	2c
SONCC-PisR.7.1.2.1	*Review General Plan or County Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-PisR.7.1.2.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat*					
SONCC-PisR.2.2.35	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2c
SONCC-PisR.2.2.35.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-PisR.10.2.9	Water Quality	No	Reduce pollutants	Set standard	Population wide	2d
SONCC-PisR.10.2.9.1	*Develop TMDLs for water bodies listed under Clean Water Act Section 303(d)*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-PisR.7.1.23	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Federal lands	3b
SONCC-PisR.7.1.23.1		*Monitor effects of livestock grazing on coho salmon habitat and adjust or discontinue grazing if effects of livestock grazing on salmon habitat are limiting coho recovery*				
SONCC-PisR.7.1.24	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	County	3b
SONCC-PisR.7.1.24.1		*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*				
SONCC-PisR.7.1.24.2		*Strengthen city and county ordinances to limit development within the 50 year flood elevation*				
SONCC-PisR.7.1.1	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Federal forest lands	3c
SONCC-PisR.7.1.1.1		*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*				
SONCC-PisR.7.1.1.3		*Plant conifers, guided by the plan*				
SONCC-PisR.5.1.10	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	3c
SONCC-PisR.5.1.10.1		*Use ODFW and SCWC fish passage barrier database to improve access based on known coho use or data identifying suitable habitat conditions above*				
SONCC-PisR.5.1.44	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-PisR.5.1.44.1		*Use ODFW and SCWC fish passage barrier database to improve access based on known coho use or data identifying suitable habitat conditions above*				
SONCC-PisR.3.1.21	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams with ODFW water rights for fish and all streams where coho salmon would benefit immediately	3c
SONCC-PisR.3.1.21.1		*Secure adequate instream flows to fulfill ODFW water rights for fish*				
SONCC-PisR.3.1.43	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-PisR.3.1.43.1		*Secure adequate instream flows to fulfill ODFW water rights for fish*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-PisR.10.2.19	Water Quality	No	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	3c
SONCC-PisR.10.2.19.1	*Develop a pesticide management plan*					
SONCC-PisR.10.2.19.2	*Implement pesticide management plan and technical assistance program*					
SONCC-PisR.10.2.38	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-PisR.10.2.38.1	*Develop a pesticide management plan*					
SONCC-PisR.10.2.38.2	*Implement pesticide management plan and technical assistance program*					
SONCC-PisR.10.7.37	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3c
SONCC-PisR.10.7.37.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-PisR.10.7.37.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-PisR.10.7.39	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-PisR.10.7.39.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-PisR.10.7.39.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-PisR.3.1.12	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	3d
SONCC-PisR.3.1.12.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-PisR.10.2.8	Water Quality	No	Reduce pollutants	Educate stakeholders	Lower mainstem, estuary, and Crooks Creek	3d
SONCC-PisR.10.2.8.1	*Develop an educational program that teaches landowners about avoiding pollution from septic systems, backyard pesticides, fuels, and nutrients*					
SONCC-PisR.10.2.20	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	3d
SONCC-PisR.10.2.20.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-PisR.10.2.20.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					

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13. Chetco River Population

Northern Coastal Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

4,500 Spawners Required for ESU Viability

356 mi^2 watershed (82% Federal ownership)

135 IP-km (84 IP-mi) (8% High)

Dominant Land Uses are ‘Recreation’ and ‘Timber Harvest’

Key Limiting Stresses are ‘Lack of Floodplain and Channel Structure’ and ‘Degraded Riparian Forest Conditions’

Key Limiting Threats are ‘Channelization/Diking’ and ‘Urban/Residential/Industrial Development’

Highest Priority Recovery Actions

• Increase instream flows • Improve timber harvest practices by revising Oregon Forest Practices Act • Increase large woody debris (LWD), boulders, or other instream structure	• Restore tidally-influenced habitats • Increase riparian vegetation • Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows

13.1 History of Habitat and Land Use

Historically, the mouth of the Chetco River and the surrounding low lying bottom lands were dominated by salt water and fresh water marshes. The population area was forested with a diversity of habitat types which supported abundant life (U.S. Forest Service (USFS) 1996a). The lower Chetco River was the center of coho salmon productivity in this population (Maguire 2001f), coinciding with areas that have the highest intrinsic potential (IP >0.66) coho salmon habitat. Large floating wood jams changed location on lower Chetco River gravel bars, scouring holes as they moved. Beaver were also abundant in the lower portions of the river and estuary and likely contributed to habitat complexity (Maguire 2001f).

The discovery of gold in the interior Chetco River basin in the 1850s precipitated the first major alteration to fish habitat. Miners excavated river terraces, leaving a lasting footprint on some stream channels. Although some of this activity occurred upstream of the range of coho salmon, it released fine sediment that affected downstream reaches. Near the coast, timber harvest intensity increased. In the early 1900s, a railroad was constructed and timber was exported from the lower tributary, Jack Creek.

After World War II, timber harvest and road building on public and private lands increased and resulted in widespread disturbance. The 1964 flood delivered massive amounts of fine sediment that filled in deep pools, changed channel configuration, and eliminated much of the coho salmon habitat (Maguire 2001f). This loss was likely greatest in the mainstem, South Fork, Eagle Creek, and Panther Creek. Long-time fishermen of the Chetco River recounted that formerly deep pools were filled and the river bar was so aggraded that you could drive on it after the flood (Maguire 2001f). Timber harvest on U.S. Forest Service lands and private land continued through the 1970s and 1980s. Land management practices have resulted in the replacement of large streamside conifers with hardwoods in most of the population area (USFS 1996b; Maguire 2001f).

The estuary was altered by the construction of levees at the mouth in 1962 to improve navigation to the ocean (Figure 13-1). Long-time residents remember that before the levees were constructed, a sand bar formed in late summer which created a lagoon with connections to tributaries and wetlands (Maguire 2001f). Levee construction disconnected wetlands and streams that were vital coho salmon habitat, and also changed the salinity and other water quality parameters by altering the tidal exchange. The Corps of Engineers dredges the navigation channel routinely to keep the entrance open to the boat basin.

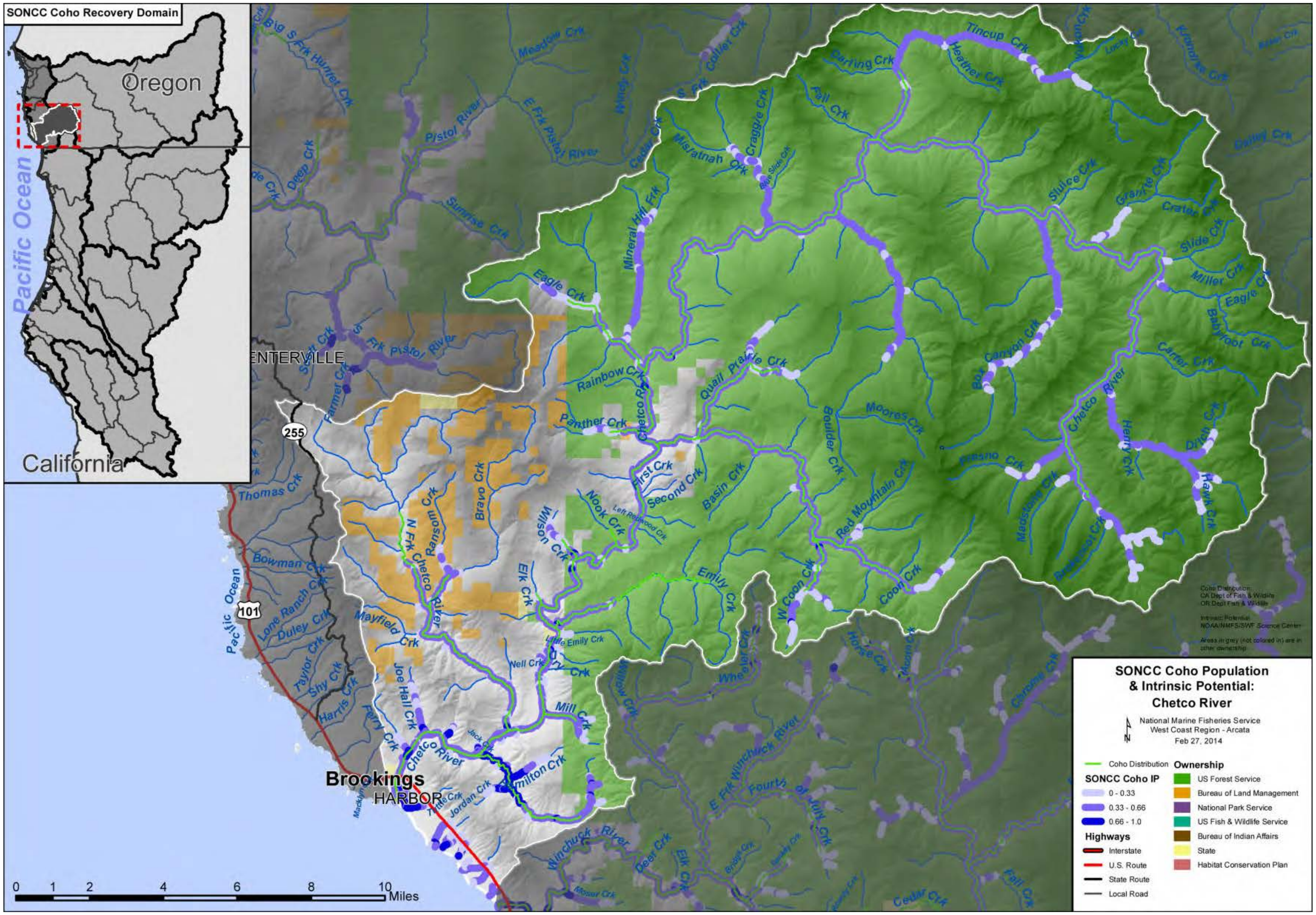

Figure 13-1. The geographic boundaries of the Chetco River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

13.2 Historic Fish Distribution and Abundance

The Chetco River coho salmon population is not well studied and there is little trend data, but local residents described coho salmon in the Chetco River estuary as formerly abundant and the target of a "net fishery" (Maguire 2001f). The lower tributaries were subject to extensive fishing pressure, with Tuttle Creek noted as having particularly large runs of coho salmon (Maguire 2001f).

The Oregon Department of Fish and Wildlife (ODFW) believe that the "abundance of coho salmon has been reduced due to modification of low gradient streams" (Maguire 2001f). The lower mainstem Chetco, North Fork Chetco, and Jack Creek are modeled as the most potentially suitable reaches for juvenile rearing (IP > 0.66) in the entire basin (Williams et al. 2006). Small patches of high IP also occur at the mouths of lower and middle Chetco River tributaries and in upstream areas of the South Fork and its tributary, Coon Creek. Moderate IP reaches occur in many upper tributaries. Table 13-1 lists tributaries with high IP (>0.66) reaches.

Table 13-1. Tributaries with high IP reaches (IP > 0.66). (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Chetco Estuary	Jack Creek	North Fork Chetco
Emily Creek	Joe Hill Creek	SF Chetco/Coon Creek
Hamilton Creek (tributary of Jack Creek)	Lower Chetco River	Tuttle Creek
Jordan Creek (tributary of Jack Creek)	Mill Creek	Wilson Creek

13.3 Status of Chetco River Coho Salmon

Spatial Structure and Diversity

Coho salmon occur in many parts of the Chetco River population area and juvenile coho salmon have been found in the upper mainstem reaches in the Kalmiopsis Wilderness (ODFW 2005a). Coho salmon are present in several tributaries throughout the population area including tributaries in the upper-most portions of the watershed (USFS 1996b). Coho salmon are present in the majority of the IP habitat identified by Williams et al. 2006.

Although the genetic structure of the population has not been studied, it is likely that diversity has been diminished as the population has declined, consistent with the known dynamics of small populations (Chapter 2). The ODFW Expert Panel expressed concern that out-of-basin hatchery-produced coho salmon may stray into the Chetco River and affect the genetic integrity of the wild population (ODFW 2008b). However, hatchery effects were not considered a stress or threat to this population given the small number of strays thought to affect the Chetco River.

Population Size and Productivity

The USFS (1996b) characterized the Chetco River coho salmon population as historically "a fair sized run," but currently relatively scarce. The population has diminished greatly from the historic levels described in Maguire (2001f). The Expert Panel stated that the Chetco River coho population has a very low abundance and is verging on extirpation (ODFW 2008b). Population estimates for 1998 to 2012 for the Chetco River are shown in Figure 13-2.

The range of estimates is from zero to 665 adults. Years with no observed returns are 1998, 1999, 2002, 2003, 2005, 2009, and 2012 (ODFW 2009a, Confer 2013). It is problematic to draw definitive conclusions from these data because the locations of sampling and water conditions at time of sampling are unknown. Some of these data come from Chinook salmon spawning surveys were coho salmon were also observed, but they did not target coho salmon. Their utility is lowered by the fact that coho salmon spawning may not occur in the same places or at the same times as Chinook salmon.

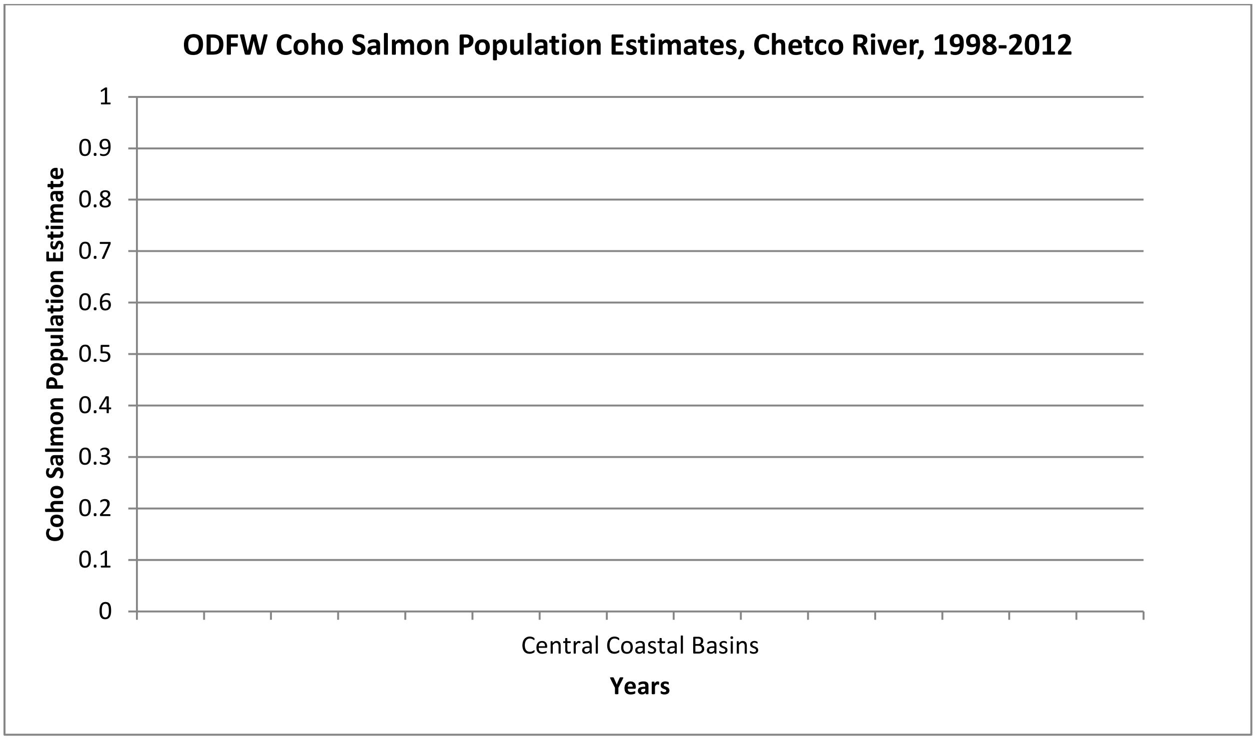

Figure 13-2. Chetco River basin-wide adult coho salmon return estimates. The data are for the years 1998 to 2012 (Confer 2013).

The more robust returns in 2001, 2004 and 2007 suggest that one year class is stronger than the other two. Unfortunately it collapsed in 2010. The lack of returns in 2003, after 307 coho spawned in the Chetco River in 2000, suggests that successful recruitment of juveniles to the adult life stage was problematic. The overall population productivity for Chetco River coho salmon appears to be very low.

Little information is available for juvenile SONCC coho salmon in the Chetco River, as well. Juveniles were found at only two locations and at very low densities within the basin during snorkeling surveys conducted in 2003 and 2004 (Jepsen and Rodgers 2004, Jepsen 2006). In a trapping operation on Jack Creek between March 9 and May 10, 2007, ODFW captured 69 out-migrant coho salmon smolts (Confer, 2007). Operation of this trap between March 13 and May 16, 2008 caught 163 coho salmon smolts (Mazur 2010). The trap did not provide enough data for ODFW to make estimates of the total outmigration for either year, but it is likely four to five times the number caught. In addition, low water levels stopped the trap in mid-May while the coho salmon smolt outmigration likely lasts to mid-June.

Extinction Risk

The Chetco River population is at high risk of extinction because the estimated average spawner abundance has been less than the depensation threshold in the three consecutive years of lowest abundance within the last twelve years (Williams et al. 2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria are related to population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Chetco River population is a core, Functionally Independent population within the Northern Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100—year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Elk River core population should have at least 2,400 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Chetco River may serve as a source of spawner strays for nearby coastal populations. At present, the capacity of the Chetco River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from nearby rivers may enhance recovery of the Chetco River population.

13.4 Plans and Assessments

State of Oregon

http://www.Oregon.gov

Expert Panel on Limiting Factors for Oregon's SONCC coho salmon populations

ODFW (2008b) convened a panel of fisheries and watershed scientists as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the concerns for the Chetco River population as follows:

Key concerns in the Chetco River were primarily loss of over-winter tributary and freshwater estuarine habitat complexity and floodplain connectivity for juveniles, especially in the lowlands which are naturally very limited in this system and have been impacted by past and current urban, rural residential, and forestry development and practices. Secondary concerns were related to a loss of large wood and habitat complexity, high water temperatures in tributaries for summer parr (excluding the mainstem, where rearing is not expected), reduced estuarine habitat for smolts, and a very low spawner abundance susceptible to genetic impacts by out-of-basin hatchery fish.

Oregon Plan for Salmon and Watersheds

The State of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is a comprehensive plan that includes voluntary actions for all of the threats currently facing coho in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary. The action plans, implementation, and annual reports can be found at http://www.oregon.gov/OPSW/.

Southwest Oregon Salmon Restoration Initiative

The Southwest Oregon Salmon Restoration Initiative (Prevost et al. 1997) was created to help fulfill a memorandum of understanding between ODFW and the National Marine Fisheries Service (NMFS) to recover coho salmon. The initiative provides the framework for recovery in southwest Oregon and helped foster formation of watershed councils. Although the Chetco River has 72.8 miles of "high value" coho salmon habitat, there are no reaches or tributaries designated as "core areas" that are the highest priority for restoration in the SONCC coho salmon ESU.

Oregon Coastal Management Program (OCMP)

The OCMP has identified several areas of the Chetco River (mainstem Chetco River from Box Canyon Creek to estuary, North Fork Chetco River, and Bravo Creek) as impaired water bodies under Clean Water Act Section 303(d) as a result of excessively high river temperatures. Due to this listing, a total maximum daily load (TMDL) must be prepared for these areas, in accordance with 40 CFR 130.6. The Oregon Department of Water Quality has initiated a TMDL for the Chetco River basin. The TMDL is in the initial scoping and data collection phase.

Cumulative Effects of Southwest Oregon Coastal Land Use on Salmon Habitat

Oregon State University (OSU) Oak Creek Labs conducted a study funded by ODFW and the Oregon Department of Forestry (ODF) to determine relationships between forest harvest and Pacific salmon productivity (Frissell 1992). The study assessed basins along the Oregon coast extending from the Sixes River to the southern border during the period from 1986 to 1992 with the most extensive research conducted in Euchre Creek to the south of the Elk River.

South Coast Watersheds Council
http://oregonwatersheds.org/

Chetco River Watershed Assessment

The Chetco River Watershed Assessment (CRWA) (Maguire 2001f) identified reduced juvenile summer and over-wintering habitat as the greatest limiting factor for coho salmon, and linked degraded habitat conditions to sedimentation of channels, reduction of large wood jams, diking and draining of wetlands, and riparian removal on the lower mainstem Chetco River and its tributaries. The report offered solutions such as the potential for reducing increased peak flows, reducing estuary eutrophication, and increasing water supply.

Chetco River Action Plan

The Chetco River Action Plan was written to address issues raised in the CRWA. Its intent is to define specific priority actions for restoration. Recommendations include educating residents regarding the need for riparian and water quality protection and water conservation. Recommended actions include increasing conifers in riparian zones, reconnecting wetlands in the lower Chetco River and estuary, and decreasing erosion potential related to roads. The document concludes Jack Creek and the North Fork Chetco have the greatest coho salmon restoration potential.

13.5 Stresses

Table 13-2. Severity of stresses affecting each life stage of coho salmon in the Chetco River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	Very High	Very High	Very High
2	Lack of Floodplain and Channel Structure[1]	High	High	Very High[1]	Very High	High	Very High
3	Impaired Estuary/Mainstem Function	-	Low	Very High	High	High	High
4	Impaired Water Quality	Low	High	Very High	High	Medium	High
5	Altered Hydrologic Function	Medium	High	High	Medium	Low	High
6	Altered Sediment Supply	Low	Medium	Medium	Medium	Low	Medium
7	Barriers	-	Low	Low	Low	Low	Low
8	Adverse Hatchery-Related Effects	Low	Low	Medium	Low	Low	Low
9	Adverse Fishery- and Collection- Related Effects	-	-	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.
[2]Increased Disease/Predation/Competition is not considered a threat to this population.

Key Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking for the population. Juvenile summer rearing habitat is impaired by high water temperatures resulting from degraded riparian conditions and water withdrawals. Winter rearing habitat is severely lacking because of channel simplification, disconnection from the floodplain, degraded riparian conditions, poor large wood availability, and an estuary which has been altered and reduced in size due to development, channelization, and diking. Large wood has been removed and is not naturally replacing at the rates required to maintain key components of habitat complexity. Overall, these findings are consistent with those of the Oregon Expert Panel (ODFW 2008b) (Section 13.4).

Degraded Riparian Forest Conditions

Degraded riparian forest condition is the most significant stress affecting coho viability in the Chetco River basin. Old growth conifers historically lined the banks of the lower mainstem Chetco River and tributaries in most of the population area. These trees helped create high quality coho salmon rearing habitat by maintaining stable banks, creating undercuts beneath roots, contributing large wood to the channel, and providing shade to maintain cool stream temperature. Canopy within the North Fork watershed is currently dominated by hardwood species. ODFW riparian surveys indicate poor riparian conditions on the North Fork Chetco with fewer than 75 conifers larger than 36 inches in diameter per thousand feet of stream length. The CRWA (USFS 1996b) used remote sensing to gauge the size of trees within 200 feet of streams and found few large conifers along reaches on USFS lands. The Oregon Department of Agriculture (2008) documented sudden oak death syndrome in the riparian zones of the North Fork Chetco River and Joe Hall Creek.

Lack of Floodplain and Channel Structure

The lower Chetco River channel has been disconnected from its estuary, floodplain, wetlands, and smaller tributaries. Tributary channels and floodplains have been simplified. Higher peak flows have increased bank erosion, caused loss of large woody structure, and scoured channels in many upper tributaries in the Chetco population area (USFS 1996b). Large wood surveys from ODFW and the USFS confirm very low levels in the North Fork, upper South Fork, Boulder Creek, and Mislatnah Creek. Historically, large floating wood jams changed location on lower Chetco River gravel bars, scouring holes as they moved (Maguire 2001f). Beaver were also abundant in the lower-river and estuary and likely contributed to habitat complexity and overwintering habitat (Maguire 2001f). Today, the Chetco River is very responsive to rain events and contributes to the displacement of juvenile coho salmon. During winter storms, discharge of the Chetco River routinely increases from less than 1,000 cfs to over 20,000 cfs within 24 hours.

Stream channels in the Chetco River tend to be wide and shallow, and pools lack both depth and complexity (Massingill 2001f). Good quality spawning gravel is present, but quantity is limited. Only large mainstem reaches have pools deeper than 3 feet. An insufficient abundance of deep pools in most lower and middle Chetco River channels limits juvenile rearing potential. For example, the South Fork Chetco River, including Coons Creek, have coho salmon present and are showing a cooling trend, but lack deep pools and large wood.

Impaired Estuary/Mainstem Function

The Chetco River estuary was historically small, and much of what once was estuarine rearing habitat no longer serves this function for coho salmon (Massingill 2001f). There is little to no remaining estuarine rearing habitat or refugia for smolts or adults. Upstream of the mouth, steep terrain adjacent to the mainstem limits the availability of tidal estuarine habitat. Formerly productive Tuttle Creek is disconnected as it now flows through several hundred feet of culverts underneath an RV Park. Reduced freshwater flows into the estuary contribute to and exacerbate stagnation and water quality problems. Lack of juvenile rearing habitat and impaired water quality in the estuary constitute an overall high stress for coho salmon.

Impaired Water Quality

Temperature is the most widespread water quality impairment in Chetco River. The river temperature exceeds ODEQ (2002a) standards coming out of the Kalmiopsis Wilderness because of sparse vegetation and riparian conditions resulting from granitic soil (Maguire 2001f). Historically, it was cooled by tributaries flowing from forested watersheds in the middle and lower basin. Most tributaries and the lower mainstem Chetco River have warmed considerably in modern times and do not meet the ODEQ (2002a) temperature criterion of MWMT 64 °F. Tributaries no longer provide a significant buffer to mainstem temperatures and their function as cold water refugia for downstream migrating coho salmon juveniles and other salmonids is now impaired. Although tributaries still provide cool water refugia, the quantity and quality of the cold water refugia has decreased over time while temperatures gradually warm. Temperature data confirm that reaches of the mainstem are acutely stressful or lethal to salmonids (Figure 13-3), indicating that cooler water inputs from tributaries has become even more important over time. The water temperature in stream channels on U.S. Forest Service (USFS) lands has been improving. Emily Creek and the South Fork Chetco River have been gradually approaching suitable water temperatures for coho salmon (USFS 1996b). The middle North Fork Chetco River and its tributary Bosley Creek, on BLM lands, are currently suitable for coho salmon, but Bravo Creek and the lower North Fork reaches on private timberlands are too warm. There are also problems with high total phosphates, and occasional high pH, in the lower Chetco River (Maguire 2001f). Water quality in the estuary is poor due to low dissolved oxygen in the summer (Maguire 2001f).

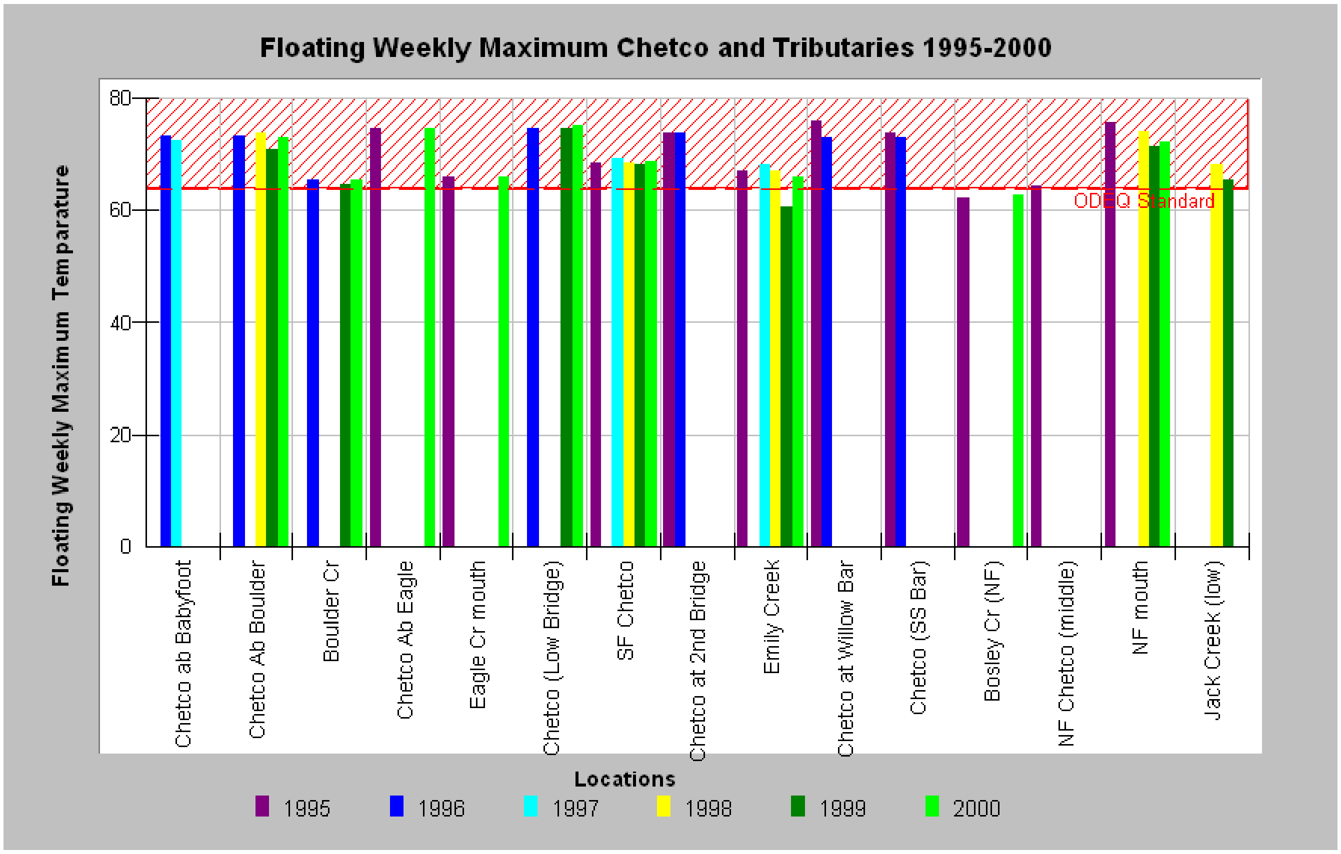

Figure 13-3. Maximum floating weekly maximum temperatures (MWMT). These data show that from 1995 to 2000, water temperature exceeded the 64 °F standard at most locations (Maguire 2001f).

Altered Hydrologic Function

In late summer and early fall, water withdrawals that reduce flow in the lower Chetco River and tributaries are of concern. The lower Chetco River, North Fork Chetco, middle mainstem Chetco, and Jack Creek are over-allocated during low flow months (Massingill 2001f). In 1964, the State of Oregon Water Rights Division established a minimum flow requirement of 80 cfs for the Chetco River. Total allocated water rights for out of stream use are 59 cfs (Maguire 2001f). Minimum flow levels were not met in 11 of the 25 years from 1970 to 1994, and the number of days per year below this level ranged from two to 77 days (USFS 1996b). These reduced flows disrupt juvenile rearing habitat as well as migration of smolts. Base flows may also decrease in the first ten years following clear cutting because of the increase in water use by young trees growing in dense stands (Murphy 1995) and the lack of water holding capability of the soil. Disconnection of the floodplain and channel disrupts exchange of surface water and groundwater that helps maintain cool water temperatures needed for juvenile rearing of coho salmon (Chapter 3).

Two areas have been identified by ODFW as Streamflow Restoration Priority Areas: Jack Creek and the Chetco River mainstem above the North Fork. These areas were determined to have both “need” (due to their fish resources) and “optimism” (availability of water resources) (Maguire 2001f).

Altered Sediment Supply

Altered sediment supply poses an overall medium stress to coho salmon in the Chetco River. Sediment contribution from landslides and erosion occurs naturally in the Chetco River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. Poor pool frequency and depth throughout the Chetco River basin (Massingill 2001f) are likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening. Overall, coarse sediment supply in the Chetco River basin has declined since the 1970s (Wallick et al. 2009) due to improved management practices on public lands in the upper basin.

Barriers

One tributary, Ferry Creek, lies in a culvert for several hundred feet just upstream of its confluence which is likely a complete barrier. Road-stream crossings in the Lower, Middle and North Fork watersheds and their tributaries that could be barriers to coho salmon or other adult and juvenile salmonids have been inventoried and necessary restoration actions are planned (Maguire 2001f), although progress is unknown. Tuttle Creek, once a highly productive coho salmon tributary to the estuary has been redirected underground through culverts with an RV park directly over. The partial barrier at the mouth of Joe Hall Creek has recently been removed by the Oregon Department of Transportation.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Chetco River population area. The ODFW Expert Panel expressed concern that out-of-basin hatchery-produced coho salmon may stray into the Chetco River and affect the genetic integrity of the wild population (ODFW 2008b). Juvenile coho salmon are likely exposed to increased competition from the stocking of significant numbers of Chinook salmon. Hatchery-origin coho salmon may stray into the Chetco River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

13.6 Threats

Table 13-3. Severity of threats affecting each life stage of coho salmon in the Chetco River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Urban/Residential/Industrial Dev.[1]	Low	High	Very High[1]	Very High	High	Very High
2	Channelization/Diking[1]	Medium	High	High[1]	High	High	High
3	Roads	Medium	High	High	High	High	High
4	Timber Harvest	High	High	High	High	Medium	High
5	Mining/Gravel Extraction	Medium	High	High	Medium	Medium	High
6	Invasive Non-Native/Alien Species	Medium	Medium	Medium	Medium	Medium	Medium
7	Agricultural Practices	Low	Medium	Medium	Medium	Medium	Medium
8	Dams/Diversion	Low	Medium	Medium	Medium	Medium	Medium
9	High Severity Fire	Low	Medium	Medium	Medium	Medium	Medium
10	Climate Change	Low	Low	Medium	Medium	Medium	Medium
11	Road-Stream Crossing Barriers	-	Medium	Medium	Low	Medium	Medium
12	Hatcheries	Low	Low	Medium	Low	Low	Low
13	Fishing and Collecting	-	-	Low	Low	Low	Low

[1]Key limiting threats and limited life stage

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are urban/residential/industrial development and channelization/diking.

Urban/Residential/Industrial Development

The number of rural landowners in the Chetco River basin has increased considerably since 1950. For example, in 1950 there were less than ten adjoining property owners near the mouth of the North Fork, and in 2001 there were 92 (Massingill 2001f). The highest intrinsic potential coho habitat is centered in the lower basin where most land is privately owned and land management is often intensive. Human population growth is concentrated around Brookings Harbor at the mouth of the Chetco River and upstream to USFS ownership at the mouth of the South Fork Chetco River. As rural populations grow, so does the demand for water, the risks of increases in peak flow, increases in sediment inputs, riparian vegetation removal, increased bank protection and water contamination. Currently, municipal uses account for most of the water withdrawals from the Chetco River and its tributaries (Massingill 2001f).

Development continues to occur adjacent to the estuary, and fill material has reduced the size and function of the estuary. Marina development and other commercial activities in and near the estuary combine with urbanization to create a high amount of impervious area that can contribute to non-point source pollution. Paved roads, parking lots, rooftops, or other surfaces that do not absorb rainfall tend to send much more water to streams, elevating peak flows and contributing pollution to streams (Booth and Jackson 1997). Leakage or percolation from rural residential septic systems is a potential source of nutrient pollution and increases the severity of summer algal blooms in the estuary.

Channelization/Diking

Nearly all of the tidal wetlands in the Chetco River have been channelized or diked and are no longer available to coho salmon. Development along the south side of the river likely eliminated limited tidal wetlands that provided off-channel habitat for coho salmon rearing and holding. Two marinas and a large jetty have been built in the estuary and most of the floodplain is developed. Many reaches of the lower Chetco River mainstem, its tributaries, and the estuary have high intrinsic potential coho salmon habitat (Williams et al. 2006); however, this portion of the river has been disconnected from the floodplain. The estuary was partially filled when levees were constructed to improve navigability into the ocean. The mouth of the river and the mainstem upstream are now channelized and diked. Tuttle Creek, which was formerly productive for coho salmon (Maguire 2001f) has been straightened, confined, and buried inside several hundred feet of culverts. The Chetco River channel above the North Fork has been confined in order to expand pastures for grazing. Streams are also forced into narrow channels due to confinement by roads throughout the population area (USFS 1996b). This leads to reduced floodplain connectivity and function, increased current velocity, and makes reaches less suitable for coho rearing.

Roads

The highest road densities in the middle, lower, and North Fork Chetco River are on private lands. Maguire (2001f) used road crossing density to evaluate the risk of sediment impacts and found the highest density of road crossings in the Chetco coastal area and middle Chetco mainstem. There was a moderately high risk due to density of road crossings in Jack Creek, and the lower and upper Chetco mainstem. The North Fork and Eagle Creek both received moderate risk ratings. On USFS land, streams with the highest road densities are Mill, Emily, Eagle, Panther, West Coon and Quail Prairie creeks, South Fork Chetco River, and the south side of the Chetco River below Long Ridge (USFS 1996b). The Chetco River is naturally very responsive to rain events and roads contribute to even greater peak flows by quickly routing water through roadside ditches. The lower Chetco River near the coast and middle mainstem is at the highest risk of damaging peak flows due to roads (Massingill 2001f). There is a moderate risk for elevated peak flows in Jack Creek, the lower mainstem Chetco, and the North Fork Chetco.

Timber Harvest

Timber harvest in the Chetco River basin poses a high threat to coho salmon due to the overlap with high IP coho salmon habitat. Only about 12% of the population area is private industrial forest, but it is focused in the most valuable coho habitat. The effects of short rotation, high intensity forestry is disproportionate to the small percentage of the land base it occupies. Landscape-scale imagery available from Google Earth shows widespread timber harvest and extensive road networks on private timber land in the western portion of the population area. More than 50 percent of the area in many small drainages along the Chetco River from Eagle Creek to the mouth has been harvested (USFS 1996b). Other parts of the population area have also experienced intense timber harvest, such as Basin Creek which has had 60 percent of its area harvested recently. These levels of timber harvest have been found to disrupt channels and diminish Pacific salmon species diversity in other Oregon coastal basins (Reeves et al. 1993).

Mining/Gravel Extraction

In July 2013, the US Department of Interior approved a 5-year administrative withdrawal of mineral rights in 17 miles of Chetco River mainstem. The near term threat of mining has been reduced, but will return after 2018. Furthermore, most of the suction dredge activity within the Chetco watershed is occurring on tributaries such as Quail Prairie Creek, Nook Creek, and Mislatnah Creek. Gold mining claims remain in the upper Chetco River basin (Zaitz 2010), which cover several miles of stream. Mining activity could potentially increase, including use of larger dredges and heavy equipment (Zaitz 2010).

The largest active gravel mining site is in the lower Chetco River near the mouth of Jack Creek, where the river is low gradient and the valley is unconfined. In the future, this operation may work outside of Corps jurisdiction, in which case would not receive Corps or NMFS review. In-stream gravel mining is expected to continue into the future with permit applications for at least two sites.

Agricultural Practices

Grazing is the principal agricultural activity in the Chetco River basin. The conversion of land to agricultural production has led to the confinement of the lower Chetco River channel and lower portions of the North Fork Chetco River and Jack Creek creating a disconnection from the historic floodplain. The levees, dikes, and general encroachment of pasture and agricultural lands onto the floodplain have greatly reduced off channel rearing habitat availability.

Dams/Diversions

One major tributary to the estuary, Ferry Creek, is dammed just upstream of its confluence. There are no other known diversions that block fish passage. Dams and diversions lead to an overall loss of water from the stream by diverting water for agricultural or municipal use. The lower Chetco River, North Fork Chetco, middle mainstem Chetco, and Jack Creek are over-allocated during low flow months (Massingill 2001f). In 1964, the State of Oregon Water Rights Division established a minimum flow requirement of 80 cfs for the Chetco River. Minimum flow levels were not met in 11 of the 25 years from 1970 to 1994, and the number of days per year below this level ranged from two to 77 days (USFS 1996). Currently, municipal uses account for most of the water withdrawals from the Chetco River and its tributaries (Massingill 2001f).

High Severity Fire

Extensive portions of the Chetco River population area burned in the 23,500 acre Silver Fire of 1987. The Biscuit Fire of 2002 burned most of the upper Chetco River, including most of the Kalmiopsis Wilderness area (Azuma et al. 2004). However, 63 percent of the area burned in the Biscuit Fire was at low to very low intensity. In the North Fork Chetco, sudden oak death syndrome is killing tan oak and bay laurel trees (ODA 2008), which can elevate fire risk because dead trees are more flammable.

Climate Change

Climate change in this region will have the greatest impact on juveniles, smolts, and adults. Although the current climate is generally cool, modeled regional average temperature predicts a moderate increase over the next 50 years. Average temperature could increase by up to 1.5^{o} C in the summer and by 1^{o} C in the winter. Annual precipitation in this area is predicted to stay within the natural range of current variability; however seasonal patterns in precipitation will likely occur (Mote and Salathe 2010). Overall, the range and degree of variability in temperature and precipitation are likely to increase. The vulnerability of the estuary and coast to sea level rise is moderate to high in this coastal population. Rising sea level may impact the quality and extent of wetland rearing habitat.

Road-Stream Crossing Barriers

There are nine remaining barriers which have been identified as problematic for fish passage. High road densities, especially on private lands, indicate the likelihood of other barriers yet to be identified. These private lands overlap most of the high IP coho salmon habitat.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Chetco River population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Invasive Non-Native/Alien Species

Sudden oak death (SOD) is a non-native pathogen which affects almost all native plants, trees, and shrubs. SOD infections often result in mortalities to some species of oaks and bay laurels. There are known outbreaks of SOD in Curry County and the Chetco River. SOD infestation in Oregon is focused in the North Fork Chetco River and is quickly spreading. The quarantine area is now 264 square miles. SOD infections, and the control efforts to limit outbreaks, result in effects to riparian function by removing trees from riparian areas. SOD poses a medium threat to SONCC coho salmon due to the current infestation and rate of spreading.

Japanese knotweed (*Polygonum cuspidatum*) has spread into the Chetco River (ODA 2010) and efforts are underway to control its spread and distribution. This is a concern because Japanese knotweed is aggressive, fast growing, and out-competes native vegetation in riparian areas. Scotch broom and gorse are also locally common and similarly invasive. If these plants replace conifers or hardwoods in riparian zones, it substantially impacts coho salmon habitat.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

13.7 Recovery Strategy

The most important factor limiting recovery of coho salmon in the Chetco River is a deficiency in the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by increasing channel complexity, restoring flow, and reducing stream temperatures. Channel complexity should be improved by restoring large wood in streams, restoring those processes that provide large wood to streams, constructing off-channel ponds or backwater habitat, restoring wetlands, moving levees, or limiting development and fill. Areas adjacent to the stream should be replanted with conifers to re-establish mature streamside forest as a source for large wood recruitment. Restoration of sufficient water may require changes in water use and allocation.

Habitat restoration and threat reduction in the Chetco River should be focused on those areas currently occupied by coho salmon, which would allow for immediate benefits to the population. Unoccupied areas must also be restored to provide enough habitat to achieve population viability and provide for conditions suitable to allow for re-colonization. The effects of fishing on this population’s ability to meet its viability criteria should be evaluated.

Table 13-4 on the following page lists the recovery actions for the Chetco River population.

Table 13-4. Recovery action implementation schedule for the Chetco River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.2.8.4	Floodplain and Channel Structure	Yes	Improve timber harvest practices	Improve regulatory mechanisms	Population wide	1
SONCC-CheR.2.8.4.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-CheR.2.8.4.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-CheR.2.8.4.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-CheR.2.8.4.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-CheR.2.8.4.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams*					
SONCC-CheR.2.4.9	Floodplain and Channel Structure	Yes	Improve estuarine habitat	Restore tidally influenced habitats	Areas of estuary where coho salmon would benefit immediately	2a
SONCC-CheR.2.4.9.1	*Assess coho use of different estuarine habitats and develop a plan to enhance those habitats (i.e. brackish wetlands, tidal sloughs, salt marshes, and tidally influenced freshwater)*					
SONCC-CheR.2.4.9.2	*Restore tidally influenced habitats, guided by the plan*					
SONCC-CheR.2.4.69	Floodplain and Channel Structure	Yes	Improve estuarine habitat	Restore tidally influenced habitats	Population wide	2b
SONCC-CheR.2.4.69.1	*Assess coho use of different estuarine habitats and develop a plan to enhance those habitats (i.e. brackish wetlands, tidal sloughs, salt marshes, and tidally influenced freshwater)*					
SONCC-CheR.2.4.69.2	*Restore tidally influenced habitats, guided by the plan*					
SONCC-CheR.22.2.43	Urban, Residential, Industrial Development	Yes	Improve flow timing or volume	Increase instream flows	Mainstem and tributaries downstream of the Kalmiopsis Wilderness	2a
SONCC-CheR.22.2.43.1	*Identify, map, and quantify all surface water diversions*					
SONCC-CheR.22.2.43.2	*Assess water diversions, prioritize, and adjust management to benefit life history requirements of coho*					
SONCC-CheR.22.2.43.3	*Secure dedicated unused water diversion rights*					
SONCC-CheR.22.2.43.4	*Verify permitted water diversions*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.2.5.8	Floodplain and Channel Structure	Yes	Improve tidal exchange of water	Set back or remove dikes or levees	Areas of estuary where coho salmon would benefit immediately	2a
SONCC-CheR.2.5.8.1	*Assess and prioritize levees for setback or removal*					
SONCC-CheR.2.5.8.2	*Remove or setback levees, guided by assessment results*					
SONCC-CheR.2.5.70	Floodplain and Channel Structure	Yes	Improve tidal exchange of water	Set back or remove dikes or levees	Population wide	2b
SONCC-CheR.2.5.70.1	*Assess and prioritize levees for setback or removal*					
SONCC-CheR.2.5.70.2	*Remove or setback levees, guided by assessment results*					
SONCC-CheR.7.1.46	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands where coho salmon would benefit immediately	2a
SONCC-CheR.7.1.46.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-CheR.7.1.46.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-CheR.7.1.46.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-CheR.7.1.75	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	2b
SONCC-CheR.7.1.75.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-CheR.7.1.75.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-CheR.7.1.75.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-CheR.7.1.3	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	2a
SONCC-CheR.7.1.3.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-CheR.7.1.3.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat and discourage development adjacent to the estuary*					
SONCC-CheR.2.1.44	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve and protect habitat	Jack Creek upstream of South Bank Road and Hamilton Creeks	2a
SONCC-CheR.2.1.44.1	*Acquire conservation easement from willing sellers/landowners*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.2.1.6	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	North Fork Chetco basin, alluvial terraces along the Lower Chetco, and Jacks Creek, and all streams where coho salmon would benefit immediately	2a
SONCC-CheR.2.1.6.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-CheR.2.1.6.2	*Place instream structures, guided by assessment results*					
SONCC-CheR.2.1.66	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-CheR.2.1.66.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-CheR.2.1.66.2	*Place instream structures, guided by assessment results*					
SONCC-CheR.2.2.5	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	North Fork Chetco basin, South Fork Chetco basin, alluvial terraces along the Lower Chetco, Jacks Creek, estuary, and all streams where coho salmon would benefit immediately	2a
SONCC-CheR.2.2.5.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-CheR.2.2.5.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-CheR.2.2.68	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-CheR.2.2.68.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-CheR.2.2.68.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-CheR.2.2.32	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	All streams where coho salmon would benefit immediately	2a
SONCC-CheR.2.2.32.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for landowners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-CheR.2.2.32.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-CheR.2.2.32.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.2.2.67	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2b
SONCC-CheR.2.2.67.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for landowners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-CheR.2.2.67.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-CheR.2.2.67.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-CheR.22.5.10	Urban, Residential, Industrial Development	Yes	Improve estuarine habitat	Improve water quality	Estuary	2b
SONCC-CheR.22.5.10.1	*Determine causal mechanisms for nutrient pollution, algae blooms, and anoxia in the estuary, starting with understanding circulation patterns in the estuary. Make recommendations for reducing algal blooms*					
SONCC-CheR.22.5.10.2	*Implement recommendations to improve water quality, guided by assessment results*					
SONCC-CheR.7.1.36	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Federal forest lands	2b
SONCC-CheR.7.1.36.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-CheR.7.1.36.2	*Plant conifers, guided by the plan*					
SONCC-CheR.22.3.48	Urban, Residential, Industrial Development	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho bearing streams	2b
SONCC-CheR.22.3.48.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-CheR.22.3.48.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.2.1.42	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve placer mining practices	All streams where coho salmon would benefit immediately, Moderate and high IP stream reaches on USFS lands in the watersheds of Quail Prairie Creek and Mislatnah Creek	2b
SONCC-CheR.2.1.42.1	*Assess the actual impacts of suction mining for gold*					
SONCC-CheR.2.1.42.2	*Develop regulations that minimize or prevent impacts to coho salmon from placer mining. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-CheR.2.1.42.3	*Educate miners regarding the ESA, coho salmon, and effects to habitat from proposed mining activities*					
SONCC-CheR.2.1.42.4	*If impacts cannot be avoided, limit placer mining*					
SONCC-CheR.2.1.7	Floodplain and Channel Structure	Yes	Increase channel complexity	Protect estuarine habitat	Estuary	2b
SONCC-CheR.2.1.7.1	*Limit development and filling of estuarine habitat through the development of regulatory mechanisms such as county or city ordinances*					
SONCC-CheR.2.1.7.2	*Maintain or strengthen current estuarine protection measures*					
SONCC-CheR.22.1.45	Urban, Residential, Industrial Development	Yes	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-CheR.22.1.45.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-CheR.22.1.45.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					
SONCC-CheR.22.1.49	Urban, Residential, Industrial Development	Yes	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-CheR.22.1.49.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-CheR.22.1.49.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-CheR.22.1.49.3	*Develop local regulatory mechanisms that reduce amount of total impervious area through incentives*					
SONCC-CheR.26.1.62	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-CheR.26.1.62.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.2.2.58	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2b
SONCC-CheR.2.2.58.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-CheR.3.1.11	Hydrology	No	Improve flow timing or volume	Increase instream flows	Lower mainstem Chetco River, Jacks Creek, and all streams where coho salmon would benefit immediately	2c
SONCC-CheR.3.1.11.1	*Determine instream flow needs for coho salmon, utilize existing USGS gauging station information*					
SONCC-CheR.3.1.11.2	*Perform a groundwater study to determine the volume of aquifer storage and the role of aquifers in streamflow*					
SONCC-CheR.3.1.11.3	*Provide incentives and education to landowners to reduce water consumption and reduce groundwater pumping and surface water diversion by utilizing conservation and storage*					
SONCC-CheR.3.1.72	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-CheR.3.1.72.1	*Determine instream flow needs for coho salmon, utilize existing USGS gauging station information*					
SONCC-CheR.3.1.72.2	*Perform a groundwater study to determine the volume of aquifer storage and the role of aquifers in streamflow*					
SONCC-CheR.3.1.72.3	*Provide incentives and education to landowners to reduce water consumption and reduce groundwater pumping and surface water diversion by utilizing conservation and storage*					
SONCC-CheR.10.2.16	Water Quality	No	Reduce pollutants	Set standard	Population wide	2d
SONCC-CheR.10.2.16.1	*Develop TMDLs for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-CheR.2.1.65	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve placer mining practices	Population wide	3b
SONCC-CheR.2.1.65.1	*Assess the actual impacts of suction mining for gold*					
SONCC-CheR.2.1.65.2	*Develop regulations that minimize or prevent impacts to coho salmon from placer mining. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-CheR.2.1.65.3	*Educate miners regarding the ESA, coho salmon, and effects to habitat from proposed mining activities*					
SONCC-CheR.2.1.65.4	*If impacts cannot be avoided, limit placer mining*					
SONCC-CheR.7.1.47	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Federal lands	3b
SONCC-CheR.7.1.47.1	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.7.1.33	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	BLM lands	3b
SONCC-CheR.7.1.33.1	*Manage timber harvest (and associated activities) on Federal lands in accordance with the Aquatic Conservation Strategy of the NWFP, or with the updated ACS guidance contained in newly revised Resource Management Plans or Land and Resource Management Plans, in order to achieve riparian and stream channel improvements for coho salmon*					
SONCC-CheR.5.1.12	Passage	No	Improve access	Remove barriers	Barriers identified in population profile (i.e. Ferry Creek, Tuttle Creek, and road-stream crossings in Lower, Middle, and North Fork watershed)	3b
SONCC-CheR.5.1.12.1	*Evaluate and prioritize barriers for removal*					
SONCC-CheR.5.1.12.2	*Remove barriers, based on evaluation*					
SONCC-CheR.5.1.37	Passage	No	Improve access	Remove barriers	BLM lands	3b
SONCC-CheR.5.1.37.1	*Evaluate and prioritize barriers for removal*					
SONCC-CheR.5.1.37.2	*Remove barriers, based on evaluation*					
SONCC-CheR.5.1.74	Passage	No	Improve access	Remove barriers	Population wide	3c
SONCC-CheR.5.1.74.1	*Evaluate and prioritize barriers for removal*					
SONCC-CheR.5.1.74.2	*Remove barriers, based on evaluation*					
SONCC-CheR.3.1.61	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3b
SONCC-CheR.3.1.61.1	*Establish a comprehensive groundwater permit process*					
SONCC-CheR.3.1.51	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams with ODFW water rights for fish and all streams where coho salmon would benefit immediately	3b
SONCC-CheR.3.1.51.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-CheR.3.1.73	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-CheR.3.1.73.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.28.1.13	Roads	No	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	3b
SONCC-CheR.28.1.13.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-CheR.28.1.13.2	*Decommission roads, guided by assessment*					
SONCC-CheR.28.1.13.3	*Upgrade roads, guided by assessment*					
SONCC-CheR.28.1.13.4	*Maintain roads, guided by assessment*					
SONCC-CheR.28.1.71	Roads	No	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-CheR.28.1.71.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-CheR.28.1.71.2	*Decommission roads, guided by assessment*					
SONCC-CheR.28.1.71.3	*Upgrade roads, guided by assessment*					
SONCC-CheR.28.1.71.4	*Maintain roads, guided by assessment*					
SONCC-CheR.10.2.41	Water Quality	No	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	3c
SONCC-CheR.10.2.41.1	*Develop a pesticide management plan*					
SONCC-CheR.10.2.41.2	*Implement pesticide management plan and technical assistance program*					
SONCC-CheR.10.2.63	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-CheR.10.2.63.1	*Develop a pesticide management plan*					
SONCC-CheR.10.2.63.2	*Implement pesticide management plan and technical assistance program*					
SONCC-CheR.10.7.60	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-CheR.10.7.60.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-CheR.10.7.60.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-CheR.10.7.64	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-CheR.10.7.64.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-CheR.10.7.64.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-CheR.1.2.31	Estuary	No	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	3d
SONCC-CheR.1.2.31.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-CheR.1.2.31.2	*Complete a full assessment of the estuary using identified parameters*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-CheR.16.1.17	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-CheR.16.1.17.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-CheR.16.1.17.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-CheR.16.1.18	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-CheR.16.1.18.1	*Determine actual fishing impacts*					
SONCC-CheR.16.1.18.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-CheR.16.2.19	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-CheR.16.2.19.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-CheR.16.2.19.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-CheR.16.2.20	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-CheR.16.2.20.1	*Determine actual impacts of scientific collection*					
SONCC-CheR.16.2.20.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-CheR.10.2.15	Water Quality	No	Reduce pollutants	Educate stakeholders	North Fork Chetco, Jacks Creek, lower Chetco, estuary	3d
SONCC-CheR.10.2.15.1	*Develop an educational program that teaches landowners and businesses about avoiding pollution from septic systems, backyard pesticides, fuels, and nutrients*					
SONCC-CheR.7.1.2	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Timberland	BR
SONCC-CheR.7.1.2.1	*Assess riparian zone to prioritize locations for planting disease-resistant Port Orford cedar trees*					
SONCC-CheR.7.1.2.2	*Plant disease-resistant Port Orford cedar trees, guided by assessment results*					

14. Winchuck River Population

Northern Coastal Stratum

Non-Core 1, Potentially Independent Population

High Extinction Risk

Population likely below depensation threshold

230 Spawners Required for ESU Viability

77 mi^2 watershed (67% Federal ownership)

57 IP-km (35 IP-mi) (16% High)

Dominant Land Uses are Forestry and Urban/Residential/Industrial Development

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Impaired Water Quality'

Key Limiting Threats are 'Channelization/Diking' and 'Urban/Residential/Industrial Development'

Highest Priority Recovery Actions

• Increase instream flows	• Improve grazing practices
• Restore tidally influenced habitats	• Remove or setback levees in the estuary
• Increase large woody debris (LWD), boulders, or other instream structure	• Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows

14.1 History of Habitat and Land Use

The lower reaches of the Winchuck River were inhabited by Anglo-American settlers after 1856. Several dairies were operated there for over a century. Dairy operations in stream side areas reduced coho salmon habitat by confining the channel to expand grazing areas. Stream-side dairies also contributed excess nutrients and pollutants as effluents were washed into waterways. Mining occurred in the upper Winchuck River watershed in Wheeler Creek as early as the mid-1850s.

The post-WWII timber harvest era impacted river habitat. The U.S. Forest Service (USFS) manages 66 percent of the Winchuck River watershed, and USFS timber harvesting activities in the 1970s and 1980s contributed to further habitat degradation. Most of the South Fork Winchuck River sub-basin is private industrial timberland that continues to be actively harvested. One resident recalls that “once the logging started, the river changed; it was dirtier, warmer, and had more sediment” (Maguire 2001g). Others observed that mainstem and tributary pools have filled in, banks have eroded, peak flows have increased, and base flows have reduced.

Until the 1970s, residential development in the watershed remained sparse. Long-time Winchuck River residents recalled that before 1975, the river valley was inhabited by 10 families who owned large tracts of land (Maguire 2001g). Then a road through the river valley was paved, development increased, and there are now more than 150 homes. Agricultural activities now include lily bulb production and cattle grazing to a lesser extent. Residential and agricultural uses are centered in the lower and middle portions of the river.

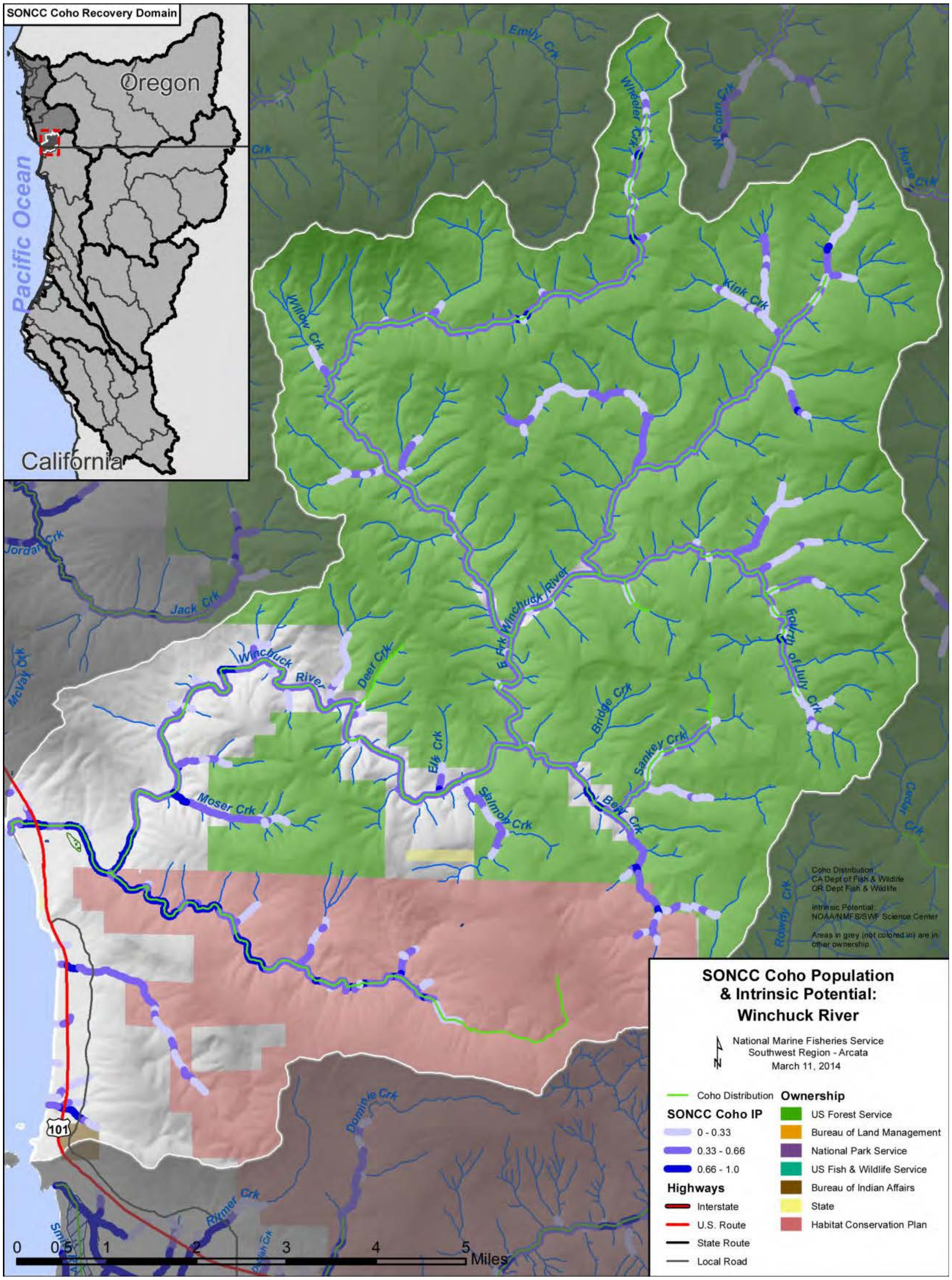

Figure 14-1. The geographic boundaries of the Winchuck River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

14.2 Historic Fish Distribution and Abundance

The Winchuck River coho salmon population is not well studied and there are no historic data sets with which to evaluate trends. High intrinsic potential (IP >0.66) for coho salmon exists in the South Fork Winchuck River and lower mainstem Winchuck River as well as in patches in the upper East Fork Winchuck, Moser, Bear, Fourth of July, and Wheeler creeks. Coho salmon likely inhabited these reaches historically (Figure 14-1). Table 14-1 lists Winchuck River reaches and tributaries with the highest coho salmon IP (>0.66).

The Oregon Department of Fish and Wildlife (ODFW) believes that the coho salmon population in the Winchuck River was naturally smaller than the Chinook population due to the large quantity of mainstem habitat with high energy flows and large substrate, but acknowledges that "abundance of coho salmon has probably been reduced due to modification of low gradient streams" (Maguire 2001g).

Table 14-1. Tributaries with instances of high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Winchuck River Estuary	Middle Winchuck (SF to EF)	East Fork Winchuck
Lower Winchuck River	Moser Creek	Fourth of July Creek
South Fork Winchuck River	Bear Creek	Wheeler Creek

14.3 Status of Winchuck River Coho Salmon

Spatial Structure and Diversity

Juvenile coho salmon surveys for 2002, 2003 and 2004 document presence of coho salmon in the South Fork, East Fork, Fourth of July, and Bear creeks and the upper mainstem Winchuck River just below the East Fork (ODFW 2005a). No juveniles were found in the lower Winchuck River or Wheeler Creek (ODFW 2005a) although subsequent survey efforts in 2007 revealed coho salmon present in Wheeler Creek. Genetic diversity has likely diminished as the population has declined and likely suffers from the effects of low population size.

Population Size and Productivity

ODFW (2008b) described the Winchuck River coho salmon population as having very low abundance verging on extirpation. ODFW (2009a) estimated basin-wide returns from 1998 to 2008. The estimate was zero for all years except in 2000 and 2007, when 37 and 163 adults were found, respectively. The lack of any detected spawner returns in many years indicates very low productivity in the Winchuck River. Drawing definitive conclusions from these data is problematic because no effort data is included, and the locations of sampling and water conditions at time of sampling are unknown. Large differences in effort between years could account for observed differences in estimates.

Young-of-the-year coho salmon have been found in many years in the South Fork Winchuck River (Figure 14-2) during the 1995 to 2009 monitored period (Green Diamond Resource Company (GDRC) 2013a).

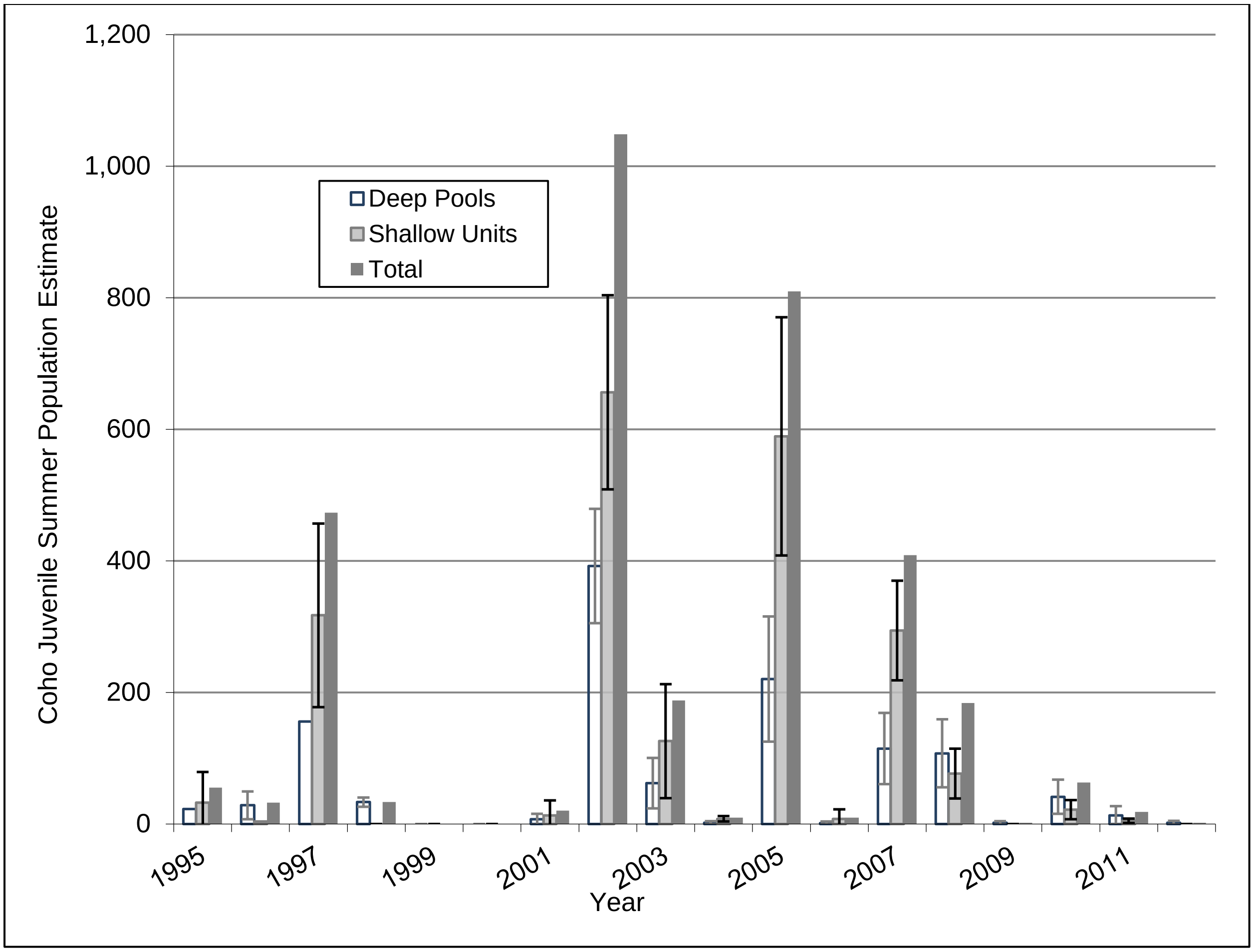

Figure 14-2: Number young of the year coho salmon found in deep pools (>=3.4 feet) and shallow units (< 3.4 feet) in the South Fork Winchuck River (95-percent confidence intervals) (GDRC 2013a).

Extinction Risk

The Winchuck River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Winchuck River population is a non-core, Potentially Independent population within the Northern Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, but strongly influenced by immigration from other populations such that they did not exhibit independent dynamics (Williams et al. 2006). The Winchuck River population is strongly influenced by nearby coastal populations such as the Chetco River and Smith River populations. Adult strays from these populations spawn and interact with coho salmon in the Winchuck River. To contribute to stratum and ESU viability, the Winchuck River non-core population needs to have at least 230 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Furthermore, the Winchuck River population will contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to other coastal populations.

14.4 Plans and Assessments

State of Oregon

Expert Panel on Limiting Factors for Oregon's SONCC coho salmon populations

ODFW (2008b) convened a panel of fisheries and watershed scientists as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the key concerns for the Winchuck River population as follows:

> Key concerns were primarily loss of over-winter tributary and freshwater estuarine habitat complexity and floodplain connectivity for juveniles, especially in the lowlands which are naturally limited in this system and have been impacted by past and current agricultural practices. Secondary concerns were reduced habitat complexity for summer and winter parr due to non-native vegetation, especially Japanese knotweed, limiting riparian species and their recruitment to the stream. Very low spawner abundance susceptible to genetic impacts by out-of-basin hatchery fish was another secondary concern.

Cumulative Effects Assessment of Timber Harvest on Salmon Habitat Southwest Oregon Coastal Streams

Oregon State University (OSU) Oak Creek Labs conducted a study funded by ODFW and the Oregon Department of Forestry (ODF) to determine relationships between timber harvest and Pacific salmon productivity (Frissell 1992). The study assessed watersheds along the Oregon coast extending from the Sixes River to the southern border during the period from 1986 to 1992.

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The State of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is a comprehensive plan that includes voluntary actions for all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary.

Southwest Oregon Salmon Restoration Initiative

The Southwest Oregon Salmon Restoration Initiative (Prevost et al. 1997) is a regional document that was created to help fulfill a memorandum of understanding between ODFW and the National Marine Fisheries Service (NMFS) to recover coho salmon. The initiative provides the framework for recovery in southwest Oregon and helped foster formation of watershed councils. The Winchuck River is recognized as having 16.9 miles of "high value" coho salmon habitat.

United States Forest Service, Rogue River-Siskiyou National Forest

Winchuck River Watershed Analysis (WA) (USFS 1995a)

Prepared in accordance with the Northwest Forest Plan, the watershed analysis identifies an approach for restoration on land managed by the USFS in the Winchuck River, which comprises 66 percent of the basin. The WA characterizes most USFS tributaries in the upper Winchuck River basin as being "in recovery" and gives the highest priority to projects designed to reduce or prevent sediment delivery to streams. Planned activities include road decommissioning and relocation; hardwood thinning and conifer planting in riparian zones; and combating the spread of Port Orford root disease in the watershed.

South Coast Watershed Council

Winchuck River Watershed Assessment

The Winchuck River Watershed Assessment (Maguire 2001g) summarizes conditions, historic changes, and restoration needs in the Winchuck River basin. Community concerns, salmonid habitat, limiting factors, and prospects for recovery of fisheries and watershed health are included.

Winchuck River Action Plan

The Winchuck River Action Plan is a companion to Maguire (2001g), and includes specific targets for restoration.

Green Diamond Resource Company (GDRC)

Green Diamond Aquatic Habitat Conservation Plan (AHCP)

The GDRC HCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in select sub-basins of the Winchuck River watershed. Approximately half of the private land in the Winchuck River basin is owned by GDRC and therefore managed according to the provisions of the AHCP. The plan has a number of provisions designed to protect coho salmon and salmon habitat throughout the company's land in the Winchuck River basin. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC's activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of covered listed aquatic species. Elements of the AHCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. As part of the AHCP, GDRC monitors the abundance of coho salmon juveniles, as well as habitat, in the South Fork Winchuck River (NMFS 2007a, GDRC 2009). More information about the GDRC AHCP can be found in Section 3.2.5.

14.5 Stresses

Table 14-2. Severity of stresses affecting each life stage of coho salmon in the Winchuck River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	Medium	Very High	Very High[1]	Very High	High	Very High
2	Impaired Water Quality[1]	Low	Very High	Very High[1]	Very High	Low	Very High
3	Altered Hydrologic Function	Medium	High	High	Medium	Low	High
4	Degraded Riparian Forest Conditions	Medium	High	High	High	Medium	High
6	Altered Sediment Supply	Medium	High	High	High	Medium	High
5	Impaired Estuary/Mainstem Function	-	Low	Very High	High	Medium	High
7	Barriers	-	Low	Medium	Low	Medium	Medium
8	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low
9	Adverse Fishery- and Collection-related Effects	-	-	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.
[2]Increased Disease/Predation/Competition is not considered a stress to this population.

Key Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited, and quality summer and winter rearing habitat are lacking for the population. Juvenile summer rearing habitat is impaired by high temperatures resulting from degraded riparian conditions and water withdrawals. Winter rearing habitat has been degraded by channelization, diking, loss of complexity, and disconnection from the floodplain. Degraded riparian conditions eliminated the source of LWD recruitment. Most historically available habitat in the estuary has been altered by development, channelization, and diking.

Lack of Floodplain and Channel Structure

Channel structure is generally considered good on lands managed by the USFS, which do not contain most of the high IP. Large wood levels were rated as very good in the East Fork Winchuck, upper Wheeler Creek, and most of the mainstem of Bear Creek. Scores are good for lower Wheeler and Fourth of July creeks, which are also located on public land. Only Upper Bear Creek located immediately downstream of private timber lands had a poor LWD score.

The Bear Creek tributary, Sankey Creek, has LWD levels that range from fair to good. Comparable data are available for some GRDC-owned timber lands in the South Fork Winchuck River. Large wood levels were rated as fair in the main stem of the South Fork Winchuck and fair or poor in two tributaries upstream from high IP in this watershed (GDRC 2013b).

Another indicator of the degree of channel structure is the mean pool frequency. Disturbed basins were found to have a mean pool frequency of 34 percent (Wood-Smith and Buffington 1996). Streams with pool frequency lower than 35 percent are therefore considered to have low pool frequency. These streams are Brush (<10 percent), Salmon (<10 percent), Bear (10 to 20 percent), upper Wheeler (20 to 35 percent), and upper Fourth of July (20 to 35 percent) creeks, as well as the upper East Fork Winchuck River (20 to 35 percent). Lower reaches of the East Fork Winchuck, Wheeler, and Fourth of July creeks had scores of greater than 35 percent pool frequency by area. Mean pool frequencies on GDRC land improved from poor to fair between 1995 and 2005 in the South Fork Winchuck River and were poor in 2005 in two tributaries located in the upper portion of the watershed (GDRC 2013b). Such data were not available for the areas of most importance for coho salmon rearing in the lower Winchuck River.

Most concern over the lack of floodplain and channel structure is focused on the South Fork and lower mainstem of the Winchuck River, where critically important juvenile rearing once occurred. Aerial photos indicate that most of the Winchuck River and South Fork have been diked and/or straightened. These floodplain modifications confine the channel and cut off its access to flood terraces. This confinement also eliminates side channels that were formerly the best coho summer and over-wintering rearing habitat.

Impaired Water Quality

Elevated water temperatures are the primary concern with impaired water quality in the Winchuck River. The lower mainstem, which has the highest coho salmon IP, is too warm. Weekly maximum temperatures downstream of the East Fork range from 67.1 °F to 70.7 °F. Tributaries flowing from National Forest lands, including the upper East Fork Winchuck, Wheeler, Bear, and Fourth of July creeks, all provide suitable water temperatures for coho salmon. The Winchuck River, from the mouth to the confluence with the East Fork Winchuck River, has been listed for temperature under Clean Water Act Section 303(d)).

In the mainstem Winchuck, fecal coliform bacteria and phosphates are moderately high; dissolved oxygen levels are sometimes low; biological oxygen demand is high; and chlorophyll measurements are the highest of all Curry County streams (Massingill 2001g).

Altered Hydrologic Function

The Winchuck River basin suffers from flow depletion and changes in peak flow related to watershed disturbance patterns. There have been no formal evaluations on the current flows in the Winchuck River, so the degree of any reduction in water amount is unknown. However, the Winchuck River Watershed Council (Maguire 2001g) recognized that “low summer flow results in elevated stream temperatures,” and that “the cool water that used to go into the river from the tributaries is now being withdrawn.” The relationship between the amount of water and the temperature of the water is well established, as are the problems with water temperature in many areas of the Winchuck.

Degraded Riparian Forest Conditions

Little data exist to quantitatively evaluate the riparian forest conditions in the Winchuck River basin exist. In 1996, the last year that data were available, the percentage of the lower river basin which had large trees (>30 inches dbh) was very low, but the percentage with medium-sized trees (>20 inches dbh) was more favorable. Current conditions are highly altered compared to conditions prior to Anglo-American settlement. Ground and aerial photos indicate that much of the lower mainstem and lower South Fork Winchuck riparian canopy has been simplified, decreased, and converted to hardwoods. Trees have been removed from riparian zones, creating narrow buffer widths and decreasing potential for large wood recruitment. The middle mainstem Winchuck River at its confluence with Elk and Salmon creeks has degraded riparian conditions (Figure 14-3). The mainstem and lower Elk Creek have narrow strips of riparian hardwoods with fields encroaching very close to the stream, while tributaries have narrow or no riparian buffers.

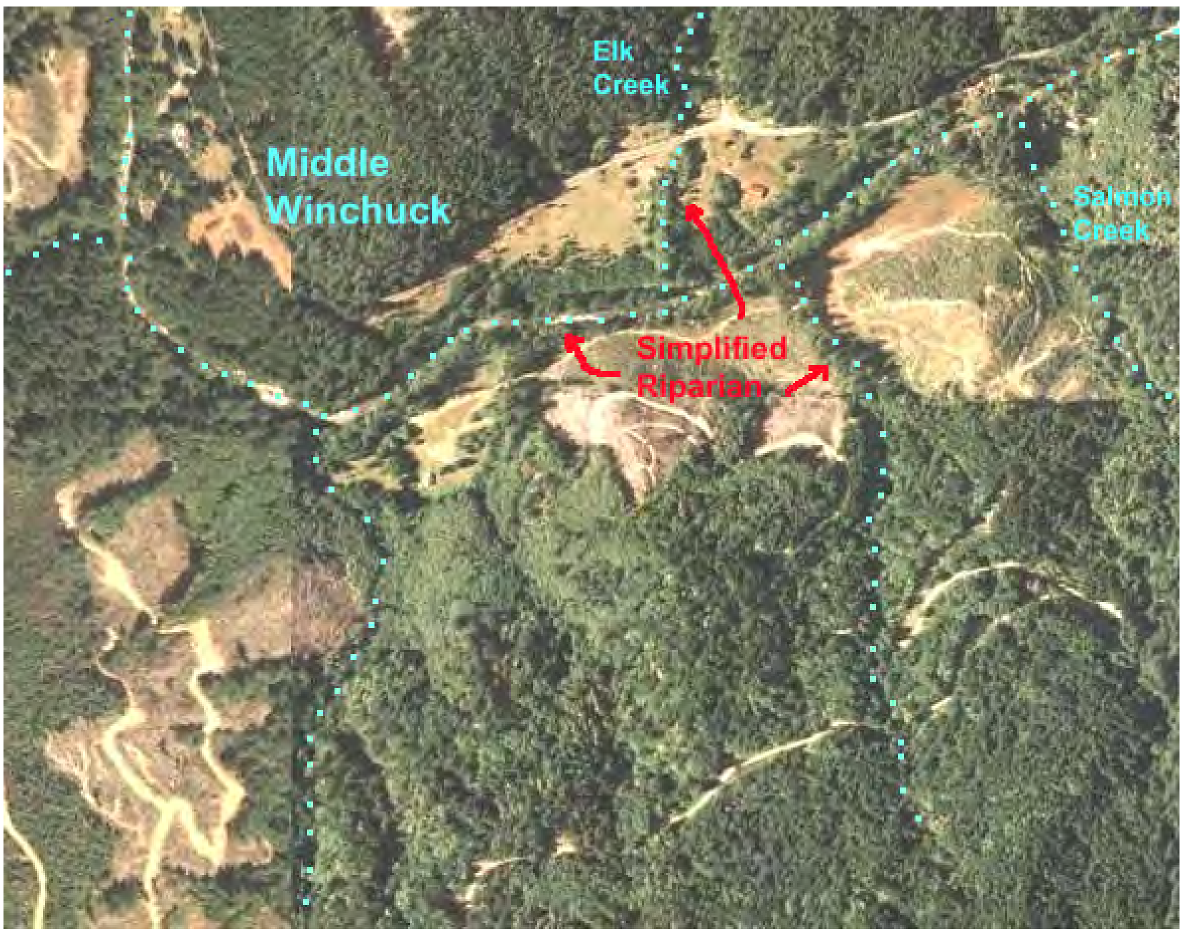

Figure 14-3. Middle mainstem Winchuck River. The confluence with Elk and Salmon creeks has a narrow riparian zone dominated mostly by hardwoods. Timber harvest has left a very narrow buffer along tributaries and appears to come very near the stream at center left. Photo from 2005.

Altered Sediment Supply

Altered sediment supply poses an overall high stress to coho salmon in the Winchuck River. Sediment contribution from landslides and erosion occurs naturally in the Winchuck River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. Poor pool frequency and depth throughout the Winchuck River basin (Maguire 2001g) are likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and diminished scour due to channel widening in some reaches.

Figure 14-4. Aerial photo of the Winchuck River estuary from 2005. Photo shows that residential development has led to channelization and diminished riparian zone width.

Impaired Estuary/Mainstem Function

Impaired estuary/mainstem function poses a high stress to coho salmon. The Winchuck estuary was historically small, and much of the estuarine habitat that did exist has been diked and filled (Figure 14-4). Numerous roads have been built on the floodplain, and the Winchuck River Road blocks access to estuarine tributaries. Historic channels have been blocked, and the mainstem is now confined, with little off-channel habitat. The lower part of the estuary does have some seasonal rearing potential downstream of Highway 101.

Maguire (2001g) identified wetland areas in the Winchuck River basin. All but one occurred in the same areas associated with high IP. Eighty-eight percent of the identified wetland area was described as moderately to highly altered. Sixty-nine percent of the wetland area has some degree of connection to a stream, although the degree of connectivity that historically occurred was likely much greater than currently observed.

Barriers

Ten barriers to migration have been identified in the lower Winchuck River (Massingill 2001g), but most of them block access to small, steep tributaries that are mostly unsuitable for coho salmon. However, access to even short reaches of these tributaries is desirable because they are cool and can provide refuge for coho salmon juveniles when mainstem temperatures are warm. As noted in the Hydrologic Function section, intermittent flows appear to exist in the lower reach of the South Fork Winchuck, which is likely a migration barrier for juveniles in summer. The overall stress score for Winchuck River barriers basin-wide is medium.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Winchuck River population area. Hatchery-origin adults may stray into the population area; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

14.6 Threats

Table 14-3. Severity of threats affecting each life stage of coho salmon in the Winchuck River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Channelization/Diking[1]	Medium	Very High	Very High[1]	Very High	High	Very High
2	Urban/Residential/Industrial Dev.[1]	Medium	Very High	Very High[1]	Very High	High	Very High
3	Agricultural Practices	Low	High	High	Medium	Low	High
4	Roads	Low	High	High	Medium	Low	High
5	Invasive Non-Native/Alien Species	Low	High	High	Medium	Low	High
6	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
7	Dams/Diversion	Low	Medium	High	Medium	Low	Medium
8	High Severity Fire	Low	Medium	Medium	Medium	Low	Medium
9	Road-Stream Crossing Barriers	-	Low	Medium	Low	Medium	Medium
10	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
11	Climate Change	Low	Low	Low	Low	Low	Low
12	Hatcheries	Low	Low	Low	Low	Low	Low
13	Fishing and Collecting	-	-	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are channelization/diking and urban/residential/industrial development.

Channelization/Diking

Channelization and confinement of a river occur when a stream is controlled and re-directed so that nearby fertile lands can be used for agriculture or residential development, or a road can be built. As described under the floodplain and channel structure stress, most of the mainstem Winchuck River has been straightened and/or diked. This extensive modification of the Winchuck River degrades critically important rearing and migratory habitat for coho salmon.

Urbanization/Residential/Industrial

Although only four percent of the basin is utilized for activities other than forestry (Maguire 2001g), development in that small area occurs in the areas which are critical for juvenile rearing of coho salmon. Residential development has consumed the floodplains of the mainstem and estuary. The value of this habitat for summer rearing and winter refugia has been greatly reduced. Maintenance of the urban developments will inhibit efforts to restore natural channel processes. Domestic water consumption is the pre-dominant use for most of the water rights in the basin and will continue to increase if there are increases in residential development (Maguire 2001g).

Agricultural Practices

Agricultural activity occurs in the lower mainstem area, one of the few segments with high IP in the basin. Use of the land for agriculture has perpetuated the impaired riverine conditions that began with timber harvest in the 1800s. The river has been channelized and disconnected from its floodplain, and growth of riparian vegetation has been prevented. Maguire (2001g) identified the land use occurring within 500 feet of the wetlands in the Winchuck River, and determined 27 percent of these wetlands were bounded by agriculture. In addition, the great majority of water diverted from the Winchuck River under out-of-stream water rights is allocated for irrigation.

Roads

Road densities are relatively low in most basins, with only the Wheeler Creek basin exceeding thresholds recognized as impaired.

Invasive Species

Japanese knotweed (*Polygonum cuspidatum*) has spread into the lower Winchuck River (ODFW 2008b). Japanese knotweed is aggressive, fast growing, and out-competes native vegetation in riparian areas. Scotch broom and gorse are also locally common and similarly invasive. If these plants replace conifers or hardwoods in riparian zones, coho salmon habitat will be substantially impacted. Sudden Oak Death detection to date are limited, but will likely increase into the future.

Timber Harvest

Timber harvest on public land has greatly diminished, but harvest remains active on private land in the South Fork Winchuck, middle mainstem Winchuck River, and upper Bear Creek, including areas with high IP coho salmon habitat. The South Fork Winchuck River watershed is intensively harvested with some areas in their third rotation (Maguire 2001g). Recent aerial photos confirm that harvest rates remain high (Figure 14-5). Although active timber harvest is not occurring in most of the basin, active harvest in the South Fork Winchuck River, which contains more than half of the high IP coho salmon in the basin, makes this threat of great concern to coho salmon recovery. However, the majority of the South Fork Winchuck River sub-basin is under an AHCP, so timber harvest is an overall medium threat to the population.

Dams/Diversions

Diversions for agriculture and residential purposes are depleting the amount of water available in the river, which in turn presents a medium threat to coho salmon and their recovery.

Figure 14-5. South Fork Winchuck aerial photo. This 2005 image shows widespread clear cuts, dense road networks, and an irrigation impoundment. Photo by USDA Farm Service Agency on June 29, 2005 from Google Earth.

High-Severity Fire

The Winchuck River is very near the coast and has moderate air temperatures and high rainfall. However, Maguire (2001g) points out that autumnal winds may elevate fire risk because they are associated with extreme high temperatures (>100° F) and high wind speeds (>35 mph) that can create extreme fire hazard conditions. Hardwood stands and even aged plantations following timber harvest may also be more at risk of catastrophic fire than the older, uneven aged forest stands they replaced. Therefore, high severity fires pose a medium threat to the Winchuck River population.

Road-Stream Crossing Barriers

Road-stream crossing barriers are not a significant threat to coho salmon in the Winchuck River based upon the lack of known barriers that exist in the watershed. Given the amount of timber harvest that has occurred in the watershed and the density of roads in the lower watershed, many partial or total barriers have yet to be identified on private land. Based on the projected population growth in this area, an increase in road-stream crossings is not likely unless timber harvest rates increase and timber harvest resumes in roadless areas.

Mining

There are two remaining mining claims in the Winchuck River basin: North Fork Wheeler Creek Mine and Mt. Emily Mine (Maguire 2001g). There is currently no known significant threat posed by these mining operations.

Climate Change

Because of the proximity of the Winchuck River basin to the coast, only a minimal increase in air temperature is projected for the years 2030 to 2050. The temperature is predicted to rise by less than 0.5 C in July, and between 0.5 and 1.5 C in January. The latter trend could reduce snow pack in higher elevations, diminishing this source of cold water for coho salmon juvenile rearing. Sea level rise could expand the estuary and the footprint of tidal wetlands, which could potentially benefit coho salmon. Therefore, climate change is a low threat to this population.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Winchuck River population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

14.7 Recovery Strategy

The most important factor limiting recovery of coho salmon in the Winchuck River is a deficiency in the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by increasing channel complexity and restoring flow. Channel complexity would be improved by constructing off-channel ponds or backwater habitat; restoring wetlands; moving levees; or limiting development and fill. To increase instream structure, LWD should be added where the channel is stable to provide structure until natural sources of LWD (mature coniferous forests) are re-established next to the stream. Restoration of sufficient water may require changes in water use and allocation.

The most immediate need for habitat restoration and threat reduction in the Winchuck River is in those areas currently occupied by coho salmon, which are identified in this profile. Unoccupied areas must also be restored to provide enough habitats to allow for coho salmon recovery. Efforts should be focused upon those areas with the most potential to support coho salmon (e.g., high IP) in the lower mainstem Winchuck River, South Fork Winchuck River, and Moser Creek.

The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 14-4 on the following page lists the recovery actions for the Winchuck River population.

Table 14-4. Recovery action implementation schedule for the Winchuck River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WinR.10.6.46	Water Quality	No	Improve agricultural practices	Improve regulatory mechanisms	Population wide	1
SONCC-WinR.10.6.46.1	*Determine the best way to revise the Agricultural Water Quality Management Act (AWQMAP) so that it does not limit recovery of SONCC coho salmon and recommend appropriate revisions*					
SONCC-WinR.10.6.46.2	*Ensure basin rules are specific and linked to implementing AWQMAP recommendations, including developing specific standards for riparian buffers*					
SONCC-WinR.10.6.46.3	*Ensure that AWQMA plans address both impaired areas and proactive prevention of water quality impairment*					
SONCC-WinR.10.6.46.4	*Adopt interim buffers equal to the buffer standards NMFS is recommending in Washington state until the state establishes its own buffers*					
SONCC-WinR.10.6.46.5	*Develop a process in the AWQMA Program that tracks and evaluates implementation*					
SONCC-WinR.10.6.46.6	*Change the complaint-based compliance monitoring process to a focused compliance program*					
SONCC-WinR.19.1.47	Timber Harvest	No	Improve timber harvest practices	Improve regulatory mechanisms	Population wide	1
SONCC-WinR.19.1.47.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-WinR.19.1.47.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-WinR.19.1.47.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-WinR.19.1.47.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-WinR.19.1.47.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams, increased shade on perennial streams, and protective buffers on intermittent streams.*					
SONCC-WinR.2.1.7	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Lower mainstem, South Fork, and Estuary, and all streams where coho salmon would benefit immediately	2a
SONCC-WinR.2.1.7.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-WinR.2.1.7.2	*Place instream structures, guided by assessment results*					
SONCC-WinR.2.1.63	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-WinR.2.1.63.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-WinR.2.1.63.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WinR.2.2.5	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Lower mainstem, South Fork, Estuary (in particular areas south of Highway 101), and all streams where coho salmon would benefit immediately	2a
SONCC-WinR.2.2.5.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-WinR.2.2.5.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-WinR.2.2.64	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-WinR.2.2.64.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-WinR.2.2.64.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-WinR.2.2.6	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	All streams where coho salmon would benefit immediately	2a
SONCC-WinR.2.2.6.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-WinR.2.2.6.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-WinR.2.2.6.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-WinR.2.2.65	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2b
SONCC-WinR.2.2.65.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-WinR.2.2.65.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-WinR.2.2.65.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-WinR.2.4.42	Floodplain and Channel Structure	No	Improve estuarine habitat	Restore tidally influenced habitats	Estuary	2a
SONCC-WinR.2.4.42.1	*Assess coho use of different estuarine habitats and develop a plan to enhance those habitats (i.e. brackish wetlands, tidal sloughs, salt marshes, and tidally influenced freshwater)*					
SONCC-WinR.2.4.42.2	*Restore tidally influenced habitats, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WinR.10.4.39	Water Quality	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-WinR.10.4.39.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-WinR.10.4.60	Water Quality	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-WinR.10.4.60.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-WinR.2.5.43	Floodplain and Channel Structure	No	Improve tidal exchange of water	Set back or remove dikes or levees	Estuary	2a
SONCC-WinR.2.5.43.1	*Assess and prioritize levees for setback or removal*					
SONCC-WinR.2.5.43.2	*Remove or setback levees, guided by assessment results*					
SONCC-WinR.2.7.4	Floodplain and Channel Structure	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands where coho salmon would benefit immediately	2a
SONCC-WinR.2.7.4.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-WinR.2.7.4.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-WinR.2.7.4.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-WinR.2.7.66	Floodplain and Channel Structure	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	2b
SONCC-WinR.2.7.66.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-WinR.2.7.66.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-WinR.2.7.66.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-WinR.22.3.40	Urban, Residential, Industrial Development	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho salmon bearing streams	2b
SONCC-WinR.22.3.40.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-WinR.22.3.40.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WinR.10.2.16	Water Quality	Yes	Reduce pollutants	Set standard	Population wide	2b
SONCC-WinR.10.2.16.1	*Develop TMDLs for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-WinR.2.7.3	Floodplain and Channel Structure	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Federal forest lands	2b
SONCC-WinR.2.7.3.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-WinR.2.7.3.3	*Plant conifers, guided by the plan*					
SONCC-WinR.26.1.59	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-WinR.26.1.59.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-WinR.2.2.55	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2b
SONCC-WinR.2.2.55.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-WinR.10.2.38	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-WinR.10.2.38.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-WinR.10.2.38.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					
SONCC-WinR.10.2.41	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-WinR.10.2.41.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-WinR.10.2.41.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-WinR.10.2.41.3	*Develop local regulatory mechanisms that limit development and reduce amount of total impervious area through incentives*					
SONCC-WinR.10.2.15	Water Quality	Yes	Reduce pollutants	Educate stakeholders	Population wide	3b
SONCC-WinR.10.2.15.1	*Develop an educational program that teaches stakeholders to reduce channel encroachment, reduce usage of toxic chemicals, maintaining septic systems, water conservation, and landscaping with native species*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WinR.28.3.12	Roads	No	Improve access	Remove barriers	Estuarine tributary crossings at Winchuck River Road and all streams where coho salmon would benefit immediately	3b
SONCC-WinR.28.3.12.1	*Assess and prioritize barriers. Develop a plan for removal*					
SONCC-WinR.28.3.12.2	*Remove barriers, guided by the plan*					
SONCC-WinR.28.3.67	Roads	No	Improve access	Remove barriers	Population wide	3d
SONCC-WinR.28.3.67.1	*Assess and prioritize barriers. Develop a plan for removal*					
SONCC-WinR.28.3.67.2	*Remove barriers, guided by the plan*					
SONCC-WinR.1.2.30	Estuary	No	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	3b
SONCC-WinR.1.2.30.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-WinR.1.2.30.2	*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*					
SONCC-WinR.1.2.30.3	*Restore estuary and tidal wetland habitat guided by the plan*					
SONCC-WinR.10.4.9	Water Quality	No	Improve flow timing or volume	Educate stakeholders	Population wide	3b
SONCC-WinR.10.4.9.1	*Provide incentives and education to landowners to reduce water consumption and reduce groundwater pumping and surface water diversion by utilizing conservation and storage*					
SONCC-WinR.3.1.58	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3b
SONCC-WinR.3.1.58.1	*Establish a comprehensive groundwater permit process*					
SONCC-WinR.10.4.8	Water Quality	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	3b
SONCC-WinR.10.4.8.1	*Determine instream flow needs for coho salmon*					
SONCC-WinR.10.4.8.2	*Measure streamflow hourly by establishing a USGS gaging station*					
SONCC-WinR.10.4.8.3	*Maintain USGS gaging station*					
SONCC-WinR.10.4.8.4	*Perform a groundwater study to determine the volume of aquifer storage and the role of aquifers in streamflow*					
SONCC-WinR.10.4.61	Water Quality	No	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-WinR.10.4.61.1	*Determine instream flow needs for coho salmon*					
SONCC-WinR.10.4.61.2	*Measure streamflow hourly by establishing a USGS gaging station*					
SONCC-WinR.10.4.61.3	*Maintain USGS gaging station*					
SONCC-WinR.10.4.61.4	*Perform a groundwater study to determine the volume of aquifer storage and the role of aquifers in streamflow*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WinR.2.7.1	Floodplain and Channel Structure	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	South Fork, East Fork, Fourth of July, and Bear creeks, Upper mainstem Winchuck River just below the East Fork, Estuary	3b
SONCC-WinR.2.7.1.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-WinR.2.7.1.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat and wetlands*					
SONCC-WinR.28.1.13	Roads	No	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	USFS land	3b
SONCC-WinR.28.1.13.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-WinR.28.1.13.2	*Decommission roads, guided by assessment*					
SONCC-WinR.28.1.13.3	*Upgrade roads, guided by assessment*					
SONCC-WinR.28.1.13.4	*Maintain roads, guided by assessment*					
SONCC-WinR.10.7.57	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-WinR.10.7.57.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-WinR.10.7.57.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-WinR.10.7.62	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-WinR.10.7.62.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-WinR.10.7.62.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-WinR.10.2.37	Water Quality	Yes	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-WinR.10.2.37.1	*Develop a pesticide management plan*					
SONCC-WinR.10.2.37.2	*Implement pesticide management plan and technical assistance program*					
SONCC-WinR.16.1.17	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-WinR.16.1.17.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-WinR.16.1.17.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WinR.16.1.18	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-WinR.16.1.18.1	*Determine actual fishing impacts*					
SONCC-WinR.16.1.18.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-WinR.16.2.19	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-WinR.16.2.19.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-WinR.16.2.19.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-WinR.16.2.20	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-WinR.16.2.20.1	*Determine actual impacts of scientific collection*					
SONCC-WinR.16.2.20.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-WinR.14.3.44	Invasive, Non-native Species	No	Reduce competition	Remove invasive riparian species	Lower Winchuck basin	3d
SONCC-WinR.14.3.44.1	*Remove invasive species of vegetation inhibiting establishment of native riparian vegetation*					

15. Smith River Population

Central Coastal Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

6,800 Spawners Required for ESU Viability

762 mi^2 watershed (78% Federal ownership)

325 IP-km (202 IP-mi) (23% High)

Dominant Land Uses are Agriculture and Timber Harvest

Key Limiting Stresses are 'Impaired Estuary/Mainstem Function' and 'Lack of Floodplain and Channel Structure'

Key Limiting Threats are 'Channelization/Diking' and 'Agriculture'

Highest Priority Recovery Actions

• Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows • Remove, setback, or reconfigure dikes and levees • Increase large woody debris (LWD), boulders, or other instream structure	• Restore natural channel form and function by reconstructing a naturally meandering channel in some tributaries • Remove barriers • Increase beaver abundance

15.1 History of Habitat and Land Use

Over the past 120 years, land use has changed less in the Smith River than in many other California watersheds, but changes have still occurred and have affected instream habitat and anadromous fish throughout the area. While most of the upper watershed remains fairly pristine and unaffected by human activities, the areas that have been impacted are in the lower Smith River, where the greatest potential to support coho salmon exists. Human activities that have affected habitat in the Smith River include timber harvest; road building; urbanization; placer, hard rock, and gravel mining; flood control (e.g., levees and tide gates); ranching; and pesticide use. Agriculture in the lower watershed and around the estuary has been, and continues to be the greatest contributor to loss and degradation of coho salmon habitat.

The Lake Earl Watershed may have at one time been connected to the Smith River. However, it is unlikely that there has been any connection in recent history. The Lake Earl Watershed was considered part of the Smith River population in Williams et al. (2008). However, because there has been no recent connection and connection is unlikely in the future, the Lake Earl Watershed was removed as part of the Smith River population.

Land ownership consists of large holdings of private land in the coastal plain, while a majority of the middle to upper watershed is public lands. Much of the private land has been under intensive land uses for the past 100 years and efforts have begun to purchase available property to protect salmonid populations. Rowdy Creek occurs in the lower watershed and is mostly in private ownership, while Mill Creek, another tributary with high IP, is now almost entirely under public ownership since the State Park acquired 25,000 acres of the watershed in 2002. With the exception of small urban areas near the communities of Fort Dick, land uses in the floodplain are primarily agricultural.

The estuary and lower river have been modified to expedite navigation, transportation, timber harvest, and agriculture. These modifications include diking, channelizing, removing woody debris, removing riparian vegetation, and dredging. Over 40 percent of the estuary has been converted for agricultural uses (Quinones and Mulligan 2005). Large scale, channel-altering floods in 1955 and 1964 added to the loss of habitat in the Smith River by decreasing pool depths, altering channel morphology, and increasing sediment deposition. Overall, these changes greatly reduced habitat diversity and instream cover complexity in the lower river and estuary (McCain et al. 1995).

In the 1940s, most agriculture in the watershed was dairy farming. In the 1950s and 1960s, flower bulb production and other industrial agricultural uses began. By 1970, irrigated pastures and lily bulb farms covered about 4,000 acres on the coastal plain. Today, this area produces 90 percent of the lily bulbs in the United States. The production of lily flowers and bulbs requires pesticide use to control nematodes and diseases, which can impact salmonids.

While agricultural use and rural development have increased to some extent, timber harvest in this watershed has decreased. Like most areas along the coast, timber harvest peaked in the mid-1900s and has decreased over the past 50 years. The effects of past timber harvest in the Smith River watershed continue to impact habitat through sedimentation from roads or road-related erosion and reduced recruitment of large wood into the river.

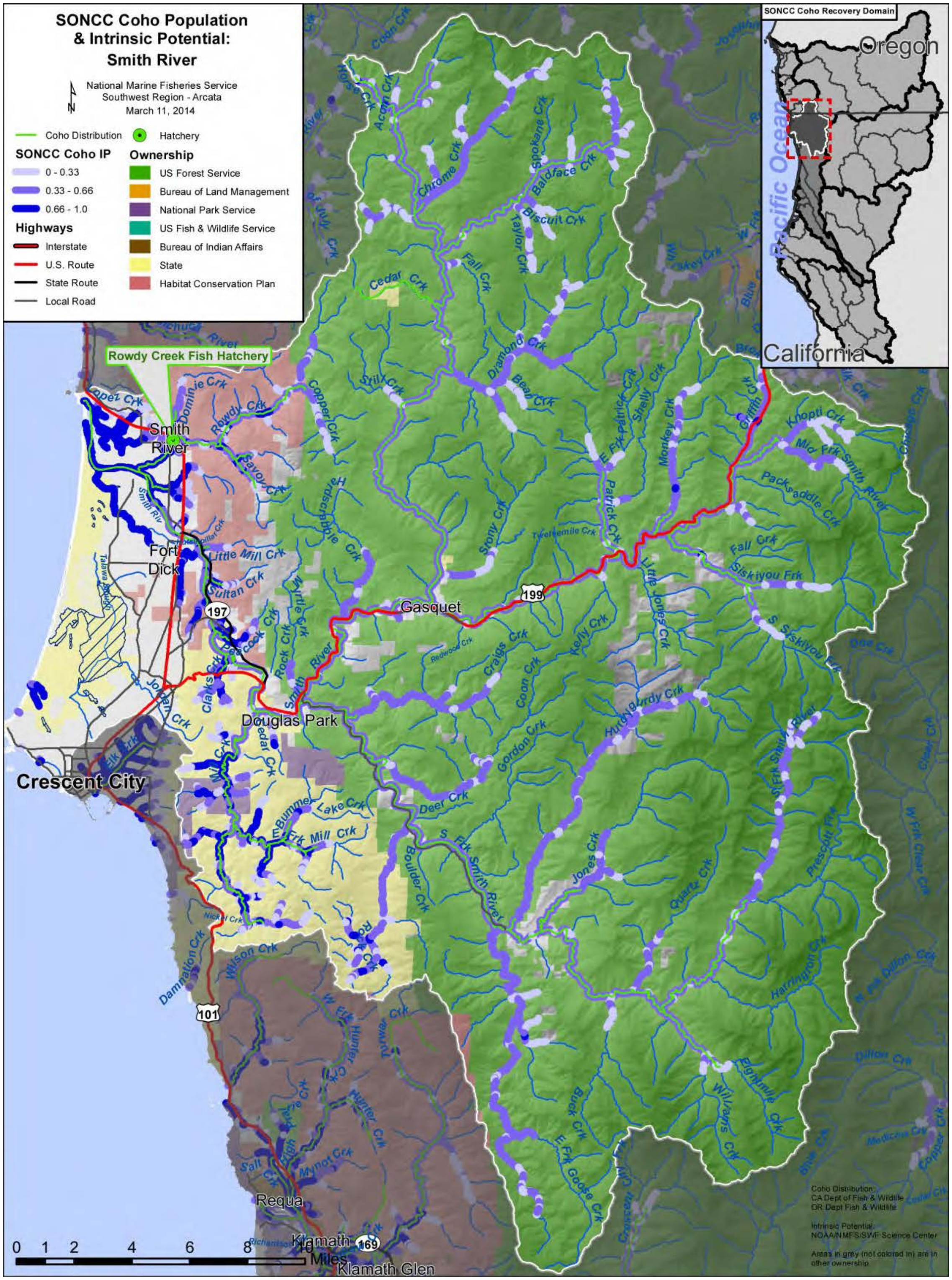

Figure 15-1. The geographic boundaries of the Smith River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Central Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

Satellite images from 1994 to 1998 show that large sections of forested land in the mid to upper Smith River watershed have undergone significant decreases in forest canopy-cover. Decreases in canopy cover are likely from timber harvesting and forest fire. Recently, this region has experienced a number of large forest fires.

Timber harvest-related erosion, along with debris from hydraulic mining, which began in the area in the 1860s, are thought to be major contributors of continued sediment loading in the Smith River. High gradients throughout the watershed along with high road densities have led to frequent mass-wasting events, which have further added to sediment loads. According to aerial photography analysis, there have been over a thousand landslides in the Smith River watershed, including hundreds over 200 feet wide (McCain et al. 1995, California Department of Fish and Game [CDFG] 1980). Some of these episodic mass-wasting events deliver large amounts of sediment into streams, and high volumes of water washes the sediment downstream.

Although many of the destructive land use practices that once occurred in the area have ceased, their legacy in the Smith River results in an altered sediment supply, impaired water quality, a lack of floodplain and channel structure, and altered estuarine function. The majority of poor habitat conditions exists in the Smith River Plain and overlap with areas of high IP value.

15.2 Historic Fish Distribution and Abundance

The Smith River is the largest watershed in the Central Coastal Stratum and includes five large tributaries: Rowdy Creek, Mill Creek, and the North Fork, South Fork, and Middle Fork of the Smith River. Although the watershed extends 32 miles inland, the tributaries with the highest intrinsic potential (>0.66) are located completely within the lower 6 miles of the watershed (Figure 15-1).

The distribution of coho salmon in the Smith River is extensive. However, forty percent of the watershed is known to be sloped at over 50 percent gradient (Bartson 1997), and does not support coho salmon. Coho salmon extend throughout the majority of lower tributaries and also use the middle and upper tributaries, but the extent of use is unknown because of the species' preference for inclines less than 3 percent (Bjornn and Reiser 1991, Garwood 2012). Middle and upper reaches have a significant amount of moderate IP habitat (0.33 to 0.66) and can support coho salmon rearing. Studies conducted in the Smith River from 1979 to 2002 show that nearly all of the tributaries in the lower river were occupied by coho salmon (Garwood 2012). The South Fork Smith River has a low gradient, is fully accessible, and is used by spawning coho salmon. Coho salmon have also been observed in a number of tributaries in the North Fork Smith River.

In 1965, CDFG estimated Smith River coho salmon spawner escapement to be 5,000, and by 1991 escapement was down to just over 800 (NMFS 2005a).

Available information suggests a decline in anadromous salmonid populations of the Smith River; however, due to the anecdotal nature of early information, there is little basis for determining the extent of the decline. Observations of the Smith River and its fisheries prior to 1935 were not recorded and subsequent observations were infrequent. A cannery that operated on the Smith River in the late 1800s provides records that indicate the harvest of all salmon species combined between 1893 and 1897 was typically over 50 tons annually (Bartson 1997). There is no way to discern what proportion of this catch was coho salmon, but presumably there was once a thriving run in the accessible tributaries of the Smith River. Rowdy Creek, a tributary of the lower river, supported large runs of anadromous fish (California Assembly 1961) prior to extensive human influences especially timber harvest. Mill Creek, a tributary of the lower river located several miles upstream from Rowdy Creek, has also been a highly productive tributary.

Table 15-1. Tributaries with high IP reaches (IP > 0.66). (Williams et al. 2006).

Subarea	Stream Name	Subarea	Stream Name
Smith River Plain	Tolowa Slough	**Mill Creek**[1]	W. Branch Mill Creek[1]
	Ritmer Creek		Bummer Lake Creek[1]
	Morrison Creek[1]		East Fork Mill Creek[1]
	Little Mill Creek[1]	**North Fork**[2]	Horse Creek
	Peacock Creek[1]	**South Fork**[1]	Rock Creek
	Clarks Creek[1]		Goose Creek
	Tryon Creek	**Middle Fork**[1]	Siskiyou Fork[2]
	Tillas Slough		Griffin Creek[1]
	Sultan Creek[1]	**Rowdy Creek**[1]	S. Fork Rowdy Creek[1]
			Dominie Creek[1]
			Savoy Creek[1]

Current estimates of the abundance and distribution of the Smith River coho salmon population are unknown for the watershed as a whole. However, there is a long-term data set beginning in 1994 that documents salmon abundance in the West Branch and East Fork Mill Creek (McLeod and Howard 2010). In addition, Scriven (2001) conducted a juvenile coho salmon distribution study throughout the Smith River watershed. Within West Branch of Mill Creek, adult coho salmon spawner counts have ranged from a high of 175 to a low of three between 1994 and 2009 with decreases in numbers seen in more current years (McLeod and Howard 2010). Estimates of total coho salmon spawners from these watersheds are unknown.

Downstream migrant traps operated on the East Fork and West Branches of Mill Creek from 1994 to 2000 showed numbers of outmigrating smolts ranged from zero to 1,500 with one brood lineage having slightly higher numbers than the other (Albro and Gray 2002). Work by Scriven in 1994 showed that juvenile densities range from 3,905 juveniles/km in West Branch of Mill Creek to 245 per kilometer in Rowdy Creek and 63 per kilometer in Patrick Creek (Scriven 2001). Although all studies indicate that Mill Creek has favorable spawning and rearing conditions for coho salmon and that productivity in this watershed is fairly high, it is far below carrying capacity as indicated by the fact that Hallock et al. (1952) was able to seine 60,602 juveniles from Mill Creek in 1951. Other tributaries where juvenile coho salmon have been found include lower tributaries such as Morrison Creek, Little Mill Creek, Sultan Creek, Peacock Creek, and Clarks Creek as well and upper tributaries including Shelly Creek, Rock Creek, and Jones Creek (Scriven 2001, Garwood 2012).

15.3 Status of Smith River Coho Salmon

Spatial Structure and Diversity

Juvenile and adult spawning surveys indicate that coho salmon in the Smith River population occur in many tributaries. Historically, coho salmon occurred in high densities in streams along the Smith River Plain including Mill Creek. Juveniles have been observed most often in Mill Creek, but have also been found further upstream in the watershed (Garwood 2012). Within the middle and upper watershed of the Smith River, coho salmon occur in many tributaries in the South and Middle Fork drainages and some tributaries of the North Fork (Garwood 2012). The majority of production appears to occur in Mill Creek where spawning coho salmon have been observed (Rellim Redwood Company 1994, Scriven 2001).

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 21 coho salmon per IP-km of habitat are needed (6,800 spawners total) to achieve low risk of extinction. However, juvenile coho salmon do maintain a relatively large distribution in the Smith River (Scriven 2001, Garwood 2012).

Population Size and Productivity

If a spawning population is too small, the survival and production of eggs or offspring will suffer because it may be difficult for spawners to find mates or predation pressure is likely to be significant. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 325 coho salmon must spawn in the Smith River each year to avoid such effects of extremely low population sizes.

Assuming Mill Creek provides the best spawning habitat in the Smith River basin, recent surveys in Mill Creek (McLeod and Howard 2010) suggest that the total population size for the Smith River basin may be less than the moderate-risk threshold for this population and at a level that puts it at high risk of extinction. Total spawner counts in the Mill Creek watershed ranged from a low of 18 in 2007 to a high of 237 in 2005 based on surveys since 1994 (McLeod and Howard 2010). Assuming Mill Creek data is representative of the entire Smith River population, the coho salmon population is experiencing a decreasing population trend since 2005. Survey of coho salmon escapement estimates in West Branch Mill Creek, East Fork Mill Creek, and Mainstem Mill Creek are shown below (McLeod and Howard 2010).

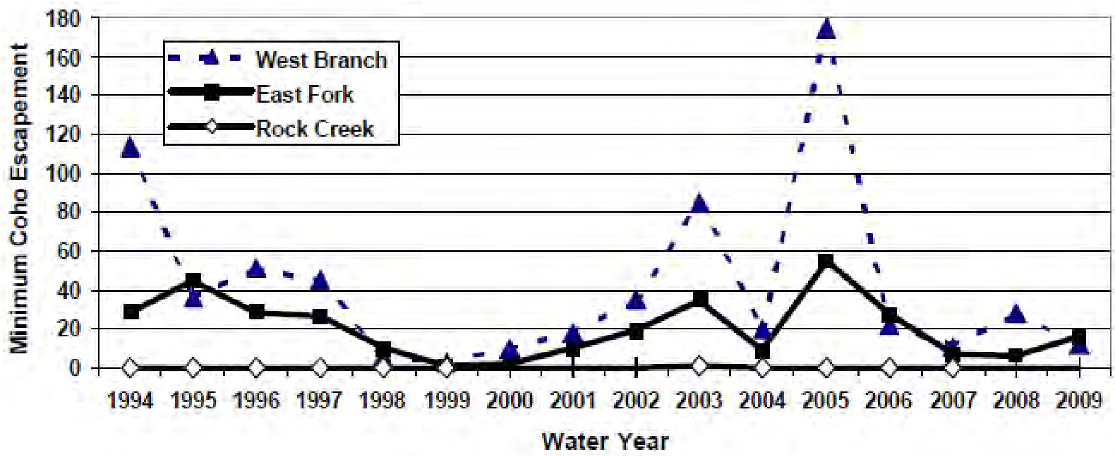

Figure 15-2. Coho escapement estimates. Data are for West Branch Mill Creek, East Fork Mill Creek and Rock Creek for 1994 to 2009 (McLeod and Howard 2010).

The Rowdy Creek Hatchery provides the longest running adult data collected by annual trapping on Rowdy Creek from October 1 through May 1 of every year. The following graph shows total adult coho salmon migrating upstream to Rowdy Creek Hatchery during spawning season from 1977 until 2010, with inconsistent survey efforts between years.

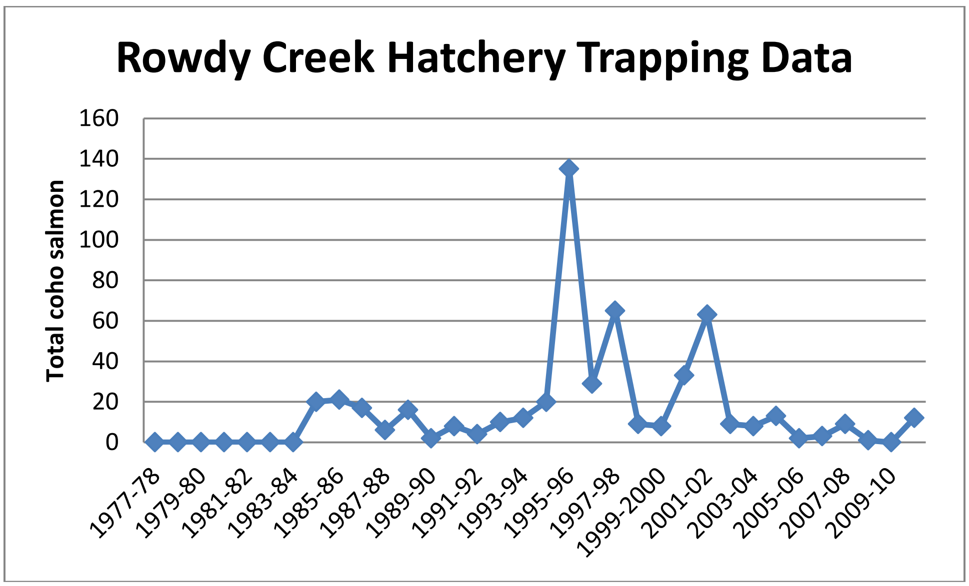

Figure 15-3. Rowdy Creek Hatchery Trapping Data for 1977 to 2010 (Van Scoyk, A., pers. comm. 2011).

Based on the IP-km modeled for the Smith River, the basin is far below its carrying capacity. Because of the low population abundance and productivity, the Smith River population is considered at high risk of extinction.

Extinction Risk

The Smith River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on viability criteria provided by William et al. (2008) (Table 3, pg. 17). These viability criteria are related to population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Smith River population is a core, Functionally Independent population within the Central Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Smith River core population should have at least 6,800 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Smith River population may serve as a source of spawner strays for nearby coastal populations. At present, the capacity of the Smith River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from nearby rivers may enhance recovery of the Smith River population.

15.4 Plans and Assessments

U.S. Forest Service, Six Rivers National Forest Assessments

The Six River National Forest has prepared a number of assessments for lands within the Smith River drainage, including:

> The South Fork Smith River Sediment Source Assessment (USFS 2003a) to evaluate sediment production trends and identify sites for mitigation such as tree planting or toe treatments.
>
> Smith River ecosystem analysis: Basin and sub-basin analyses and late successional reserve assessment (McCain et al. 1995) with recommendations for improving salmon populations, with a focus on upgrading and storm proofing roads and upgrading culverts.
>
> Roads Analysis and Off-Highway Vehicle Strategy (USFS 2005) to develop road and OHV management recommendations.

Green Diamond Resource Company (GDRC)

Green Diamond Habitat Conservation Plan (HCP)

The GDRC HCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in select watersheds in the Smith River. Approximately 25 percent of private land in the Smith River watershed is owned by GDRC and therefore managed according to the provisions of the HCP. The plan has a number of provisions designed to protect coho salmon and salmon habitat on GDRC land in the watershed. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC's activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of aquatic species. Elements of the HCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. More information about HCPs in the Smith River watershed can be found in Section 3.2.5.

Redwood National and State Parks

General Plan Amendment and Environmental Impact Report for Del Norte Coast Redwood State Park-Mill Creek Addition

http://www.parks.ca.gov/?page id=246s1

The National Park Service and California State Parks manages a significant amount of land in the Smith River Watershed in Redwood National Park and Jedidiah Smith and Del Norte Coast Redwoods State Parks (RNSP), including some of the most important coho habitat in Mill Creek. The California Department of Parks and Recreation has completed a number of restoration projects in the RNSP including the installation of LWD structures, road decommissioning, and second growth forest restoration.

California Department of Fish and Game

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. Priority actions in the Recovery Strategy for the Smith River hydrologic unit include barrier removal, floodplain and channel restoration, estuarine slough and wetland restoration, and study of the impacts of the Rowdy Creek hatchery steelhead on coho salmon.

Smith River Advisory Council

Smith River Anadromous Fish Action Plan

The Smith River Advisory Council was formed in 1990 as an independent group of representatives from city, county, state and federal agencies and landowners, Tribes, industry, agriculture, and other stakeholders. These stakeholders and agency representatives attend open meetings to discuss Smith river fishery and watershed issues. In 2002, the Smith River Advisory Council was funded by the Fisheries Restoration Grant Program to publish the Smith River anadromous fish action plan, which identified specific actions and funding sources to improve anadromous fish habitat throughout the Smith River basin. The recommendations included decommissioning roads, replacing culverts, planting riparian vegetation, and monitoring. The Plan encourages collaborative involvement and monitoring.

Other Plans, Reports, or Projects

Smith River Project
http://www.bardicmedia.com/smith/index.shtml

Smith River Flood Plain Pesticide Aquatic Ecological Exposure Assessment

Prepared for The Smith River Project by the Center for Ethics and Toxics, the assessment identified high pesticide use in the approximately 11-square-mile area of the Smith River floodplain. The second part of this study found that levels of use exceeded the federal government's established level of concern for endangered aquatic organisms for four of five pesticides studied.

Smith River Fisheries and Ecosystem Report (Humboldt State University (HSU) 1997)

Prepared by the Institute for River Ecosystems at HSU, the Smith River Fisheries and Ecosystem Report summarizes a detailed history and overview of the Smith River along with trends in fisheries and habitat, and a proposed restoration strategy.

Natural Resources of Lake Earl and the Smith River Delta

This report, written by Monroe et al. (1975), identifies specific resources and land uses in the Smith River Plain; issues in these areas, and recommends courses of action needed to insure resource protection.

Mill Creek Fisheries Monitoring Program

The Mill Creek Fisheries Monitoring Program has been monitoring the freshwater life history of salmonids in the West Branch and East Fork of Mill Creek and in Rock Creek since 1993. The monitoring has been funded by the CDFW, Smith River Alliance, and Save the Redwoods League since 2001. The program is transitioning to become a life cycle monitoring station as defined in Fish Bulletin 180 (Adams et al. 2011).

Snorkel surveys for juvenile coho salmon in tributaries to the Smith River, California

A graduate student from Humboldt State University assessed the distribution of juvenile coho salmon in the Smith River for his M.S. thesis (Scriven 2001).

Other Conservation Partners

- *Smith River Rancheria*
- *Smith River Alliance*
- *Save-the-Redwoods League*
- *Siskiyou Land Conservancy*
- *Rural Human Services*
- *Western Rivers Conservancy*
- *Del Norte County Resource Conservation District*

15.5 Stresses

Table 15-2. Severity of stresses affecting each life stage of coho salmon in the Smith River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses (Limiting Factors)	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Impaired Estuary/Mainstem Function[1]	-	Medium	Very High[1]	Very High	Medium	Very High
2	Lack of Floodplain and Channel Structure[1]	Medium	High	High[1]	High	Medium	High
3	Impaired Water Quality	Low	High	High	High	High	High
4	Barriers	-	Medium	High	High	Medium	High
5	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
6	Altered Sediment Supply	Medium	Medium	Low	Low	Medium	Medium
7	Degraded Riparian Forest Conditions	-	Medium	Medium	Medium	Low	Medium
8	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
9	Increased Disease/Predation/Competition	Low	Medium	Medium	Low	Low	Low
10	Altered Hydrologic Function	Low	Low	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for the Smith River population are impaired estuary/mainstem function and lack of floodplain and channel structure, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. The juvenile life stage is most limited, primarily due to a lack of access to, and decrease in the quantity of high quality winter

(Stillwater Sciences 2006) and summer rearing habitat, and the estuarine rearing life history trait historically found in the population is limited by the degraded conditions in the Smith River estuary. Although habitat quality in the middle and upper parts of the basin have not been heavily impacted by land use, many areas in the lower parts of the Smith River and the Smith River estuary are creating limitations on the survival and viability of the Smith River coho salmon population. Additionally, the high pesticide use associated with agriculture in the Smith River Plain adjacent to streams and drainages that enter the Smith River Estuary may be affecting the survival of coho salmon.

The majority of refugia habitat in the Smith River occurs in the lower and middle reaches of the watershed, which currently is being affected by agricultural practices and degraded habitat quality. There are also several tributaries in the middle and upper watershed that are known to support coho salmon and likely provide good rearing habitat and refugia from poor water quality in the lower river, both of which are considered vital habitat for the Smith River coho salmon population.

Of particular importance are the five tributaries to the Smith River that flow into the estuary: Rowdy Creek, Ritmer Creek, Delilah Creek, Yontocket Slough, and Morrison Creek. Tributaries and sloughs near the estuary provide vital habitat for juveniles and fry that are swept downstream during high flow events. This habitat increases survival of juveniles, which increases overall productivity and life history diversity of this population. The juveniles in these streams may express an estuarine life history pattern for rearing. Given the high flows and steep conditions found in the middle and upper Smith River watershed, low gradient tributaries near the estuary likely contribute to the success and continued survival of coho salmon in the Smith River. The lower Smith River and its tributaries are critical to the recovery of coho salmon in the Smith River (Frissell 1992). Therefore, the continued degradation of these habitats has a large impact on the entire population. Further upstream, refugia areas with good water quality are likely to be available in most cases, but are not always accessible or usable due to high gradients and barriers. These most likely occur where cold, clean water comes in from tributaries and where groundwater emerges into the stream.

Impaired Estuarine Functions

This stress refers to just the estuary conditions in the Smith River, since this is a single population basin (see Chapter 3 for further description of this stress).

The estuary is important to the growth and survival of coho and any change or loss of access to estuarine habitat can severely affect the productivity of the population. Overall, the ability of the estuary to provide foraging and refuge opportunities is diminished and estuarine function is limited by existing modifications of the floodplain and channel. Impaired estuarine function is a high threat to juveniles and smolts in the population. A combination of factors has led to a severely degraded estuarine function in the Smith River.

There are several estuary sloughs which contribute valuable rearing habitat for coho salmon, but much of the historic tidal wetland habitat (>70 percent) and nearly all the historic tidal channels have been lost to agricultural and rural development through diking, dredging, the presence of tide gates, and filling. Approximately 40 percent of Smith River estuarine surface area was reduced between 1856 and 1966 (Quinones and Mulligan 2005). Dikes and levees along the channel prevent natural flow and change sediment and wood delivery in and out of the estuary. Behind the levees, filling of the estuary reduces functional rearing and refugia habitat and prey production. Sediment accumulation in accessible estuary areas restricts and simplifies channel habitat by decreasing pool and wetland depths and influencing the distribution and abundance of prey populations such as macro-invertebrate and benthic plankton. These effects are exacerbated by the presence of reed canary grass in many backwater channels and slough areas. Overall, the Smith River estuary has limited cover, especially in the lower reach of the estuary (Quinones and Mulligan 2005). Cover, especially coarse woody debris contributes to estuarine function and habitat value (Koski 2009).

Lack of Floodplain and Channel Structure

The Smith River is degraded from a lack of large woody debris, an accumulation of sediment, levees, and a simplified floodplain and channel structure, which is considered a high threat to the Smith River population. This lack of floodplain and channel structure decreases pool quality and depth, and off channel habitat, which causes a lack of suitable summer and winter rearing habitat for juveniles. Fry, juveniles, and smolts are impacted by lack of floodplain and channel structure because these life stages depend heavily on complex instream habitat and off-channels rearing habitat. Habitat surveys in Rowdy Creek found an average of only 3.5 large wood pieces per 100 feet of recruitment zone (GDRC 2006) and in some upper reaches of Chrome and Spokane Creeks, large woody debris frequency was rated as poor (<1.5 USFS rating). However, Spokane and Chrome Creeks have relatively high gradients and, therefore, wood is less likely to recruit. In a related dataset, pool frequency in some of these upper reaches was also rated as fair (10 to 20 percent by area) and pool depths were found to be less than 3 feet, which is thought to be a suitable depth for use by both juveniles and adults.

Other reaches lower in the watershed were rated as having very good (>35 percent) pool frequency and pool depth in some reaches of Rowdy Creek had average depths ranging from poor (<2 ft.) to very good (>3.3 ft.). The lack of floodplain and channel structure affects egg and adult life stages because it reduces the quality and quantity of spawning gravel, changes the channel morphology and flow regime, and creates a lack of instream cover for juveniles. The lack of large woody structures and associated winter rearing habitat has been identified as a key limiting factor for juvenile coho salmon in the Smith River (GDRC 2006, Stillwater Sciences 2006). Tributaries in the lower Smith River and the estuary are particularly affected by a lack of floodplain and channel structure, and the lack of woody structures and floodplain connectivity in the estuary likely severely limits estuarine rearing.

Impaired Water Quality

Water quality in the Smith River is thought to be good in the middle and upper river, but may be compromised in the estuary and lower river where agricultural is greatest and a restricted tidal prism prevents sufficient flows to flush sediment and pollutants. The contaminants of concern originate from point and non-point source pollution from farms, dairies, and urbanized areas that flow directly into the river. Of particular concern is the lily farming that occurs in the Lower Smith River. Recent testing in the lower Smith River has revealed copper concentrations that may have acute toxic effects and impair olfaction and reproduction of coho salmon (North Coast

Regional Water Quality Control Board [NCRWQCB] 2011). Copper is a component in a number of pesticides and fungicides used on lily fields. The current level of chemical contamination is a high risk for juvenile salmonids (Bailey and Lappe 2002). The NCRWQCB is currently developing a non-point source pollution control program that should assist in decreasing non-point sources of chemical, sediment, and nutrient pollution from reaching the Smith River and its tributaries.

Water quality data including temperature and aquatic insect diversity measures such as the Ephemeroptera, Plecoptera, Trichoptera (EPT) index and Index of Biological Integrity (IBI) provide an indication of water quality in the Smith River. These data show that temperature is generally good (<15 °C) with only isolated reaches in Mill Creek and the South Fork with fair or poor temperature (>17 °C). Aquatic insect B-IBI NorCal, which is an indicator of stream health, was rated as good (60 to 80) in sampled locations along the mainstem Smith River from the mouth of Peacock Creek up into the North, Middle, and South Forks. Aquatic Invertebrate EPT on the other hand, indicated that there may be extensive pollutants in some tributaries. Samples from Jones Creek in the South Fork Smith River had a low (<12) number of taxa that may indicate the presence of pollutants in that stream. Other measurements in the upper watershed were either good (≥23; Middle Fork) or fair to poor (<18; Eightmile Creek).

Barriers

Barriers to fish passage in the Smith River are primarily due to road-stream crossings and aggradation or degradation of the channel and are thought to be a high stress for many life stages in the population. According to the California Fish Passage Assessment Database (CalFish 2009) there are approximately 150 road-stream crossing barriers within the Smith River Hydrologic Unit (HU). Forty-eight of the road-related barriers, ranging from partial to complete barriers, occur in the lower watershed where stream reaches are characterized as high IP for coho salmon. Known complete barriers identified in the database are in the Tenmile Creek, West Fork Patrick Creek, Yontocket Slough, Shelly Creek and Buck Creek. The majority of these barriers are associated with farm and small county access roads, and create passage problems through changes in hydrology and creating alluvial sills that block tributary mouths. In addition to tide gates, these crossings prevent access to the already limited amount of overwintering habitat in the coastal plain (Stillwater Sciences 2006). The California Department of Fish and Game (CDFG) has funded several fish passage restoration projects since 2005, including barrier removals on Cedar, Clarks, Peacock, and Rowdy creeks (CDFG 2010a). Nevertheless, there are at least several dozen remaining fish barriers in the lower basin, which are considered a high stress for the juvenile and smolt life stages and a medium stress for the rest of the life stages. Because a large number of barriers remain in the lower basin blocking a large amount of spawning, winter refugia, and summer rearing habitat, the overall impact from barriers is considered high.

Adverse Hatchery-Related Effects

Rowdy Creek Hatchery produced coho salmon from the 1930s but the species is no longer produced there. The genetic effect of past hatchery operations on coho salmon in the Smith River is unknown. The hatchery still produces 100,000 steelhead and 150,000 Chinook salmon, which are stocked into the Smith River. Hatchery coho salmon from other watersheds, such as the Rogue River, are found in the Smith River. Adverse hatchery-related effects pose a medium risk to all life stages of coho salmon in the Smith River, primarily because of the ongoing in-basin stocking with steelhead and Chinook salmon from Rowdy Creek Hatchery (Appendix B).

Altered Sediment Supply

Altered sediment supply presents a low to medium stress to coho salmon in the Smith River. Large introductions of sediment originating from historic timber harvest practices, mining, and an estimated 2,000 landslides are thought to contribute to increased sediment delivery to the Smith River. Excluding the coastal plain, 90 percent of the basin has high or extreme erosion potential (CDFG 1980), as evidenced by the high number of landslides and debris torrents found throughout the watershed. Although erosion can be high and sediment tends to accumulate in the Smith River Plain, river flows are generally high enough and persistent enough to prevent sediment accumulation and turbidity in the lower parts of the basin. Data on sedimentation indicates that some areas have accumulated fine sediment and suffer from filling of pools and increases in the amount of fine sediment. Measurements of sediment accumulation in pools (V*) in West Branch Mill Creek and Clarks Creek had fair ratings (>0.25), displaying effects from both anthropogenic and natural causes. Other data from a tributary of the North Fork (Cedar Creek) and the East Fork of Mill Creek showed a very good V* rating (<0.15) and did not show that pool depth and quality in this area were altered.

Mean particle size was rated between fair and poor (<50 mm) in Clarks Creek, West Branch Mill Creek, and the North Fork (Cedar Creek), indicating unnatural proportions of fine sediment as compared to background levels. Only the East Fork of Mill Creek was given a good rating (50 to 60 mm). In areas where sediment does tend to accumulate (especially in the estuary), pools are filled, gravels cemented, and stream habitat simplified, creating stress for both adults and juveniles through decreases in available spawning and rearing habitat. Salmon eggs and fry are particularly susceptible to any introduction of fine sediment because it can smother redds and kill eggs by depriving them of oxygen.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions pose a medium stress for most life stages of coho salmon in the Smith River. Riparian vegetation in the lower reaches of the Smith River is inadequate due to the conversion of this area for agriculture, residential development and timber harvest. Past timber harvest in the Rowdy Creek drainage has resulted in a paucity of large woody debris and future harvest rotations are expected to continue to reduce the recruitment of large woody debris far into the future. Inadequate riparian vegetation simplifies instream habitat, elevates water temperatures from increased insolation, increases erosion and sedimentation, and decreases the amount of large woody debris recruitment that is essential to the survival of juvenile salmonids in the lower watershed. In the middle and upper Smith River watershed, most areas have riparian forest dominated by thick hardwood and conifer species and conditions are considered adequate for shading and contributing large woody debris. The USFS rated the middle and upper Smith River as having very good (fully functional) stream corridor vegetation in their habitat surveys of the area.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Increased Disease/Predation/Competition

Currently, juvenile hatchery Chinook and steelhead released from the Rowdy Creek Hatchery are likely exerting predatory and competitive pressure on native coho salmon.

Altered Hydrologic Function

The Smith River experiences a relatively natural hydrologic regime due to the absence of large dams and other significant alterations to channel morphology or hydrology. The USFS rated the upper watershed as having very good (fully functional) water quantity and flow regime, and although areas lower in the watershed exhibit impacts from changes in land use, localized water withdrawal and diversion of flows, altered hydrologic function is considered a low stress to the Smith River coho salmon population. In the lower watershed and estuary, there are numerous diversions for agriculture, but the cumulative effect does not currently result in a shortage of flow in the mainstem needed for salmon, but it is unknown how diversions may affect tributary streams.

Crescent City, including Pelican Bay State Prison, diverts surface water from the mainstem (Katelman 2005) and the Smith River Community Services District operates three wells to supply water to the Town of Smith River and surrounding developments. In addition, the Gasquet Community Services District provides water for their service area. The total amount of water extracted for Crescent City and the Smith River Community Services District ranges from two to three million gallons per day, but this amount, along with the other diversions, has had no known detectable effect on surface flows of the river (Voight and Waldvogel 2002). Agricultural use is the second largest source of water extraction, but the total amount is minimal and also does not affect surface flows (Voight and Waldvogel 2002). Generally, the hydrologic function in the watershed is good, primarily because of abundant rainfall in the region, which supplies sufficient water for agriculture, municipalities, and salmon.

15.6 Threats

Table 15-3. Severity of threats affecting each life stage of coho salmon in the Smith River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads	High	High	High	High	High	High
2	Channelization/Diking[1]	Low	High	High[1]	High	High	High
3	Road-Stream Crossing Barriers	Medium	Medium	High	High	High	High
4	Agricultural Practices[1]	Low	High	High[1]	High	Medium	High
5	Urban/Residential/Industrial Dev.	Medium	Medium	Medium	Medium	Medium	Medium
6	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
7	Mining/Gravel Extraction	Medium	Medium	Medium	Medium	Medium	Medium
8	High Severity Fire	Medium	Medium	Low	Low	Medium	Medium
9	Climate Change	Low	Low	Medium	Medium	Medium	Medium
10	Invasive Non-Native/Alien Species	Low	Medium	Medium	Medium	Low	Medium
11	Fishing and Collecting	-	-	Low	Low	Medium	Low
12	Timber Harvest	Low	Low	Low	Low	Low	Low
13	Dams/Diversion	Low	Low	Low	Low	Low	Low

[1] Key limiting threats and life stage

Key Limiting Threats

The two key limiting threats to the Smith River population, those which most affect recovery by influencing stresses, are channelization/diking and agricultural practices.

Roads

Roads are considered a high threat to coho salmon in the Smith River. Erosion on many abandoned or unmaintained roads is a chronic source of fine sediment input to many streams and is exacerbated in the middle and upper parts of the basin by steep hillsides and an unstable geology. With a history of both agricultural use and timber harvest, the Smith River Plain is characterized by high road density. Road surveys indicate that a majority of the watershed contains more than 3 miles of road per square mile, and the areas with the highest densities of roads (>3 mi/sq. mi) include the Smith River Plain, Rowdy Creek, Mill Creek, the South Fork, the lower North Fork and scattered watersheds in the Upper Middle Fork. Erosion and the associated sediment delivery to streams affect multiple life stages, including the egg life stage, because fine sediment can smother eggs. Fry, juveniles and adults are adversely affected by road-related sedimentation due to the decreases in pool quality and quantity and the simplification of spawning and rearing habitat. When sediment builds up, the channel widens and becomes shallower, pools fill, and gravel is buried, making streams less favorable for spawning and rearing. Overall, timber management and mining roads in the mid and upper reaches and farm roads in the coastal plain pose a high threat to all life stages of coho salmon in the Smith River population. This threat will likely reduce in the future as measures are undertaken by public land managers to decommission and upgrade roads throughout the Smith River watershed.

Channelization/Diking

The overall threat to coho salmon from channelization and diking is high and will continue as long as dikes and levees remain in place. The extent of channelization and diking in the historic floodplain and estuary of the Smith River watershed is extensive and interferes directly with the ecological function in this area, decreasing rearing quality in the lower reaches of the basin. Although the historic extent of tidal wetlands is not known, it is likely that close to 7,000 acres of tidal wetlands have been converted to agricultural land. Remaining tidal channels are severely truncated and channelized, providing only a fraction of their potential as rearing habitat. The lower reaches of streams, such as Rowdy Creek, are also channelized and important rearing habitat has been reduced and degraded. Low gradient stream channels directly connected to the estuary allow for estuarine life history traits that are unique to this population, and the degradation and inaccessibility of these habitats may have a significant effect on the Smith River coho salmon population. Without restoration of historic tidal wetlands and tidal channels, estuarine function will continue to be limited. The early life stages of coho salmon that rely on the estuary for growth and survival are most affected.

Road-stream Crossing Barriers

Road-stream crossing barriers are a high threat to the population, and although some work has gone into removing barriers throughout the watershed, the current number and extent of barriers mean that it will likely remain at this elevated status in the future, or until all high priority barriers have been removed or remediated. According to the California Fish Passage Assessment Database (CalFish 2009) there are potentially 150 road-stream crossing barriers in the Smith River HU. Of these, roughly half have been assessed, a third have been prioritized and nineteen have been given a high priority for removal. Most road-stream crossing barriers are in tributaries in the middle and upper Smith River, but a few are lower down in tributaries in the Smith River Plain and cause passage problems for the Smith River coho salmon population. Until recently, notable barriers existed in Rowdy Creek and Mill Creek blocking much of the high IP habitat for spawning and rearing coho salmon. Barriers on Jordan Creek were especially restricting until 2001 when a state fish passage restoration project was implemented. Since 2005, the California Department of Fish and Game has sponsored several fish passage restoration projects, including barrier removals on Cedar, Clarks, Peacock, and Rowdy, creeks (CDFG 2010a). A list of highly ranked road-stream crossing barriers identified in 2002 is given in Table 15-4.

Table 15-4. List of high priority barriers in the Smith River watershed. Length of anadromous habitat, when given, was estimated in Taylor (2001) and the Smith River Anadromous Fish Action Plan (Voight and Waldvogel 2002). Prioritization is from the CalFish (2009) and Taylor (2001).

Priority	Stream Name	Road Name	Subarea	County	Miles of upstream habitat
High	Sultan Creek	Culvert Hwy 197	Smith River Plain	Del Norte	1
High	Shelly Creek	Patrick's Creek Road	Middle Fork Smith River	Del Norte	
High	Rock Creek	Culvert Hwy 197	Smith River Plain	Del Norte	0.13
High	Little Mill Creek	Culvert Hwy 197	Smith River Plain	Del Norte	1
Very High	Clarks Creek	Culvert Hwy 199	Smith River Plain	Del Norte	1.3
High	Morrison Creek	Culvert Hwy 101	Smith River Plain	Del Norte	1
High	Ritmer Creek	Oceanview Drive	Smith River Plain	Del Norte	
High	Griffin Creek	Hwy 199	Middle Fork Smith River	Del Norte	0.13
High	Dominie Creek	Culvert Hwy 101	Smith River Plain	Del Norte	1.7
High	Unnamed Trib to Smith River	Hwy 199	Middle Fork Smith River	Del Norte	0.13
High	Griffin Creek	Hwy 199	Middle Fork Smith River	Del Norte	0.15
High	Griffin Creek	Oregon Mountain Road	Middle Fork Smith River	Del Norte	
High	Unnamed Trib to Smith River	Hwy 199	Middle Fork Smith River	Del Norte	0.06
High	Unnamed Trib to Smith River	Hwy 197	Smith River Plain	Del Norte	0.04
High	Unnamed Trib to Smith River	Hwy 197	Smith River Plain	Del Norte	
High	Unnamed trib to Morrison Ck	Hwy 101	Smith River Plain	Del Norte	0.3
High	Tryon Creek	Hwy 101	Smith River Plain	Del Norte	0.3
High	Brush Creek	Hwy 101	Smith River Plain	Del Norte	0.4
High	Unnamed Trib to Smith River	Hwy 101	Smith River Plain	Del Norte	0.3
High	Peacock Creek	Tan Oak Drive	Smith River Plain	Del Norte	1.2
High	Ritmer Creek	Oceanview Drive	Smith River Plain	Del Norte	0.5
High	Tryon Creek	At Estuary	Smith River Plain	Del Norte	<.25
High	Huntspilar Creek	Highway 197	Smith River Plain	Del Norte	0.75
High	Morrison Creek	County Road D4	Smith River Plain	Del Norte	1.5
High	Coldwater Creek	Highway 199	Smith River Plain	Del Norte	0.75

Agricultural Practices

Agriculture practices are not common in the middle and upper reaches of the Smith River (0 to 2 percent of land use), but are very prevalent (>10 percent) in the Smith River Plain. Therefore, agricultural practices are considered an overall high threat to coho salmon in the Smith River.

The coastal plain is dominated by agricultural activities focused on flower production, produce, and dairy farming. These farms may contribute pesticides, fungicides, herbicides, erosion, and animal waste into the watershed, and are commonly associated with levees to protect fields. The NCRWQCB is currently developing a non-point source pollution control program that should assist in decreasing non-point sources of chemical, sediment, and nutrient pollution from reaching the Smith River and its tributaries. Because of the land clearings, agricultural practices are partially responsible for the significant decrease in large woody recruitment in the lower basin. The life stages most affected by agricultural practices are juveniles and smolts because they spend weeks to months rearing in the affected floodplain and estuarine areas and are particularly susceptible to water quality contaminants and poor habitat quality.

Urban/Residential/Industrial Development

Urban, residential, and industrial development is considered a medium threat to coho salmon in the Smith River because it occurs in the Smith River Plain where the highest quality-rearing habitat is located. Communities within the Smith River watershed and Smith River Plain are generally small and rural. The largest community in the Smith River watershed, the Town of Smith River, is surrounded by areas used for agriculture and includes several small communities in the coastal plain near Rock Creek and Peacock Creek. Most communities have fewer than 1,000 residents and do not appear to be undergoing significant growth. Crescent City, the largest city in the county, is located south of the Smith River watershed and supports nearly all of the county's population of nearly 29,000 people. Agricultural areas may be subdivided for rural residential use and future impacts may include the loss of wetlands, degraded water quality, channelization and diking, and altered hydrology. Recent public lands acquisitions, including 9,500 acres of Goose Creek watershed from Green Diamond Resources Company in 2006 and a pending 5,400 acre acquisition from ALCO Holdings, Inc., make the Smith River Recreation Area approximately 315,000 acres. California State Parks has also expanded by gaining 25,000 acres of the Mill Creek Watershed in 2002. Private lands not managed by a HCP, compose 15.7 percent of the Smith River watershed.

Hatcheries

Hatcheries pose a medium threat to all life stages of coho salmon in the Smith River. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Mining/Gravel Extraction

Although mining activities have ceased for the most part in the population area, there continues to be numerous metal mining activities along reaches of middle and upper tributaries on Forest Service lands (McCain et al. 1995) and a gravel mine in the coastal plain. According to Bartson (1997), mining remains a source of sediment to the Smith River, although the extent of the problem remains unknown. Many areas historically disturbed by mining are actively eroding (McCain et al. 1995), and are exacerbated by the steep, unstable geology characteristic of the Smith River watershed. Although mining companies have expressed interest in mining for heavy metals in this watershed, Smith River NRA Act prohibits the formation of any new mining claims in California. In 1996, the Forest Service formulated administrative rules concerning mining in the NRA. However, a portion of the North Fork Smith River occurs in Oregon, which does not have the same prohibitions. The Forest Service is currently evaluating a proposal to mine Baldface Creek in the North Fork Smith River. Because of the proposed mining in the North Fork Smith River, NMFS believes the overall threat to coho salmon associated with mining in this watershed is moderate.

High Severity Fire

Fire is considered a medium threat to the Smith River coho salmon population. The inland reaches of the Smith River are thirty-two miles from the coast, forest dominated, and have an inherent risk of wildfire. Unnatural fuel loads due to past timber harvest and fire suppression could make this a greater threat if not fully addressed through fuels reduction and ecological fire management. The effects of high severity fire could be severely detrimental, creating excessive amounts of erosion, loss of riparian vegetation, and degraded water quality. Overall, the threat from fire is low to medium because of the ongoing efforts in the watershed to reduce fuel loads.

Climate Change

Climate change poses a medium threat to this population. Ongoing and anticipated climate change in this region is likely to add further risk of forest fires, which would contribute to a decrease in canopy closure, increase sedimentation, degrade water quality, and have overall negative impacts to ecosystem processes. Additionally, decreased canopy closure increases the potential for erosion and ground instability, which leads to more sediment in the river system. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. Modeled regional temperature shows a moderate increase over the next 50 years. Average temperature could increase by up to 2 °C in the summer and by up to 1 °C in the winter and annual precipitation in this area is predicted to trend downward over the next century. Snowpack in upper elevations of the basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009).

The vulnerability of the estuary and coast to sea level rise is moderate to high in this population. Juvenile and smolt rearing and migratory habitat is most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation will also likely impact water quality and hydrologic function in the summer. Rising sea level will also impact the quality and extent of estuarine rearing habitat. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, as with all populations in the ESU, adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Invasive Non-Native/Alien Species

Of notable concern is the expansion of exotic reed canary grass, *Phalaris arundinacea*, a cool-season perennial grass that grows successfully in northern latitudes. Reed canary grass is considered a serious threat to riparian and streamside corridors, wetlands, marshes, floodplains, and wet prairies by forming large dense stands. These stands exclude and displace desirable native plants, constrict waterways and promote silt deposition and are widely tolerant to degraded conditions (Lyons 1998). Colonies established outside of the water channel are known to promote channel incision through erosion of soil beneath the dense mats of rhizomes, causing cutaways where water flows rapidly between stands (Lyons 1998). This species is widely found in the Smith River watershed and is suspected of inhibiting coho salmon access to the use of tributaries like Yontocket Slough and Tryon Creek.

Also of concern is the establishment of the New Zealand mud snail (NZMS), *Potamopyrgus antipodarum*, which is native to New Zealand, but in the late 1980s was discovered to have spread to North America. This small invasive mollusk is now found in many waters across the West and the spread of this invasive species is believed to occur by migrant fish and waterfowl, and people's waders, fishing gear, and bait. In September 2008, a sparse number of New Zealand mud snails were found in Tillas Slough of the Smith River watershed. Adverse impacts of this introduction include reduction in the insect species diversity and abundance and diminished availability of critical food resources to fish (IUCN 2010).

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Timber Harvest

Timber harvest is considered a low threat to coho salmon in the Smith River. Currently timber harvest in the Smith River watershed is conducted in small units on land owned by Green Diamond Resource Company and the U.S. Forest Service's Six Rivers National Forest. The area with the greatest extent of timber harvest (>35 percent of land use) is in the upper reaches of Rowdy Creek, Dominie Creek, and Ritmer Creek on industrial timberland. Most of the private land used for timber harvest is managed under the Green Diamond Resource Company's 50 year Habitat Conservation Plan and Candidate Conservation Agreement with Assurances (HCP) (GDRC 2006) that includes minimization and mitigation measures consisting of road and riparian management, slope stability, and harvesting restrictions. The impacts of timber harvesting may result in the loss of pool habitat, loss of large wood and stream complexity, altered hydrology and nutrient cycling, and increased sediment loads. Maintenance of poor habitat conditions in areas with high harvest rates (>2% annually) will continue to have a negative effect on all life stages of coho salmon utilizing those areas. Timber harvest on public land is minimal and primarily associated with fuels reduction. As part of the aquatic conservation strategy of the Northwest Forest Plan (USDA and USDI 1994), the Smith River was designated as a key watershed, which has restrictions on timber harvest in the watershed.

Dams/Diversions

Diversions and dams are considered a low threat to the population. There are no known dams that limit coho salmon access in the Smith River. Water diversions predominantly support agriculture, urban areas, rural residences, timber operations and road maintenance in the lower watershed and coastal plain. A hydrologic assessment of the diversions in the Smith River watershed has not been completed, but at this time withdrawals are not thought to significantly alter streamflow and no major diversions are planned for the future in this basin. However, the California State Park operates a diversion on West Branch Mill Creek, one of the most important tributaries for coho salmon in the Smith River and this diversion is considered a threat to coho salmon during some portions of the year.

15.7 Recovery Strategy

Coho salmon in the Smith River experience some advantages over other rivers in the region due to the geology of the basin that enables the river to move sediment and to sustain cooler temperatures. The relatively low urban development in the area and the high ratio of public lands to private lands also helps to preserve the river ecosystem. Nevertheless, the coho salmon in the Smith River have declined substantially and are dependent on rearing areas in the lower watershed where development and agriculture have the greatest adverse effects. Although restoration and public land acquisition has resulted in improved habitat and ecosystem functions in the Smith River, the loss of estuary, slough, and floodplain habitats continue to negatively affect the viability of coho salmon.

Recovery of the population will require enhancing existing juvenile coho salmon habitat and expanding the spatial structure of the population. Tributaries in the Smith River Plain have the highest IP habitat, and should therefore be the first place to look for opportunities. Throughout the lower watershed, a focus should be on improving fish passage and floodplain and channel structure, especially where overwintering, low-velocity habitat can be created, improved, or accessed. Therefore, restoration of the Smith River estuary, which lacks extensive wetland and tidal channel rearing habitat, is imperative. In addition, agricultural run-off needs to be assessed to determine if agricultural chemicals are reaching the Smith River and its tributaries. If agricultural chemicals are found in concentrations that may be harmful to coho salmon or their habitat, then actions must be undertaken to reduce the concentration levels of agricultural chemicals reaching the Smith River and its tributaries. On a larger scale, sediment from roads and the paucity of LWD needs to be addressed watershed-wide. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 15-5, beginning on the following page, lists the recovery actions for the Smith River population.

Table 15-5. Recovery action implementation schedule for the Smith River population.
Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Smith River Plain, Estuary, sloughs, tributaries, and Copper, Savoy, Dominie, Rowdy creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-SmiR.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SmiR.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-SmiR.2.1.55	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-SmiR.2.1.55.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SmiR.2.1.55.2	*Place instream structures, guided by assessment results*					
SONCC-SmiR.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Smith River Plain and all streams where coho salmon would benefit immediately	2a
SONCC-SmiR.2.2.3.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SmiR.2.2.3.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-SmiR.2.2.57	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-SmiR.2.2.57.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SmiR.2.2.57.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-SmiR.2.2.4	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Smith River Plain, tributaries, Rowdy and Mill creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-SmiR.2.2.4.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-SmiR.2.2.4.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-SmiR.2.2.4.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.2.2.58	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2b
SONCC-SmiR.2.2.58.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-SmiR.2.2.58.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-SmiR.2.2.58.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-SmiR.2.2.5	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Lower Mainstem, Smith River Plain, and all streams where coho salmon would benefit immediately	2a
SONCC-SmiR.2.2.5.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-SmiR.2.2.5.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-SmiR.2.2.59	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Population wide	2b
SONCC-SmiR.2.2.59.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-SmiR.2.2.59.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-SmiR.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Restore natural channel form and function	Smith River Plain, Rowdy and Dominie creeks; East Fork Mill Creek Road, Mill Creek confluence, and all streams where coho salmon would benefit immediately	2a
SONCC-SmiR.2.2.2.1	*Assess channelized reaches and develop a plan for reconstructing a natural meandering channel*					
SONCC-SmiR.2.2.2.2	*Reconstruct channelized reaches guided by the plan*					
SONCC-SmiR.2.2.56	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Restore natural channel form and function	Population wide	2b
SONCC-SmiR.2.2.56.1	*Assess channelized reaches and develop a plan for reconstructing a natural meandering channel*					
SONCC-SmiR.2.2.56.2	*Reconstruct channelized reaches guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.2.2.46	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2a
SONCC-SmiR.2.2.46.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-SmiR.1.2.13	Estuary	Yes	Improve estuarine habitat	Reduce pollutants	Smith River Plain, Smith River Estuary	2b
SONCC-SmiR.1.2.13.1	*Monitor/assess the Smith river and its tributaries for pollutants*					
SONCC-SmiR.1.2.13.2	*Work with stakeholders to reduce pollutants from entering areas that are important to the survival and recovery of coho salmon*					
SONCC-SmiR.1.3.12	Estuary	Yes	Increase tidal exchange of water	Improve hydrologic function to restore tidal prism	Estuary	2b
SONCC-SmiR.1.3.12.1	*Complete a hydrologic study to assess estuary function and identify restoration actions to restore the tidal prism*					
SONCC-SmiR.1.3.12.2	*Complete restoration actions identified in the plan*					
SONCC-SmiR.5.1.14	Passage	No	Improve access	Remove barriers	Cedar, Rowdy, Patrick, Morrison, Peacock, Sultan, Dominie, Ritmer, Jordon, West Branch Mill, Little Mill, Tryon, Elk, Camp Six and Yonkers creeks; Pala Road crossing; Picnic Road crossing (Hamilton Creek)	2b
SONCC-SmiR.5.1.14.1	*Evaluate and prioritize barriers for removal*					
SONCC-SmiR.5.1.14.2	*Remove barriers, based on evaluation*					
SONCC-SmiR.5.1.62	Passage	No	Improve access	Remove barriers	Population wide	2d
SONCC-SmiR.5.1.62.1	*Evaluate and prioritize barriers for removal*					
SONCC-SmiR.5.1.62.2	*Remove barriers, based on evaluation*					
SONCC-SmiR.7.1.8	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Remove invasive species	Smith River Plain and all areas where coho salmon would benefit immediately	2b
SONCC-SmiR.7.1.8.1	*Implement an invasive species prevention and removal plan for reed canary grass*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SmiR.7.1.66	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Remove invasive species	Population wide	2c
SONCC-SmiR.7.1.66.1	*Implement an invasive species prevention and removal plan for reed canary grass*					
SONCC-SmiR.26.1.49	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-SmiR.26.1.49.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-SmiR.10.2.10	Water Quality	No	Reduce pollutants	Educate stakeholders	Smith River watershed, Smith River Plain	2b
SONCC-SmiR.10.2.10.1	*Develop and implement a program to educate stakeholders on methods to reduce effects of pollutants on coho salmon*					
SONCC-SmiR.10.2.9	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	All areas where coho salmon would benefit immediately	2b
SONCC-SmiR.10.2.9.1	*Identify pollution sources, and develop a strategy to minimize input to stream channels*					
SONCC-SmiR.10.2.9.2	*Implement strategy to reduce pollution to meet objective*					
SONCC-SmiR.10.2.53	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	2d
SONCC-SmiR.10.2.53.1	*Identify pollution sources, and develop a strategy to minimize input to stream channels*					
SONCC-SmiR.10.2.53.2	*Implement strategy to reduce pollution to meet objective*					
SONCC-SmiR.10.2.11	Water Quality	No	Reduce pollutants	Remove pollutants	Smith River Plain, South Fork, North Fork, Middle Fork, Mill and Rowdy creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-SmiR.10.2.11.1	*Locate and prioritize mine tailings and mill sites. Develop a plan for remediation*					
SONCC-SmiR.10.2.11.2	*Take necessary actions to ensure responsible parties remediate mine tailing piles, guided by the plan*					
SONCC-SmiR.10.2.51	Water Quality	No	Reduce pollutants	Remove pollutants	Population wide	2d
SONCC-SmiR.10.2.51.1	*Locate and prioritize mine tailings and mill sites. Develop a plan for remediation*					
SONCC-SmiR.10.2.51.2	*Take necessary actions to ensure responsible parties remediate mine tailing piles, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SmiR.7.1.6	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Smith River Plain, Estuary, Mainstem Smith River, tributaries, Rowdy Creek	2c
SONCC-SmiR.7.1.6.1		*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*				
SONCC-SmiR.7.1.6.2		*Thin, or release conifers, guided by the plan*				
SONCC-SmiR.7.1.6.3		*Plant conifers, guided by the plan*				
SONCC-SmiR.7.1.64	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	2d
SONCC-SmiR.7.1.64.1		*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*				
SONCC-SmiR.7.1.64.2		*Thin, or release conifers, guided by the plan*				
SONCC-SmiR.7.1.64.3		*Plant conifers, guided by the plan*				
SONCC-SmiR.1.3.39	Estuary	Yes	Increase tidal exchange of water	Remove or replace tidegates	Tillas Slough and other tide gates where coho salmon would benefit immediately	3a
SONCC-SmiR.1.3.39.1		*Inventory tidegates and develop a plan that prioritizes removal or replacement. Research possible incentive opportunities and work with landowners to replace tidegates with fish friendly versions*				
SONCC-SmiR.1.3.39.2		*Remove or replace tidegates as described in the plan*				
SONCC-SmiR.1.3.50	Estuary	Yes	Increase tidal exchange of water	Remove or replace tidegates	Population wide	3b
SONCC-SmiR.1.3.50.1		*Inventory tidegates and develop a plan that prioritizes removal or replacement. Research possible incentive opportunities and work with landowners to replace tidegates with fish friendly versions*				
SONCC-SmiR.1.3.50.2		*Remove or replace tidegates as described in the plan*				
SONCC-SmiR.5.2.38	Passage	No	Decrease mortality	Screen all diversions	All streams where coho salmon would benefit immediately	3b
SONCC-SmiR.5.2.38.1		*Assess diversions and develop a screening program*				
SONCC-SmiR.5.2.38.2		*Screen all diversions*				
SONCC-SmiR.5.2.63	Passage	No	Decrease mortality	Screen all diversions	Population wide	3d
SONCC-SmiR.5.2.63.1		*Assess diversions and develop a screening program*				
SONCC-SmiR.5.2.63.2		*Screen all diversions*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SmiR.5.1.40	Passage	No	Improve access	Remove barriers	Ritmer Creek (Ocean View Drive), unnamed tributaries to Smith at Fred Haight and Neighbors Road	3b
SONCC-SmiR.5.1.40.1		*Assess and prioritize barriers using the plan developed by the Smith River Recovery Planning Group*				
SONCC-SmiR.5.1.40.2		*Remove barriers, guided by the plan*				
SONCC-SmiR.3.1.17	Hydrology	No	Improve flow timing or volume	Increase instream flows	East Fork of Mill Creek, Smith River watershed, Lake Earl watershed, Smith River Plain, and all areas where coho salmon would benefit immediately	3b
SONCC-SmiR.3.1.17.1		*Evaluate diversions and water use. Develop a plan to reduce diversions*				
SONCC-SmiR.3.1.17.2		*Reduce diversions, guided by the plan*				
SONCC-SmiR.3.1.60	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-SmiR.3.1.60.1		*Evaluate diversions and water use. Develop a plan to reduce diversions*				
SONCC-SmiR.3.1.60.2		*Reduce diversions, guided by the plan*				
SONCC-SmiR.7.1.7	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Lower tributaries, Smith River Plain, and all areas where coho salmon would benefit immediately	3b
SONCC-SmiR.7.1.7.1		*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*				
SONCC-SmiR.7.1.7.2		*Develop grazing management plans to improve water quality and coho salmon habitat*				
SONCC-SmiR.7.1.7.3		*Plant vegetation to stabilize stream bank*				
SONCC-SmiR.7.1.7.4		*Fence livestock out of riparian zones*				
SONCC-SmiR.7.1.7.5		*Remove instream livestock watering sources*				
SONCC-SmiR.7.1.65	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-SmiR.7.1.65.1		*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*				
SONCC-SmiR.7.1.65.2		*Develop grazing management plans to improve water quality and coho salmon habitat*				
SONCC-SmiR.7.1.65.3		*Plant vegetation to stabilize stream bank*				
SONCC-SmiR.7.1.65.4		*Fence livestock out of riparian zones*				
SONCC-SmiR.7.1.65.5		*Remove instream livestock watering sources*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.8.1.15	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Smith River Plain, South Fork, North Fork, Middle Fork, Mill and Rowdy creeks; Mill Creek Road, and all areas where coho salmon would benefit immediately	3b
SONCC-SmiR.8.1.15.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-SmiR.8.1.15.2	*Decommission roads, guided by assessment*					
SONCC-SmiR.8.1.15.3	*Upgrade roads, guided by assessment*					
SONCC-SmiR.8.1.15.4	*Maintain roads, guided by assessment*					
SONCC-SmiR.8.1.67	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-SmiR.8.1.67.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-SmiR.8.1.67.2	*Decommission roads, guided by assessment*					
SONCC-SmiR.8.1.67.3	*Upgrade roads, guided by assessment*					
SONCC-SmiR.8.1.67.4	*Maintain roads, guided by assessment*					
SONCC-SmiR.10.2.37	Water Quality	No	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	3b
SONCC-SmiR.10.2.37.1	*Develop a pesticide management plan*					
SONCC-SmiR.10.2.37.2	*Implement pesticide management plan and technical assistance program*					
SONCC-SmiR.10.2.52	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-SmiR.10.2.52.1	*Develop a pesticide management plan*					
SONCC-SmiR.10.2.52.2	*Implement pesticide management plan and technical assistance program*					
SONCC-SmiR.10.7.48	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-SmiR.10.7.48.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-SmiR.10.7.48.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-SmiR.10.7.54	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-SmiR.10.7.54.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-SmiR.10.7.54.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SmiR.1.2.32	Estuary	Yes	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	3d
SONCC-SmiR.1.2.32.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-SmiR.1.2.32.2	*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*					
SONCC-SmiR.1.2.32.3	*Restore estuary and tidal wetland habitat guided by the plan*					
SONCC-SmiR.16.2.23	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SmiR.16.2.23.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-SmiR.16.2.23.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-SmiR.16.2.24	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SmiR.16.2.24.1	*Determine actual impacts of scientific collection*					
SONCC-SmiR.16.2.24.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-SmiR.17.2.20	Hatcheries	No	Reduce adverse hatchery impacts	Identify and reduce impacts of hatchery on SONCC coho salmon	Rowdy Creek Hatchery	3d
SONCC-SmiR.17.2.20.1	*Develop Hatchery and Genetic Management Plan*					
SONCC-SmiR.17.2.20.2	*Implement Hatchery and Genetic Management Plan*					
SONCC-SmiR.8.1.16	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-SmiR.8.1.16.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-SmiR.8.1.16.2	*Stabilize landslides with appropriate treatments, guided by the plan*					

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16. Elk Creek Population

Central Coastal Diversity Stratum

Dependent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

8.26 mi^2 watershed (0% Federal ownership)

17 IP-km (11 IP-mi) (88% High)

Dominant Land Use is Urban and Residential Development

Key Limiting Stresses are 'Degraded Riparian Forest Conditions' and 'Lack of Floodplain and Channel Structure'

Key Limiting Threats are 'Channelization and Diking' and 'Urban/Residential/Industrial Development'

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, and other instream structure • Re-connect channel to existing off-channel ponds, wetlands, and side channels • Remove invasive riparian species	• Re-vegetate riparian areas with native species • Restore a natural hydrograph • Improve water retention by maintaining open spaces and reducing impervious surfaces

16.1 History of Habitat and Land Use

Over the past century, alterations from timber harvest, grazing, and urban, residential, and industrial development have diminished Elk Creek's original stream functions, and reduced the quality of habitat for coho salmon. Intensive timber harvest began in the early 1900s and continued into the 1950s. Although much of the valley was harvested during this time, intact stands of old-growth redwood remain in the hills of the upper basin. These stands are now within Jedediah Smith Redwoods State Park. Timber harvest in the basin likely affected salmonids by destabilizing stream banks, increasing sediment inputs to stream habitat, and increasing water temperatures. These adverse impacts have decreased over time as vegetation has become reestablished in riparian areas. Remnant millponds in the lower basin may also impact aquatic habitat by contaminating water quality; however, their connectivity to Elk Creek, and their contaminant load, is unknown (Burgess 2008). Soil at a mill superfund site in the Crescent City area has been contaminated by numerous chemicals (US Environmental Protection Agency (USEPA) 2008). Although no information on water quality is available for Elk Creek at this time, Elk Creek may be similarly affected.

Historically, most of the land within the population area was used for agriculture and dairy farming, but this has transitioned over time to livestock ranching and hay production within a few large tracts of private land. Remnant stream diversions and dams exist in several locations, but the current connectivity of these structures to Elk Creek is unknown.

Stock watering is accomplished by the pumping of ground water or by diverting water from creeks (Burgess 2008). Land designated for grass and hay cropland is cultivated and mowed seasonally to provide forage for livestock.

Urban, residential, and industrial development within the Elk Valley has had a major impact on aquatic habitat. The growth of Crescent City since the early twentieth century has resulted in approximately 40 percent of the basin being developed (Mintier & Associates et al. 2001). Land use development is confined primarily to Crescent City and to a portion of Del Norte County lands. The greatest degree of habitat alteration from development has occurred in the lower valley. Most of the coastal wetlands and estuarine rearing habitat that might have existed in the lower basin at one time has been dredged, channelized, and/or filled, and the stream in this area is channelized underground through a 500 ft. long box culvert under Highway 101.

The types of activities associated with development that affect salmon and salmon habitat include construction of impervious surfaces, removal of riparian vegetation, the building of roads and road-stream crossings, and diking, dredging, and filling of wetland and floodplain areas. Potential threats to water quality have also arisen from urban runoff and roadway pollutants. The North Coast Regional Water Quality Control Board (NCRWQCB) has identified residential sewage systems as a potential water quality concern in the Elk Creek basin (Mintier & Associates et al. 2001).

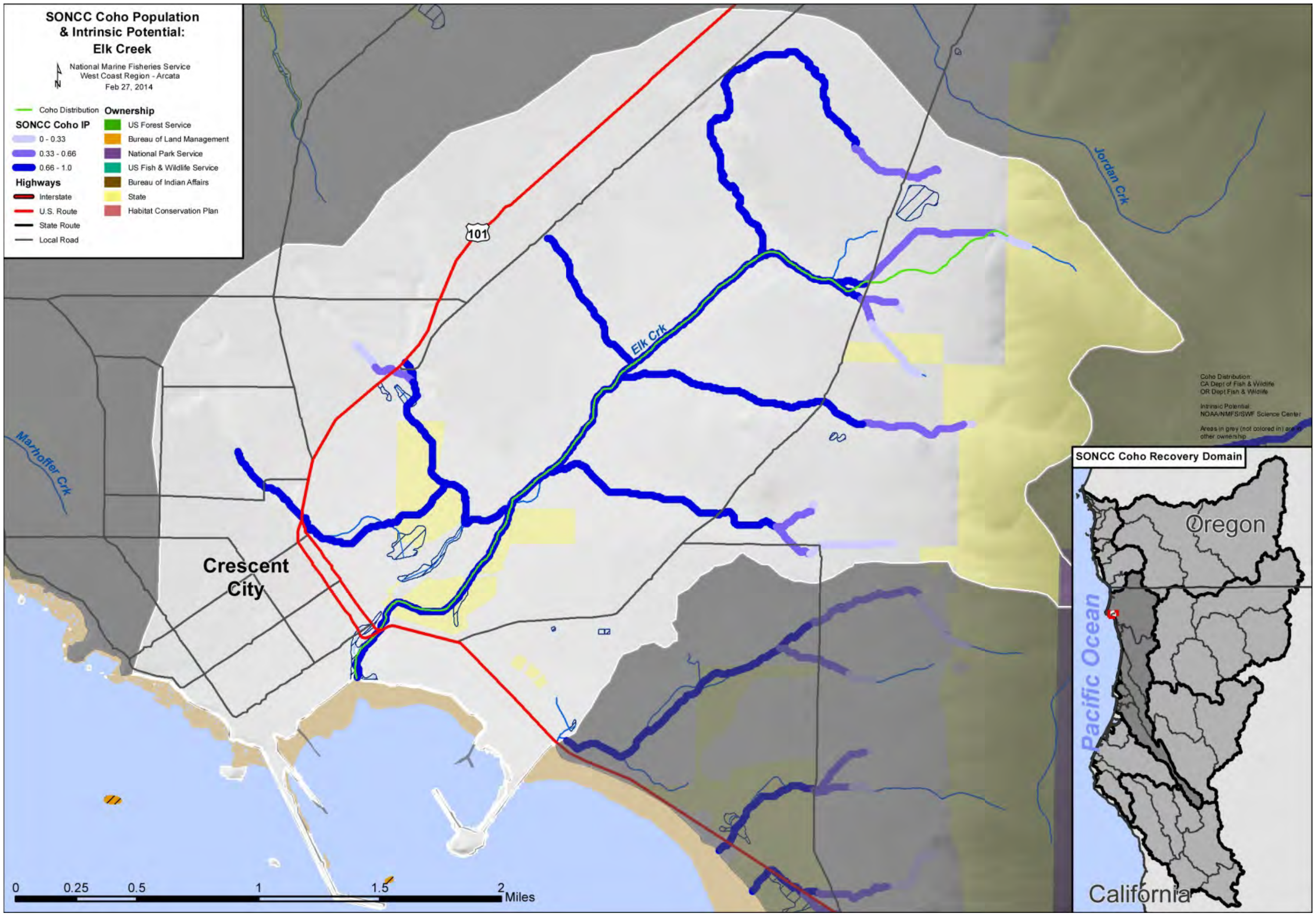

Figure 16-1. The geographic boundaries of the Elk Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

A small portion of the basin has been protected for natural resource value through various measures. These measures include a zoned Habitat Conservation Area by Del Norte County throughout the Elk Valley, the Jedediah Smith Redwoods State Park in the uppermost part of the basin, and the CDFW's Elk Creek Wetlands Wildlife Area just south-east of Crescent City. Management and regulations in place within these areas provide benefits to aquatic habitat although the degrees of protection vary by ownership.

16.2 Historic Fish Distribution and Abundance

Although little is known about coho salmon use of Elk Creek, the IP model indicates that much of the area has the potential to support juveniles (Figure 16-1). Areas of high IP value (IP>0.66) are spread throughout the entire basin and into all major tributaries entering Elk Creek. In general, the Elk Valley appears to have very good potential for rearing habitat.

The abundance and distribution of coho salmon in the Elk Creek basin is not well studied or documented; however, longtime residents of the basin have commented that both the size and the number of salmonids observed have declined in recent decades (RNSP 2005). There are no historical records of adult coho salmon runs in the basin and only a few small-scale surveys for juvenile coho salmon have been conducted over the past two decades. The oldest known survey data, taken in the late 1980s by CDFG, confirm the presence of juvenile, young-of-the-year (YOY) coho salmon in Elk Creek (Garwood et al. 2012). California Department of Fish and Wildlife conducted juvenile surveys between 2000 and 2003 which indicated that coho salmon primarily utilize the eastern portion of the basin and may be concentrated in the Nune's Creek drainage area east of Elk Valley Road (Garwood et al. 2012). These surveys demonstrated the presence of YOY every year in the lower part of Nune's Creek near the Elk Valley Road crossing with an average of 32 juveniles observed per year. Age-1+ juveniles were observed only one year (2001) during the 2000–2003 sampling effort. One age-1+ fish was also found lower in the system in the mainstem Elk Creek in 2000 (Garwood et al. 2012).

Coho salmon have been found up to about 4 miles from the mouth of Elk Creek. Urban and industrial development in the western and southern portion of the basin may have affected the distribution of coho salmon in these areas. Little information is available about many of the creeks in the basin, but many have been highly degraded and may be accessible only at certain times of the year.

Table 16-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Subarea	**Stream Name**
Smith River Plain	Elk Creek[1] (all tributaries)

[1]Denotes a "Key Stream" as identified in the State of California's Coho Salmon Recovery Strategy

16.3 Status of Elk Creek Coho Salmon

Spatial Structure and Diversity

In assessing the viability of the Elk Creek population, the spatial structure criterion arises as a key concern. The geographic size of the Elk Creek population, occupying a single small coastal basin approximately 21.4 square km, makes it naturally vulnerable to extinction risk. Although historically coho salmon may have used tributaries throughout the basin at various times throughout the year, survey data indicates they may currently occupy only a few smaller tributaries. Much of the historic habitat available to coho salmon in Elk Creek has been lost to development and degradation. The available habitat for both spawning and rearing has been severely restricted and overall opportunity and capacity within the system is low under current conditions.

There is no information on specific population traits, life history characteristics, or genetic diversity of the Elk Creek population and therefore no information to assess the diversity of the population. Because of the small number of individuals, this population is expected to have a low genetic and life history diversity.

Population Size and Productivity

Based on the limited available data on the size and productivity of the Elk Creek population, this population appears to be depressed in abundance and may consist of only a handful of spawning adults each year. A spawner survey in 1999 found just one coho salmon carcass (CDFG 1999), and 16 coho salmon carcasses were found in Nune's Creek in 2005 (Burgess 2008). Considering the information available for this basin, and comparing with other coastal basins in northern California, there are probably fewer than 50 adults that comprise the Elk Creek SONCC coho salmon population (Brown et al. 1994, Weitkamp et al. 1995).

The presence of juveniles in the basin suggests suitable incubating conditions in reaches where coho salmon successfully spawn. Previous data from CDFG juvenile surveys (CDFG 2004a) indicate low number of juveniles (average 32 juveniles per year) distributed throughout a small portion of the basin (CDFG 2004a). Only a few age-1+ smolt size coho salmon have ever been found. These data indicate rearing capacity for the system may be low, or that juveniles are leaving the system earlier than expected.

With the low number of spawning adults observed in the Elk Creek population, and the relatively few smolt-size juveniles found, it is likely this basin supports a small but potentially consistent population with presumably low overall productivity. As a dependent population, abundance and productivity is highly influenced by nearby populations, which contribute spawners as strays. The Smith River population to the north and the Klamath River population to the south are both likely sources of strays to the Elk Creek population. Both these populations have been severely restricted, have low numbers of returning adults compared to historic runs, and are at moderate to high risk of extinction. The lack of productivity in these neighboring systems and the associated reduction in strays entering Elk Creek further increases this population's risk of extinction.

Extinction Risk

Not applicable because Elk Creek is not an independent population.

Role in SONCC Coho Salmon ESU Viability

The Elk Creek population is considered dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and receives sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006, Williams et al. 2008). Although dependent populations are not viable on their own, they do increase connectivity through dispersal among independent populations and provide individuals for other populations, acting as a source of colonists in some cases. By exchanging spawners, the Elk Creek population interacts with other Central Coastal populations such as the Smith River population and plays an important role in the health and status of the ESU.

16.4 Plans and Assessments

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The relevant recommendations in the CDFG Recovery Strategy for the Elk Creek population were general for the entire Smith River Plain hydrologic subarea (HSA) and did not include any specific analysis for this basin. Any relevant recommendations for the HSA have been considered and incorporated into the recovery strategy and list of recovery actions for this population.

16.5 Stresses

Table 16-2. Severity of stresses affecting each life stage of coho salmon in Elk Creek. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Degraded Riparian Forest Conditions[1]	-	High	High[1]	High	High	High
2	Lack of Floodplain and Channel Structure[1]	High	High	High[1]	High	High	High
3	Altered Sediment Supply	Medium	Medium	Medium	Medium	Medium	Medium
4	Impaired Water Quality	Low	Medium	Medium	Medium	Low	Medium
5	Altered Hydrologic Function	Low	Medium	Medium	Medium	-	Medium
6	Impaired Estuary/Mainstem Function	-	Low	Medium	Medium	Low	Medium
7	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low
8	Barriers	-	Low	Medium	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage
[2]Increased Disease/Predation/Competition is not considered a stress for this population

Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are degraded riparian forests and lack of floodplain and channel structure and the limited life stage is the juvenile. There is no current habitat information to indicate the presence of refugia areas or vital habitat areas in the Elk Creek basin.

Degraded Riparian Forest Conditions

Degraded riparian forest condition is the most significant stress affecting coho salmon recovery in Elk Creek. This factor is a high stress across all life stages, except for the egg stage, because of its impact on water temperature, sedimentation, bank stability, and stream complexity. Riparian conditions are most degraded in areas affected by development and agricultural use. Degraded conditions occur throughout the basin, but occur primarily near Crescent City and in agricultural lands in the northwestern portion of the basin. In areas where these impacts are greatest, riparian vegetation has been either completely removed or degraded to the point where it is no longer benefitting stream conditions. Stresses influencing spawning and rearing coho salmon result from loss of canopy cover and shading as well as the loss of large wood.

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure is considered a high stress to the Elk Creek population and presents a high stress to all life stages, especially in areas that have been highly altered through urbanization and channelization. In the lower part of the basin, development in and around Crescent City has resulted in simplification of tributary streams and the mainstem Elk Creek. Much of the mainstem is channelized and numerous unnatural channels exist within Elk Valley. In many areas, the creek and its tributaries are completely disconnected from the floodplain. This is the case at the mouth where the stream passes under Highway 101 and Crescent City through a 500-foot box culvert. These lower reaches would naturally exhibit complex floodplain and channel characteristics.

Altered Sediment Supply

Because Elk Creek is a low gradient coastal system, it naturally stores fine sediment in the meandering mainstem channels and wetlands. Past agriculture and current grazing in the valley along with urban and industrial development have led to increased sediment loads and unnatural storage of sediment in Elk Creek and its tributary streams. The effects have been a simplification of stream habitat by the widening and filling of channels and backwater habitats. The added sediment also reduces or eliminates macro-invertebrate habitat, thereby decreasing foraging opportunities for juveniles.

Impaired Water Quality

Stresses on coho salmon in Elk Creek from impaired water quality are considered moderate. Impairments likely arise from chemical contamination. Point source pollution from developed areas and non-point source runoff pollution from roads occurs throughout the valley. Remnant mill sites in the lower basin may also contaminate water quality. The fry, juvenile, and smolt life stages are most susceptible to the impacts of impaired water quality because juveniles inhabit the basin for extended periods of time. The extent of impaired water quality in Elk Creek is unknown at this time due to a lack of information.

Altered Hydrologic Function

Altered hydrologic function presents a moderate stress to fry and juvenile coho salmon in Elk Creek. The hydrologic regime of the creek has been altered primarily as a result of the development that has occurred in and around Crescent City. Impervious surfaces have led to decreased water storage capacity in the basin, increased frequency of flooding and peak flow volumes, and decreased base flow. Many road-stream crossings are undersized to accommodate natural flows and prevent proper flushing in the system. There are no known water withdrawals within the basin; however, it is likely there are groundwater pumps and diversions associated with the agricultural and rural development north of Crescent City. Overall, the amount of available habitat for juvenile rearing in the basin has decreased and natural biological and physical processes on which these fish depend have been altered due to hydrologic alterations in the basin.

Impaired Estuary/Mainstem Function

Little is known about the historic extent of estuarine area in Elk Creek. Currently this area is confined to six acres of tidal sand flat south of the Hwy 101 culvert. Based on the natural drainage pattern and elevations in the area, much of the historical estuarine tidal area likely has been dredged and filled to accommodate the highway and commercial/industrial development. The reduction in the amount of estuarine habitat and the loss of natural estuarine functions have likely resulted in a loss of foraging and growth opportunities for juveniles as well as the loss of transitional migratory habitat for smolts.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Barriers

Overall, barriers present a low stress to the coho salmon in Elk Creek. However, road-related barriers have been found in Nune's Creek and in two other tributaries that pass under Elk Valley Road on the eastern side of the basin (CalFish 2009). These barriers block fish access during certain flows and create unnatural sediment and debris storage.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Elk Creek population area. Hatchery-origin adults may stray into the population area; however, the proportion of adults that are of hatchery origin is unknown. Hatchery-origin coho salmon may stray into Elk Creek; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

16.6 Threats

Table 16-3. Severity of threats affecting each life stage of coho salmon in Elk Creek. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Channelization/Diking[1]	Medium	High	High[1]	High	High	High
2	Urban/Residential/Industrial Dev.[1]	Medium	High	High[1]	High	High	High
3	Agricultural Practices	Low	Medium	Medium	Medium	Medium	Medium
4	Roads	Low	Medium	Medium	Medium	Medium	Medium
5	Road-Stream Crossing Barriers	-	Medium	Medium	Medium	Medium	Medium
6	Timber Harvest	Low	Low	Low	Low	Low	Low
7	Fishing and Collecting	-	-	Low	Low	Low	Low
8	Dams/Diversion	Low	Low	Low	Low	Low	Low
9	High Severity Fire	Low	Low	Low	Low	Low	Low
10	Climate Change	Low	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and life stage
[2]Invasive Non-Native/Alien Species, and Mining/Gravel Extraction are not considered threats to this population

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are channelization/diking and urban/residential/industrial development.

Channelization/Diking

Development in the Elk Creek basin has resulted in channelization and diking of the mainstem, tributaries, and floodplain of Elk Creek. Most of the channel modification and diking has been confined to central Elk Valley and Crescent City. Remnant channelization and ponding associated with milling near the lower end of Elk Creek have altered the hydrology of the creek in the lower basin. Complex channel networks throughout the valley are likely remnants of past milling activities and agricultural practices. Given the wide floodplain in the lower basin, Highway 101 likely impinges flow and tidal inundation. Currently the creek is channelized at its mouth through a long box culvert that passes under the highway and Crescent City. The result of these alterations has been a simplification of the system and alteration of natural hydrology to the point where relatively few intact reaches remain. Development in the Crescent City area is likely to continue in the future, so channelization/diking is considered a medium threat for eggs and a high threat for all other life stages.

Urban/Residential/Industrial Development

Roughly 40 percent of the Elk Creek basin has been developed for urban, residential, and industrial use and development is likely to continue into the future. Projected annual population growth is approximately 2 percent for Crescent City, which will likely result in more urban and rural development in and around Elk Creek. Although some county zoning restrictions in the central basin limit the type and extent of development, the headwaters of many tributaries are likely to be affected by new residential and urban development. Impacts related to development include increased impervious surface area, loss of riparian vegetation, road construction, and the diking, dredging, and filling of wetland and floodplain areas. Potential threats to water quality also arise from urban runoff, roadway pollutants, and onsite sewage systems. This threat is considered medium for the egg stage and high for all other life stages due to the continuing urban, residential, and industrial use, and ongoing impacts related to development.

Agricultural Practices

Agriculture in the Elk Creek basin primarily includes cattle ranching and associated hay operations. Because agriculture is restricted to only a portion of the basin, it is only a medium threat to coho salmon in Elk Creek. The greatest threat arises from cattle that have unrestricted access to some reaches of Elk Creek. Stream banks in these reaches are mostly denuded of vegetation and bank and streambed erosion have been observed in these areas (Burgess 2008). Impacts to aquatic ecosystems include decreased bank stability, increased sediment inputs, loss of shade- and cover-providing riparian vegetation, and elevated coliform levels in water. Cattle in a live stream channel can also be a physical barrier to migrating salmonids.

Roads

Although roads occur at very high density (>3 mi./sq. mi.) within the basin, they are considered only a moderate threat because the majority are paved. The building of more unpaved roads is unlikely. Existing unpaved roads within the Elk Valley are likely the main source of sediment to Elk Creek.

Road-stream Crossing Barriers

Road-stream crossing barriers are not a significant threat to coho salmon in Elk Creek, based on the few known barriers that exist in the basin. The Five Counties Fish Passage Assessment listed several sites in Elk Creek where fish passage has been compromised by a crossing (Taylor 2001). At least one of these, on Nune's Creek, has been identified as a barrier to juvenile and adult fish passage at certain flows. Other culverts in this drainage likely store fine sediment and create unnatural pooling (NMFS 2005). Several other partial barriers and undersized culverts have been found in tributaries to Elk Creek (See Table 16-4). Given the amount of development and the density of roads in the basin, there are likely many more barriers yet to be identified.

Table 16-4. List of known road barriers in the Elk Creek basin. Length of anadromous habitat was estimated based on IP maps and prioritization (Taylor 2001).

Priority	Stream Name	Road Name	Miles of upstream habitat
1	Nune's Creek #1	Elk Valley Rd.	0.5 miles
2	Elk Creek Tributary	Elk Valley Rd.	0.5 miles
3	Nune's Creek #2	Elk Valley Rd.	0.5 miles
4	Elk Creek Tributary	Elk View Rd	1.5 miles

Timber Harvest

Historically, much of the basin was used for timber harvest; however, harvest is currently limited to small-scale harvest on private lands. Most harvestable tracts are less than 100 acres. More land throughout the valley could be used for timber harvest and therefore, timber harvest is considered to be a low threat.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Dams/Diversions

Although diversions and dams are known to exist in the basin, these structures are isolated, no longer used, and do not limit fish passage.

High Severity Fire

The threat of high severity fire is low because much of the basin is un-forested, fuel loading is low, and climatic conditions do not favor frequent or high-intensity fires in the coastal zone.

Climate Change

Climate change poses a low threat to this population due to its cooler climate, and low risk of temperature increase and precipitation change over the next 50 years (see Appendix B for modeling methods). Overall, the range and degree of variability in temperature and precipitation are likely to increase in all populations. Adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Elk Creek population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

16.7 Recovery Strategy

The Elk Creek basin has a large amount of high IP habitat for its small size. The recovery criterion for this population is that 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival. Although much of the basin has been developed, numerous opportunities exist to help restore coho salmon in the basin. Coho salmon are known to use much of the available habitat in the basin, but in some areas this habitat has been severely degraded. In order to help increase the size, health, and distribution of the population, actions should focus on increasing the quality and quantity of habitat available. By addressing the major threat to the population - urban, residential, and industrial development in and around Crescent City - many of the major stresses affecting coho salmon will be abated. Improving the condition of riparian areas is the most important step in the recovery of the population, but other important actions include reducing sediment loading, increasing floodplain and channel complexity, improving water quality, restoring hydrologic function, and improving fish passage. Additionally, measures to restrict or control development and to protect habitat and habitat functions are necessary to prevent further degradation. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 16-5 on the following page lists the recovery actions for the Elk Creek population.

Table 16-5. Recovery action implementation schedule for the Elk Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkC.7.1.15	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Remove invasive species	Crescent City, Upper Elk Valley, Eastern Tributaries, and all streams where coho salmon would benefit immediately	2b
SONCC-ElkC.7.1.15.1	*Remove invasive species which are inhibiting establishment of native riparian vegetation*					
SONCC-ElkC.7.1.35	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Remove invasive species	Population wide	2c
SONCC-ElkC.7.1.35.1	*Remove invasive species which are inhibiting establishment of native riparian vegetation*					
SONCC-ElkC.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2b
SONCC-ElkC.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-ElkC.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-ElkC.2.1.31	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2c
SONCC-ElkC.2.1.31.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-ElkC.2.1.31.2	*Place instream structures, guided by assessment results*					
SONCC-ElkC.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Central Elk Valley and tributaries in Crescent City, and all streams where coho salmon would benefit immediately	2b
SONCC-ElkC.2.2.3.1	*Develop plan to reconnect priority channelized stream reaches to historic side channels and wetlands*					
SONCC-ElkC.2.2.3.2	*Reconnect historic side channels and wetlands, guided by the plan*					
SONCC-ElkC.2.2.32	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Population wide	2c
SONCC-ElkC.2.2.32.1	*Develop plan to reconnect priority channelized stream reaches to historic side channels and wetlands*					
SONCC-ElkC.2.2.32.2	*Reconnect historic side channels and wetlands, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ElkC.7.1.16	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Revegetate riparian areas	Crescent City, Upper Elk Valley, eastern tributaries	2c
SONCC-ElkC.7.1.16.1		*Develop a riparian management plan with landowners that establishes riparian buffers on their property through planting, invasive species removal, or protection measures*				
SONCC-ElkC.7.1.16.2		*Implement the riparian management plan*				
SONCC-ElkC.7.1.17	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Crescent City, Upper Elk Valley, eastern tributaries	3b
SONCC-ElkC.7.1.17.1		*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*				
SONCC-ElkC.7.1.17.2		*Develop watershed-specific guidance for managing riparian vegetation*				
SONCC-ElkC.5.1.20	Passage	No	Improve access	Reduce flow barrier	Elk Valley Road, Nune's Creek	3b
SONCC-ElkC.5.1.20.1		*Inventory, describe, and map migration and flow barriers and develop a plan to restore passage*				
SONCC-ElkC.5.1.20.2		*Restore passage, guided by plan*				
SONCC-ElkC.5.1.21	Passage	No	Improve access	Remove structural barrier	Elk Valley Road, Nune's Creek, and all streams where coho salmon would benefit immediately	3b
SONCC-ElkC.5.1.21.1		*Upgrade culverts to accommodate fish passage at all life stages*				
SONCC-ElkC.5.1.34	Passage	No	Improve access	Remove structural barrier	Population wide	3d
SONCC-ElkC.5.1.34.1		*Upgrade culverts to accommodate fish passage at all life stages*				
SONCC-ElkC.3.1.4	Hydrology	No	Improve flow timing or volume	Restore hydrograph	Central Elk Valley and Crescent City	3b
SONCC-ElkC.3.1.4.1		*Complete comprehensive flow study to determine the natural flow regime through Elk Valley*				
SONCC-ElkC.3.1.4.2		*Disconnect unnatural channels and ditches that cannot support spawning or rearing*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkC.3.2.9	Hydrology	No	Increase water storage	Improve water retention	Central Elk Valley and Crescent City, and all streams where coho salmon would benefit immediately	3b
SONCC-ElkC.3.2.9.1	*Using regulatory mechanisms, maintain open space lands (e.g., agriculture, forestland) for water retention and limit addition of impervious surfaces in the watershed*					
SONCC-ElkC.3.2.9.2	*Using regulatory mechanisms, manage runoff from impervious surfaces in such a way that it does not negatively impact hydrologic function*					
SONCC-ElkC.3.2.33	Hydrology	No	Increase water storage	Improve water retention	Population wide	3c
SONCC-ElkC.3.2.33.1	*Using regulatory mechanisms, maintain open space lands (e.g., agriculture, forestland) for water retention and limit addition of impervious surfaces in the watershed*					
SONCC-ElkC.3.2.33.2	*Using regulatory mechanisms, manage runoff from impervious surfaces in such a way that it does not negatively impact hydrologic function*					
SONCC-ElkC.8.1.12	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	3c
SONCC-ElkC.8.1.12.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-ElkC.8.1.12.2	*Decommission roads, guided by assessment*					
SONCC-ElkC.8.1.12.3	*Upgrade roads, guided by assessment*					
SONCC-ElkC.8.1.12.4	*Maintain roads, guided by assessment*					
SONCC-ElkC.8.1.36	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-ElkC.8.1.36.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-ElkC.8.1.36.2	*Decommission roads, guided by assessment*					
SONCC-ElkC.8.1.36.3	*Upgrade roads, guided by assessment*					
SONCC-ElkC.8.1.36.4	*Maintain roads, guided by assessment*					
SONCC-ElkC.10.2.18	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Central Elk Valley and Crescent City, and all areas where coho salmon would benefit immediately	3c
SONCC-ElkC.10.2.18.1	*Identify point and nonpoint pollution sources throughout the watershed, especially those sites known to have been associated with past milling operations (e.g. Lower Elk Valley ponds)*					
SONCC-ElkC.10.2.18.2	*Implement strategy to minimize pollution such as hydrologically disconnect contaminated sites from Elk Creek (esp. contaminated mill sites)*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkC.10.2.29	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	3d
SONCC-ElkC.10.2.29.1	*Identify point and nonpoint pollution sources throughout the watershed, especially those sites known to have been associated with past milling operations (e.g. Lower Elk Valley ponds)*					
SONCC-ElkC.10.2.29.2	*Implement strategy to minimize pollution such as hydrologically disconnect contaminated sites from Elk Creek (esp. contaminated mill sites)*					
SONCC-ElkC.10.7.28	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-ElkC.10.7.28.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-ElkC.10.7.28.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-ElkC.10.7.30	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-ElkC.10.7.30.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-ElkC.10.7.30.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-ElkC.7.1.14	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Upper Elk Valley	BR
SONCC-ElkC.7.1.14.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-ElkC.7.1.14.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-ElkC.7.1.14.3	*Plant vegetation to stabilize stream bank*					
SONCC-ElkC.7.1.14.4	*Fence livestock out of riparian zones*					
SONCC-ElkC.7.1.14.5	*Remove instream livestock watering sources*					
SONCC-ElkC.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Elk Valley	BR
SONCC-ElkC.2.2.2.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-ElkC.2.2.2.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-ElkC.2.2.2.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-ElkC.1.2.10	Estuary	No	Improve estuarine habitat	Restore estuarine habitat	Estuary, downstream of Highway 101	BR
SONCC-ElkC.1.2.10.1	*Develop a plan to restore historic tidal channels and wetlands*					
SONCC-ElkC.1.2.10.2	*Restore tidal wetlands and tidal channels in historic estuary, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ElkC.3.1.5	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-ElkC.3.1.5.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-ElkC.3.1.6	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	BR
SONCC-ElkC.3.1.6.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-ElkC.3.1.6.2	*Implement water dedications to increase instream flows using the streamlined process*					
SONCC-ElkC.3.1.7	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	BR
SONCC-ElkC.3.1.7.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-ElkC.3.1.8	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	BR
SONCC-ElkC.3.1.8.1	*Establish a comprehensive groundwater permit process*					
SONCC-ElkC.2.2.27	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	BR
SONCC-ElkC.2.2.27.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-ElkC.8.1.11	Sediment	No	Reduce delivery of sediment to streams	Improve land management practices	Central and Upper Elk Valley	BR
SONCC-ElkC.8.1.11.1	*Develop an educational program that shares BMPs for major land practices (e.g. timber harvest agriculture, water treatment, grazing, private roads)*					
SONCC-ElkC.10.2.19	Water Quality	No	Reduce pollutants	Educate stakeholders	Central Elk Valley and Crescent City	BR
SONCC-ElkC.10.2.19.1	*Reduce or minimize both domestic and municipal sources of nutrient input (i.e., sewage treatment plant discharge and storm drain runoff). Support efforts by cities and rural communities to complete system upgrades to achieve CWA compliance*					

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17. Wilson Creek Population

Central Coastal Diversity Stratum

Dependent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

26.5 mi^2 watershed (11% Federal ownership)

19 IP-km (12 IP-mi) (54% High)

Dominant Land Uses are Timber Harvest and Recreation

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Degraded Riparian Forest Conditions'

Key Limiting Threats are 'Roads' and 'Timber Harvest'

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, and other instream structure • Increase conifer riparian vegetation • Remove structural barriers	• Reduce road-stream hydrologic connection • Increase beaver abundance • Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows

17.1 History of Habitat and Land Use

Historically, timber harvest dominated the land use in the population area, and continues in many areas today. Lasting impacts to instream habitat from historic timber harvest operations include increased sedimentation and erosion from unpaved roads and road crossings, decreased large wood recruitment, and decreased channel complexity. Currently 75 percent of land in the watershed is used for timber production while the remaining 25 percent is the Del Norte Coast Redwoods State Park and Redwood National Park (Pacific Watershed Associates (PWA) 2004). In the early 1900s, California established Del Norte Coast Redwoods State Park, which has numerous intact old-growth stands, while the federal government has managed Redwood National Park, which includes some previously harvested lands, for conservation goals since 1968. In 1994, the State of California and the National Park Service agreed to manage the parks jointly. Highway 101, built in 1926, continues to impair estuarine function of some streams and is a barrier to fish passage on at least one stream. While in a relatively rural area, there has been residential and industrial development in and around the Wilson Creek population area. In the streams immediately south of Crescent City, rural development and roads impact coho salmon habitat through alterations to fish passage and stream function. More recently, the housing developments in the northern part of the population area have encroached on these small coastal creeks.

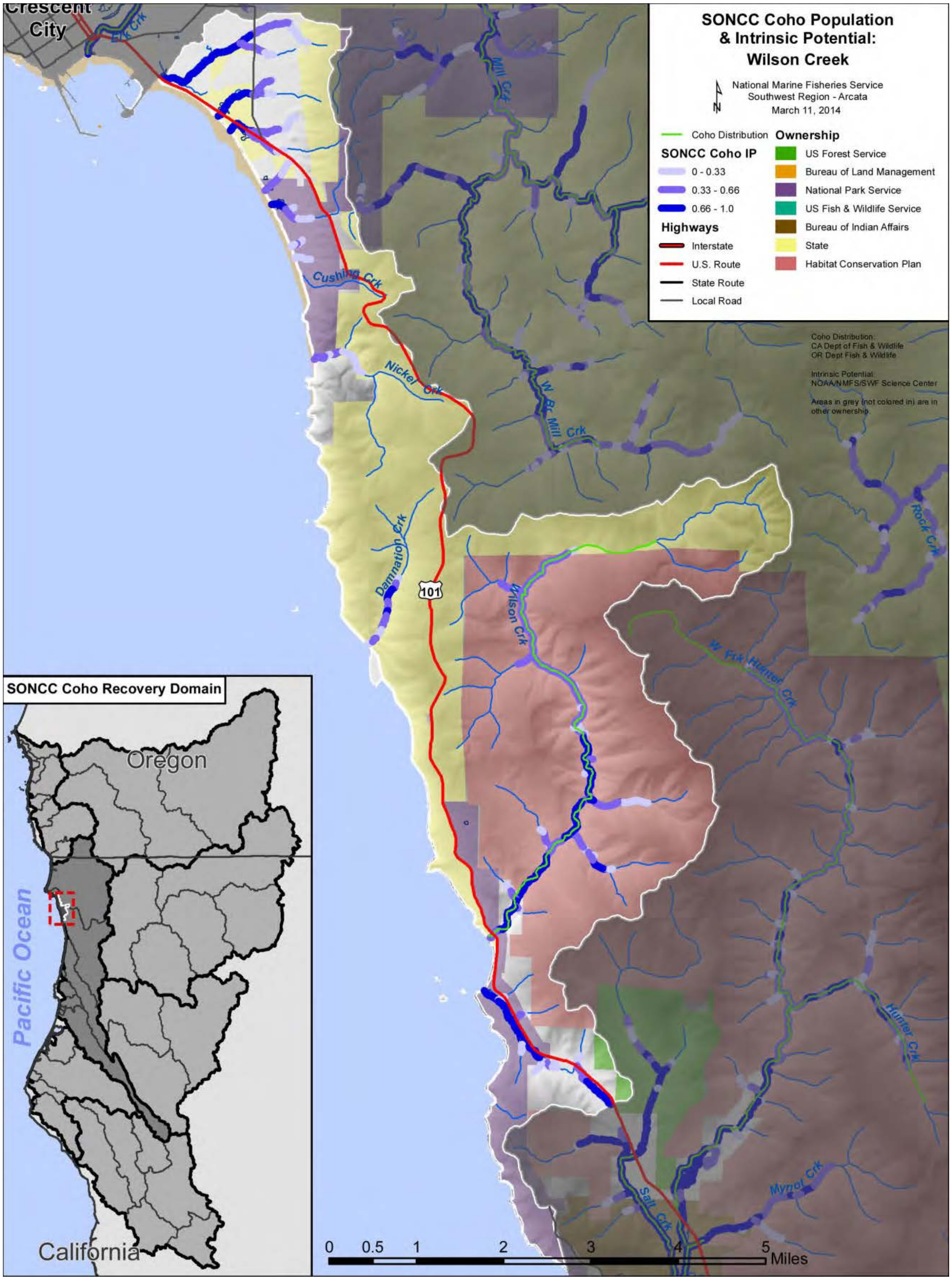

Figure 17-1. The geographic boundaries of the Wilson Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

17.2 Historic Fish Distribution and Abundance

The Wilson Creek population area is comprised of Wilson Creek as well as several smaller creeks along the coast north and south of Wilson Creek. The population area includes seven small creeks just south of Crescent City, which are currently unnamed, as well as Cushing Creek, Nickel Creek, Damnation Creek, Wilson Creek, and Lagoon Creek. Each of these creeks contributes to the persistence and continued survival of the Wilson Creek population of coho salmon. Aside from a small subset of historical data on juvenile abundance in Wilson Creek, no long-term data exist on coho salmon characteristics in the Wilson Creek population area. Fish rescue data taken between 1939 and 1952 ranged from 41,507 juveniles in 1940 to 1,957 juveniles in 1952 (Brown and Moyle 1991) and suggest highly variable, but at times substantial, numbers of juvenile coho salmon occupying the Wilson Creek drainage. Redwood National Park conducted presence-absence salmonid surveys in three Wilson Creek drainages in 2006 and 2011: Nickel Creek, and lower Cushing and Damnation Creeks; no SONCC coho were detected. The lower four miles of the creek has high intrinsic potential (IP > 0.66). Other creeks in the area also exhibit high IP values for coho salmon including Nickel Creek, Cushing Creek, Lagoon Creek and several unnamed, small coastal streams south of Crescent City. The highest potential is primarily restricted to the coastal bottomlands of these streams. Many of these streams may have supported coho salmon in the past and likely provided habitat for occasional strays and juveniles in years with abundant returns. Wilson Creek is probably the only creek in the population area to have independently supported large coho salmon runs in the past.

Table 17-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Subarea	Stream Name	Stream Name
Wilson Creek	Cushing Creek	Unnamed coastal creeks approximately 2 miles south of Crescent City
	Damnation Creek	
	Lagoon Creek	
	Wilson Creek[1]	
[1]Denotes a "Key Stream" as identified in the State of California's Coho Salmon Recovery Strategy		

17.3 Status of Wilson Creek Coho Salmon

Spatial Structure and Diversity

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access have diverged from historical conditions, the greater the extinction risk. The geographic extent of this population, which occupies an area less than 30 square miles, and encompasses only a few small coastal watersheds, make it naturally isolated. Although the availability of suitable, high IP habitat suggests that historically coho may have occupied streams throughout the population area, recent surveys suggest their current distribution is limited to the Wilson Creek drainage.

Many of the creeks within the population area have never been surveyed for fish presence or habitat condition, and only Wilson Creek has been thoroughly surveyed for coho salmon. Survey data is lacking for determining the presence and distribution of juveniles in the additional drainages in the basin, but the presence of high IP habitat suggests these areas could potentially support coho salmon. Redwood National Park conducted a juvenile coho survey in Damnation Creek in 2011, and determined coho salmon are present (RNP 2013). The unnamed creeks just south of Crescent City have the highest potential for having had historic runs and supporting current runs, but current presence/absence data does not exist. A very limited amount of habitat and/or fisheries data is available for Lagoon Creek, Nickel Creek, and Cushing Creek, and none confirm the presence of coho salmon in these small watersheds. The presence of steelhead in Nickel Creek, however, suggests current habitat conditions may be suitable for coho salmon.

Within Wilson Creek, natural fish passage barriers and stream conditions restrict the availability of summer rearing habitat. Known rearing habitat is found in most of the area upstream of the Redwood National and State Parks boundary (below which the stream is intermittent in summer) and downstream of the Green Diamond Resource Company (GDRC) property line (above which a natural waterfall exists). This reach is approximately 5 miles long with four major tributaries. High IP values in this reach exist in the first 2.5 miles upstream of the park boundary. Survey data indicates the presence of coho salmon juveniles although no documented spawning by coho salmon occurs in the area. While other high IP areas exist in the Wilson Creek basin, it is likely that these areas are degraded by historic and current land use activities such as timber harvest, road building, and development. Salmon spawn in only 2.5 km of the historic 18.8 kilometers of habitat (13 percent), indicating a severe restriction in distribution and spatial structure.

Population Size and Productivity

Data suggest the size of the Wilson Creek population is highly variable and the population is dependent on production from other populations. Williams et al. (2008) characterized the population as dependent because of its low productive potential and high degree of outside influence. NMFS is aware of only one coho spawning survey for the population, conducted in Wilson Creek, which documented only one redd. However, the presence of juvenile coho salmon (GDRC 2009) and use of Wilson Creek by other salmonid species for spawning confirms the presence of suitable spawning conditions (GDRC 2006). In small spawning populations, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may become too great. This situation accelerates a decline toward extinction.

It is likely that much of the production that occurs in this population is in Wilson Creek, where coho salmon juveniles consistently occur. The number of juveniles has varied widely as indicated by Green Diamond summer surveys between 1995 and 2010. The estimated population was almost 1,400 in 1995, fell to fewer than 50 by 1999 and 2000, fluctuated between about 500 to 11,000 juveniles from 2001 to 2008, was 0 in 2009, and then rose to 1843 in 2010 (GDRC 2011a). Prior to this sampling effort, CDFG observed only two outmigrating coho smolts leaving the system in 1987, and concluded the low recruitment was due to low young-of-the-year (YOY) survival and an overall lack of suitable rearing habitat. Coho salmon presence was detected for 13 of 16 brood years sampled in the years 1983 to 2002 (Garwood et al. 2012). Despite the fairly consistent presence of coho salmon in the Wilson Creek population, the low abundance of spawners and the highly variable population numbers indicate low population size and poor productivity.

Extinction Risk

Not applicable because Wilson Creek is not an independent population.

Role in SONCC Coho Salmon ESU Viability

The Wilson Creek population is dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and likely received sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006). Although such populations may not be fully viable on their own, they do increase connectivity by allowing dispersal among independent populations, acting as a source of colonists in some cases. Historically, the Wilson Creek population would have interacted with other potentially independent populations, such as the Smith River to the north or the Lower Klamath River to the south, as well as the dependent Elk Creek population to the north. Any restored habitat in Wilson Creek provides potential connectivity and increased resiliency in the SONCC coho salmon ESU.

17.4 Plans and Assessments

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The California Fish and Game Commission adopted the Recovery Strategy for California Coho Salmon in February 2004. The CDFG Recovery Strategy for the Wilson Creek population includes recommendations for the Wilson Creek hydrologic subarea (HSA) but not for the other watersheds in the population area. The recommendations developed by CDFG for all SONCC coho salmon populations have been considered and incorporated into the recovery strategy and list of recovery actions where appropriate.

Wilson Creek Watershed Assessment and Erosion Prevention Planning Project

This CDFG-funded project (PWA 2004) identified current and future sources of sediment from roads within the Wilson Creek watershed. This work included a) an analysis of historic photos to determine road construction history; b) an inventory of current and future road-related sediment sources for 109 miles of timber management roads; and c) a prioritized plan for cost-effective erosion control and erosion prevention treatments for the Wilson Creek basin. The analysis identified 520 sites with the potential to deliver sediment to streams and prioritized the areas for treatment before they deliver sediment to Wilson Creek and its tributaries.

Redwood National and State Parks

Fish Distribution and Status Survey

In 2006, the RNSP surveyed seven watersheds within the park to determine the distribution and status of threatened and non-listed salmonid species. Included in this survey was an assessment of the lower 135 meters of Nickel Creek.

Green Diamond Resource Company (GDRC)

Green Diamond Habitat Conservation Plan (HCP)

The GDRC HCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in the Wilson Creek watershed. The plan has a number of provisions designed to protect coho salmon and salmon habitat on GDRC lands in the Wilson Creek watershed. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC's activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of aquatic species. Elements of the HCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. More information about the GDRC HCP can be found in Section 3.2.5.

17.5 Stresses

Table 17-2. Severity of stresses affecting each life stage of coho salmon in the Wilson Creek population. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	High	High	Very High[1]	High	High	Very High
2	Degraded Riparian Forest Conditions[1]	-	High	High[1]	High	High	High
3	Altered Sediment Supply	High	High	High	Medium	Medium	High
4	Altered Hydrologic Function	Medium	Medium	Medium	Medium	Low	Medium
5	Impaired Estuary/Mainstem Function	-	Low	Medium	Medium	Medium	Medium
6	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low
7	Impaired Water Quality	Low	Low	Low	Low	Low	Low
8	Barriers	-	Low	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.
[2] Increased Disease/Predation/Competition is not considered a stress for this population.

Key Limiting Stresses, Life Stages, and Habitat

Lack of floodplain and channel structure and degraded riparian conditions are the key limiting stresses for the Wilson Creek coho salmon population. These stresses are likely limiting juveniles by causing decreases in rearing habitat, large wood, simplifying instream habitat, and causing the disconnection of refugia for winter and summer rearing habitat. Additionally, these stresses affect adult coho salmon by decreasing available spawning habitat in high IP streams and tributaries.

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure and associated decreases in rearing habitat pose a high or very high stress to coho salmon across all life history stages. Alterations to instream habitat have led to a significant decrease in the quality and quantity of rearing habitat, which consequently reduces juvenile coho survival and viability in the Wilson Creek population area. Sedimentation from current and historic timber harvest, road building, and development has led to the filling, widening and simplification of stream channels, disconnection of floodplains and other off channel areas, and the loss of pool habitat. These changes have also affected flow regime, the availability and quality of spawning habitat, and bedload movement throughout the basin.

The amount of in-channel large wood is likely substantially lower than historical conditions. There have been two habitat surveys in the Wilson Creek watershed, one in 1994 (GDRC 2006) and another in 2005 (GDRC 2011b). The total number of pieces of large wood in the active channel increased from 2.1 per 100 feet to 2.9 per 100 feet, with most of the change due to an increase in the number of pieces in the smallest size category (6-20 feet long and 1-1.9 feet in diameter). This increase is likely due to the placement of large wood structures in Wilson Creek over the past 10 years. The amount of large wood in Wilson Creek is lower than in most other inventoried streams on Green Diamond land (GDRC 2006), well below levels required for healthy stream function, and the small size of this wood (less than 2 foot diameter) reflects the alder-dominant riparian zones prevalent in the watershed. The lack of large diameter wood results in decreased amounts of in channel shelter and decreases the formation of pools and other refugia vital to juvenile survival (CH2MHILL 2006). Percent pools by length remained static between the 1994 and 2005 surveys at 28-29 percent, while the proportion of pools greater than 3ft deep by occurrence decreased from 55 percent to 48 percent.

Channels predicted to be moderate IP habitat in some small unnamed streams in the lowlands of the northern portion of the population area appear to have been filled in to accommodate agriculture and residential development, because they currently lack defined stream channels but there is riparian vegetation present upstream (Figure 17-2).

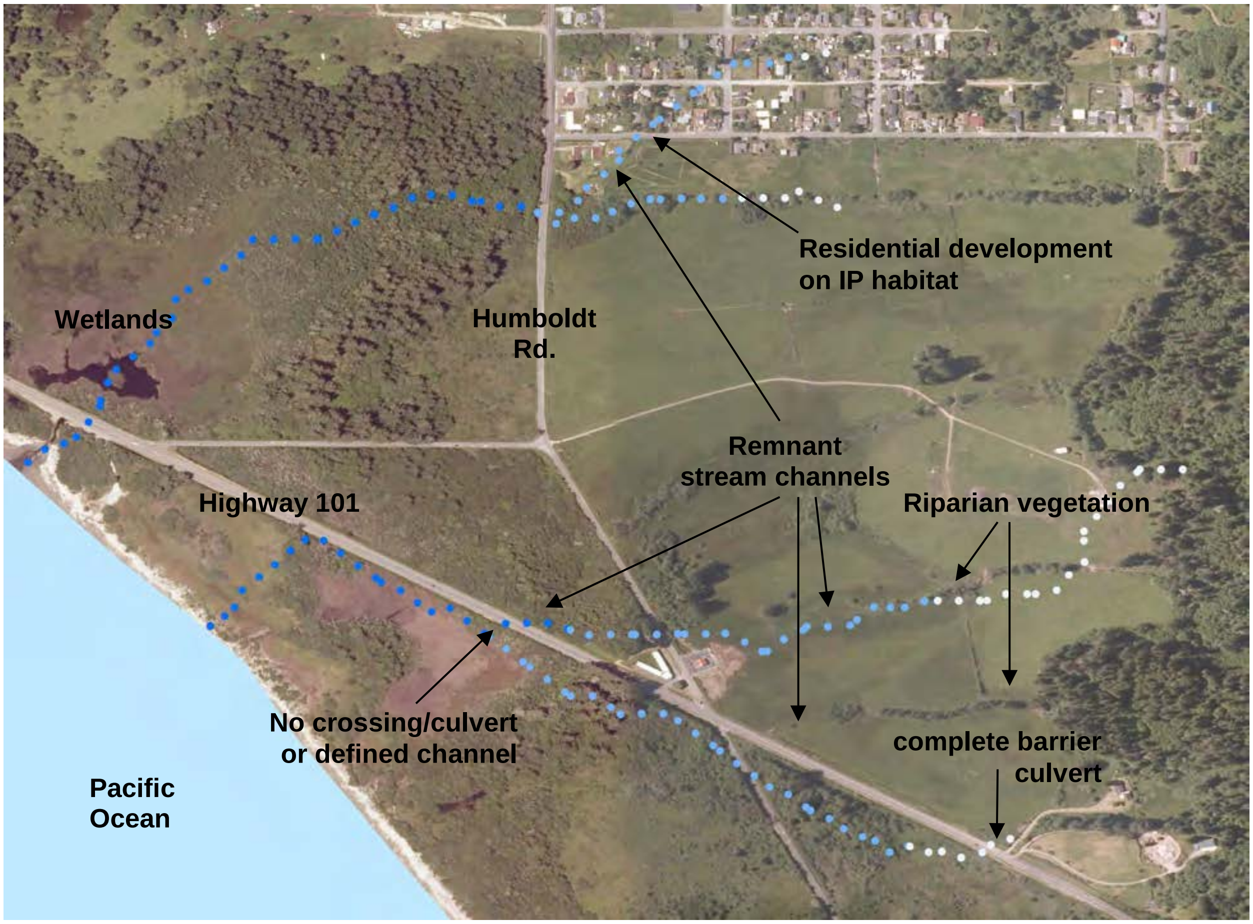

Figure 17-2. Aerial photo of the floodplain of un-named creeks in the northern portion of the population area, just south of Crescent City. Dotted lines represent IP habitat (Williams et al. 2006). Photo from the U.S. Department of Agriculture (USDA) National Agriculture Imagery Program (NAIP) taken in 2010.

Degraded Riparian Forest Conditions

The impacts of degraded riparian conditions on juvenile and adult coho salmon include increased sedimentation and bank instability, and lack of stream complexity due to poor wood recruitment. These impacts are the result of historic timber harvest practices and residential development throughout the watershed. Mean percent canopy in Wilson Creek decreased from 79 percent in 1994 to 58 percent in 2005 and is provided almost entirely by hardwoods (GDRC 2006, 2011b).

Altered Sediment Supply

Altered sediment supply is a high stress to the early life stages of coho salmon in the Wilson Creek population. Alterations to the sediment supply have resulted from historic and current timber harvests in the basin, road building in unstable areas, and removal of vegetation from riparian areas and upslope sites for urban development. Sediment loading has led to the filling in and widening of stream channels, increase in fine sediment, decreases in pool depth and complexity, mortality of eggs and smothering of redds, and changes in channel form that may result in passage problems. In lower Wilson Creek, sediment deposits have eliminated surface flows during certain times of the year, limiting connectivity for migrating juveniles. Assessments of erosion and sedimentation in the watershed (PWA 2004) confirm the high level of this stress. The percent of pool tailouts with 0-25% embeddedness decreased from 37 percent in 1994 to 28 percent in 2005 (GDRC 2006, 2011b), suggesting the fine sediment levels may be decreasing in Wilson Creek.

Altered Hydrologic Function

Sediment has eliminated surface flows in up to 3 miles of the lower part of Wilson Creek during low flow conditions, which has limited connectivity and decreased juvenile rearing habitat. Summer fish surveys by Green Diamond in 2010 and 2011 found that the creek remained wet for approximately another 0.5 miles downstream than it did between 1995 and 2009 (GDRC 2011b). A review of aerial photos indicates annual variability of which portions of the lower creek are dry. Natural hydrologic function is important for maintaining summer juvenile rearing habitat for juvenile coho.

Impaired Estuary/Mainstem Function

The major coho-producing stream, Wilson Creek, lacks an estuary (GDRC 2006). It is unclear if this is a natural condition or is caused by channel confinement and fill associated with Highway 101. Other small streams in the population area are experiencing loss of estuarine habitat and degradation of estuarine conditions due to diking, development of wetlands (Figure 17-2), and changes to the hydrograph. Highway 101 creates a permanent dike near the mouths of some of the unnamed streams immediately south of Crescent City, diminishing tidal exchange, creating passage barriers, and disconnecting vital estuarine and off channel wetland habitat. Estuarine and brackish habitats can increase the size and survival of out migrating juvenile salmon. Eliminating impediments to natural estuarine function would increase the value of this habitat and increase growth and survival of juveniles.

Impaired Water Quality

Water temperatures at monitored locations are highly suitable for coho salmon in Wilson Creek (GDRC 2006, 2011b), suggesting that the coastal climate maintains cool water despite the poor riparian shade. Groundwater seeps could also potentially contribute to cool water temperatures. Instream measurements are lacking, but turbidity during winter storm events is likely high. Highway 101 runs through the lower portions of the streams in the population area and is a potential source of chemical/petroleum spills from accidents. Also, the lower end of Lagoon Creek in the southern part of the population area was historically a millpond and is known to contain chemical contaminants (Anderson, D., pers. comm. 2010).

Barriers

Overall, barriers present a low level of stress to the Wilson Creek population. The PWA (2004) Wilson Creek assessment identified 91 road-stream crossings in the watershed, including three sites identified as potential fish barriers located on tributaries with moderate IP habitat. Green Diamond has since remedied all three sites (GDRC 2013b). Surveys have identified at least two impassible culverts on creeks with high IP values in unnamed creeks south of Crescent City (CalFish 2009), one of which is located on Highway 101 and has little or no IP habitat upstream (Figure 17-2). In addition, there is no culvert across Highway 101 at one stream with predicted moderate IP, because either the stream channel never existed or it was filled in (Figure 17-2).

Road-stream crossings may prevent juvenile movement and migration during certain times of the year and identified impassable culverts prevent coho salmon from using habitat in those smaller watersheds. Additionally, a number of barriers may exist in key streams, which cause decreased habitat availability and limit the potential spatial structure in the population area.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Wilson Creek population area. Hatchery-origin adults may stray into the population area; however, the proportion of adults that are of hatchery origin is unknown. Hatchery-origin coho salmon may stray into Wilson Creek; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

17.6 Threats

Table 17-3. Severity of threats affecting each life stage of coho salmon in the Wilson Creek population. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	High	Very High	Very High[1]	High	High	Very High
2	Timber Harvest[1]	Medium	Medium	Medium[1]	Medium	Low	Medium
4	Climate Change	Low	Low	Low	Low	Medium	Low
5	Urban/Residential/Industrial Dev.	Low	Low	Medium	Low	Low	Low
3	Fishing and Collecting	-	-	Low	Low	Low	Low
6	Agricultural Practices	Low	Low	Low	Low	Low	Low
7	Channelization/Diking	Low	Low	Low	Low	Low	Low
8	Dams/Diversion	Low	Low	Low	Low	Low	Low
9	High Severity Fire	Low	Low	Low	Low	Low	Low
10	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low

[1] Key limiting threats
[2] Mining and Gravel Extraction and Invasive Non-Native/Alien Species are not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and timber harvest.

Roads

Road density within the Wilson Creek population area is over 3 miles of road per square mile of watershed area. Roads are not maintained in many areas, creating landslides, increased sedimentation and alteration of hydrologic function throughout the population area. Watersheds with high road density are thought to be “not properly functioning” (NMFS 1996). Over 109 miles of road in the Wilson Creek watershed exist, of which only a portion are needed for timber operations in the area.

Although timber harvest in Redwood National and State Parks ceased in 1968, the remaining roads (many of which are now trails) continue to degrade stream conditions on public lands. Roads contribute the majority of the sediment to the creeks in the Wilson Creek population area and cause loss of habitat complexity within streams (PWA 2004). Much of the excess sediment sources in the Wilson Creek basin originate from poorly built road-stream crossings, areas of landslide erosion, and road surface and ditch erosion. Increased sediment delivery in Wilson Creek has filled pools, widened channels, and simplified stream habitat, decreasing spawning and rearing habitat quantity and quality throughout the area. The Enderts Beach Road/Del Norte Redwoods Coastal Trail, which was originally the historic Highway 101, runs along the entire coast within the Del Norte Coast Redwoods State Park, potentially blocking fish passage in some areas and contributing to sedimentation and erosion in small coastal watersheds (Burgess 2008, Sanders, M., pers. comm. 2008).

Timber Harvest

Although timber harvest was once considered a major threat to coho salmon in the Wilson Creek population, it currently presents a medium threat due to the more limited extent of timber harvest today. Nevertheless, a distinct contrast in tree size is evident between private lands in Wilson Creek (with mainly small trees 10 to 19.9” in diameter) and public lands in western Wilson Creek and in Damnation Creek (with mainly large trees >30” in diameter). Within Green Diamond property, harvest occurs at a moderate level and under the direction of the company’s HCP, which addresses ways to minimize and mitigate effects from timber harvest through measures related to road and riparian management, slope stability, and harvesting activities. Poor riparian conditions in Wilson Creek and throughout the population area are attributed to historic timber harvest activities. Although some watersheds outside of Wilson Creek may have partly recovered some riparian structure and function, the cessation of timber harvest in riparian areas has been too recent to allow many areas to progress to the necessary late seral stage that provides benefits for salmonids. While working under an HCP provides direction for less intensive and harmful timber harvest activities, the continuation of any amount of timber harvesting will continue to be a threat to the Wilson Creek coho salmon population.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Climate Change

There is moderate risk of a change in average precipitation over the next 50 years (Appendix B). Modeled regional average temperature shows a moderate increase over the next 50 years (Appendix B). Average temperature could increase by up to 1^{o} C in the summer and by a similar amount in the winter. The risk of sea level rise is low (Thieler and Hammer-Klose 2000). Adults may be negatively impacted by climate-related ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Urban/Residential/Industrial Development

Due to the current land ownership, threats from urban, residential, and industrial development are minimal in most of the population area; however there is potential for additional development in the floodplain and watersheds of the small-unnamed creeks south of Crescent City.

Agricultural Practices

Most of the Wilson Creek population area (80 percent) is comprised of state and federal parks and timberlands covered by an HCP. Given that only a fraction of the land base is used for agricultural production, agriculture poses a low threat to all life stages of coho salmon in the population area. There is some cattle grazing on private non-HCP land in the Wilson Creek watershed, but the potential effect on aquatic habitat is unknown. Legacy effects of past agriculture appear to include the filling of channels in some unnamed streams south of Crescent City to facilitate increased agricultural production (Figure 17-2).

Channelization/Diking

Channelization and diking is a low threat to coho salmon in the area, although Highway 101 acts as a dike near the mouth of several unnamed streams south of Crescent City and interferes with hydrologic connectivity. The highway may also act as a dike on Lagoon Creek, which has been highly altered and lacks much of its historic hydrologic function.

Dams/Diversions

Dams and diversions present a low threat to the Wilson Creek coho salmon population. A logjam located near the mouth of Lagoon Creek is probably related to a dam or structure that was built to form the mill pond at the old mill site. It is unknown if this jam is creating a passage problem for fish or causing other hydrologic issues. A natural lagoon may have once been present at this site but was also likely modified to help form the millpond. The likelihood that illegal withdrawal is occurring is minimal since most of the land is in Redwood National and State Parks, or owned by Green Diamond.

High Severity Fire

The Wilson Creek population area is located in a cool, Mediterranean climate, with no history of episodic or seasonal fire. The area is characterized by cool, wet winters and surrounding redwood forests keep forest conditions moist and fire potential low.

Road-Stream Crossing Barriers

Road-stream crossing barriers pose a low threat to the Wilson Creek coho salmon population. However, a number of barriers exist in key streams and limit or prevent access to high IP stream reaches and reduce connectivity within high IP streams. Road-stream crossings preventing fish passage have been identified in the Wilson Creek watershed, and at least two impassable culverts have been identified in the creeks south of Crescent City.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Wilson Creek population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

17.7 Recovery Strategy

The most immediate need for habitat restoration and threat reduction in the Wilson Creek population area is the mainstem of Wilson Creek, which is the only creek currently occupied by coho salmon. Unoccupied areas must also be restored to provide enough habitat for coho salmon recovery.

The inherent capacity to support coho salmon in the Wilson Creek population area is evident, yet the Wilson Creek population is severely depressed and likely occupies only one small coastal watershed with less than 5 miles of stream habitat. The Wilson Creek population is dependent and therefore cannot be viable on its own; however, it is necessary to restore habitat within the basin so that it can support all life stages of coho salmon and provide connectivity between other populations in the ESU. The recovery criterion for this population is that coho salmon must occupy 80% of available IP habitat in years following spawning of brood years with high marine survival. The most important factor limiting recovery of coho salmon in Wilson Creek is a lack of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by increasing habitat complexity within the channel, re-establishing off-channel rearing areas, restoring riparian forests, and reducing threats to instream habitat.

Little is known about creeks in the population area other than Wilson Creek, but occupancy of these creeks would provide greater spatial diversity and capacity to the population. Before time or money is invested in these creeks, however, it must be determined whether coho salmon are present, and the quality and quantity of the habitat there should be evaluated. The effects of fishing on this population’s ability to meet its viability criteria should be evaluated.

Table 17-4 on the following page lists the recovery actions for the Wilson Creek population.

Table 17-4. Recovery action implementation schedule for the Wilson Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WilC.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Unnamed creeks south of Crescent City and Wilson Creek, and all streams where coho salmon would benefit immediately	2b
SONCC-WilC.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-WilC.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-WilC.2.1.26	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2c
SONCC-WilC.2.1.26.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-WilC.2.1.26.2	*Place instream structures, guided by assessment results*					
SONCC-WilC.2.2.11	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Unnamed creeks south of Crescent City and Lower Wilson Creek, and all streams where coho salmon would benefit immediately	2b
SONCC-WilC.2.2.11.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-WilC.2.2.11.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-WilC.2.2.28	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2c
SONCC-WilC.2.2.28.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-WilC.2.2.28.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-WilC.2.2.10	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Unnamed creeks south of Crescent City, Lower Wilson Creek, and all streams where coho salmon would benefit immediately	2b
SONCC-WilC.2.2.10.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-WilC.2.2.10.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-WilC.2.2.10.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WilC.2.2.27	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2c
SONCC-WilC.2.2.27.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-WilC.2.2.27.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-WilC.2.2.27.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-WilC.5.1.4	Passage	No	Improve access	Remove barriers	Lagoon Creek and unnamed coastal creeks, Highway 101	2b
SONCC-WilC.5.1.4.1	*Evaluate and prioritize barriers for removal*					
SONCC-WilC.5.1.4.2	*Remove barriers, based on evaluation*					
SONCC-WilC.5.1.5	Passage	No	Improve access	Remove structural barriers	All streams where coho salmon would benefit immediately	2b
SONCC-WilC.5.1.5.1	*Assess barriers and prioritize for removal or upgrade to ensure passage at all lifestages*					
SONCC-WilC.5.1.5.2	*Remove barriers, based on evaluation*					
SONCC-WilC.5.1.29	Passage	No	Improve access	Remove structural barriers	Population wide	2c
SONCC-WilC.5.1.29.1	*Assess barriers and prioritize for removal or upgrade to ensure passage at all lifestages*					
SONCC-WilC.5.1.29.2	*Remove barriers, based on evaluation*					
SONCC-WilC.7.1.2	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	2c
SONCC-WilC.7.1.2.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-WilC.7.1.2.2	*Thin, or release conifers, guided by the plan*					
SONCC-WilC.7.1.2.3	*Plant conifers, guided by the plan*					
SONCC-WilC.8.1.7	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	RNSP lands in lower Wilson Creek, Nickel Creek, and unnamed tributaries; and all streams where coho salmon would benefit immediately	2c
SONCC-WilC.8.1.7.1	*Decommission roads, guided by Wilson Creek Watershed Assessment and Erosion Prevention Planning Project*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-WilC.8.1.30	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2d
SONCC-WilC.8.1.30.1	*Decommission roads, guided by Wilson Creek Watershed Assessment and Erosion Prevention Planning Project*					
SONCC-WilC.10.7.23	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-WilC.10.7.23.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-WilC.10.7.23.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-WilC.10.7.25	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-WilC.10.7.25.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-WilC.10.7.25.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-WilC.7.1.3	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
SONCC-WilC.7.1.3.1	*Apply best management practices for timber harvest*					
SONCC-WilC.2.1.24	Floodplain and Channel Structure	No	Increase channel complexity	Determine restoration potential in streams other than Wilson Creek	All streams in population area excluding Wilson Creek	3d
SONCC-WilC.2.1.24.1	*Conduct presence/absence surveys and habitat inventory to determine restoration potential for coho salmon. Develop a plan for restoration if warranted.*					
SONCC-WilC.2.1.24.2	*Restore streams, guided by the plan*					
SONCC-WilC.8.1.6	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	BR
SONCC-WilC.8.1.6.1	*Limit road construction on steep streamside slopes, headwall swales, and shallow-deep seated landslide areas*					
SONCC-WilC.8.1.6.2	*Limit loading and hauling of logs during high risk periods (high rainfall periods)*					

18. Lower Klamath River Population

Central Coastal Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

5,900 Spawners Required for ESU Viability

492.3 mi^2 watershed (40% Federal ownership)

205 IP-km (127 IP-mi) (28% High)

Dominant Land Use is Timber Harvest

Key Limiting Stresses are ‘Altered Sediment Supply’ and ‘Lack of Floodplain and Channel Structure’

Key Limiting Threats are ‘Agriculture’ and ‘Channelization/Diking’

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, or other instream structure • Construct off-channel habitats, alcoves, backwaters, and old stream oxbows • Re-connect existing off channel ponds, wetlands, and side channels	• Remove, setback, or reconfigure levees and dikes • Reduce road-stream hydrologic connection • Increase beaver abundance

18.1 History of Habitat and Land Use

For over a century, timber harvest has been the dominant land use within the Lower Klamath River (LKR) sub-basin. Small-scale commercial harvest began in the mid- to late-1890s, while intensive timber harvest began in the 1950s with a peak harvest in the late 1960s. By 1969, approximately 50 percent of the sub-basin was logged, and by 1994 almost all of the remaining old-growth was logged, including riparian zones (Gale and Randolph 2000). Analysis of aerial photographic data indicated that 90 percent of the sub-basin was logged between 1948 and 1997, and the watersheds most impacted by timber harvest included South Fork Ah Pah, Surpur, Morek, Tully, and Johnsons creeks (Gale and Randolph 2000). As timber harvest increased, so did road construction. By 1994, the road density in the sub-basin was 5.3 miles of road per square mile of land, with an associated 7,249 road-stream crossings. Stemming from this period of timber harvest and road building was an increased frequency in landslides and debris torrents. Between 1948 and 1997, there were: (1) about 1,729 landslides, 760 of which could be linked to anthropogenic activities, and (2) approximately 255 debris torrents, with 131 linked to anthropogenic activities (Gale and Randolph 2000). The addition of lands in the lower LKR watershed to Redwood National Park in 1968, and again in 1978, brought about the cessation of timber harvest there, and improved road maintenance and decommissioning.

Today, Green Diamond Resource Company (GDRC, formerly Simpson Timber Company) conducts the majority of timber harvest in the sub-basin and operates under a Habitat Conservation Plan (GDRC 2006). The principal human population centers that are near fish-bearing tributaries include Requa, Klamath and Klamath Glen in the lower portion of the sub-basin, and Wautek (Johnsons) and Pecwan in the upper portion of the sub-basin. The arrival of Europeans brought about the quick extirpation of beavers in low-gradient riparian habitat, including the Lower Klamath estuary (WATER Institute 2014). The loss of beaver dams and ponds reduced rearing habitat opportunities for salmonids.

Other activities have also played a role in the sub-basin history with rural residential development occurring concurrently with the timber harvest. The principal human population centers that are near fish-bearing tributaries include Requa, Klamath and Klamath Glen in the lower portion of the sub-basin, and Wautek (Johnsons) and Pecwan in the upper portion of the sub-basin. Although only a small portion of the sub-basin is suitable terrain for agriculture, conversion of land for farming and ranching resulted in a loss of floodplain habitat in the LKR, including the estuary, which reduces available rearing habitat for juvenile coho salmon. Flood protection for residential communities along the Lower Klamath, construction of the original Redwood Highway, and then construction of the Highway 101 bypass further reduced both floodplain and riparian habitat. Small-scale gravel mining and water diversions have also had localized impacts on the habitat in the LKR (Gale and Randolph 2000) by causing sediment disturbance and potentially increasing sediment deposition onto coho salmon redds in the tributaries or reducing the tributary instream flows.

In addition to anthropogenic activities, floods over the last 150 years have also greatly affected stream channels and riparian ecosystems on the LKR mainstem (Harden et al. 1978, Kelsey 1980, Lisle 1981, 1989). These floods mobilized large amounts of sediment, led to substantial channel aggradation and widening, removed critical riparian forests, and resulted in subsequent loss of LWD (Payne and Associates 1989, Gale and Randolph 2000).

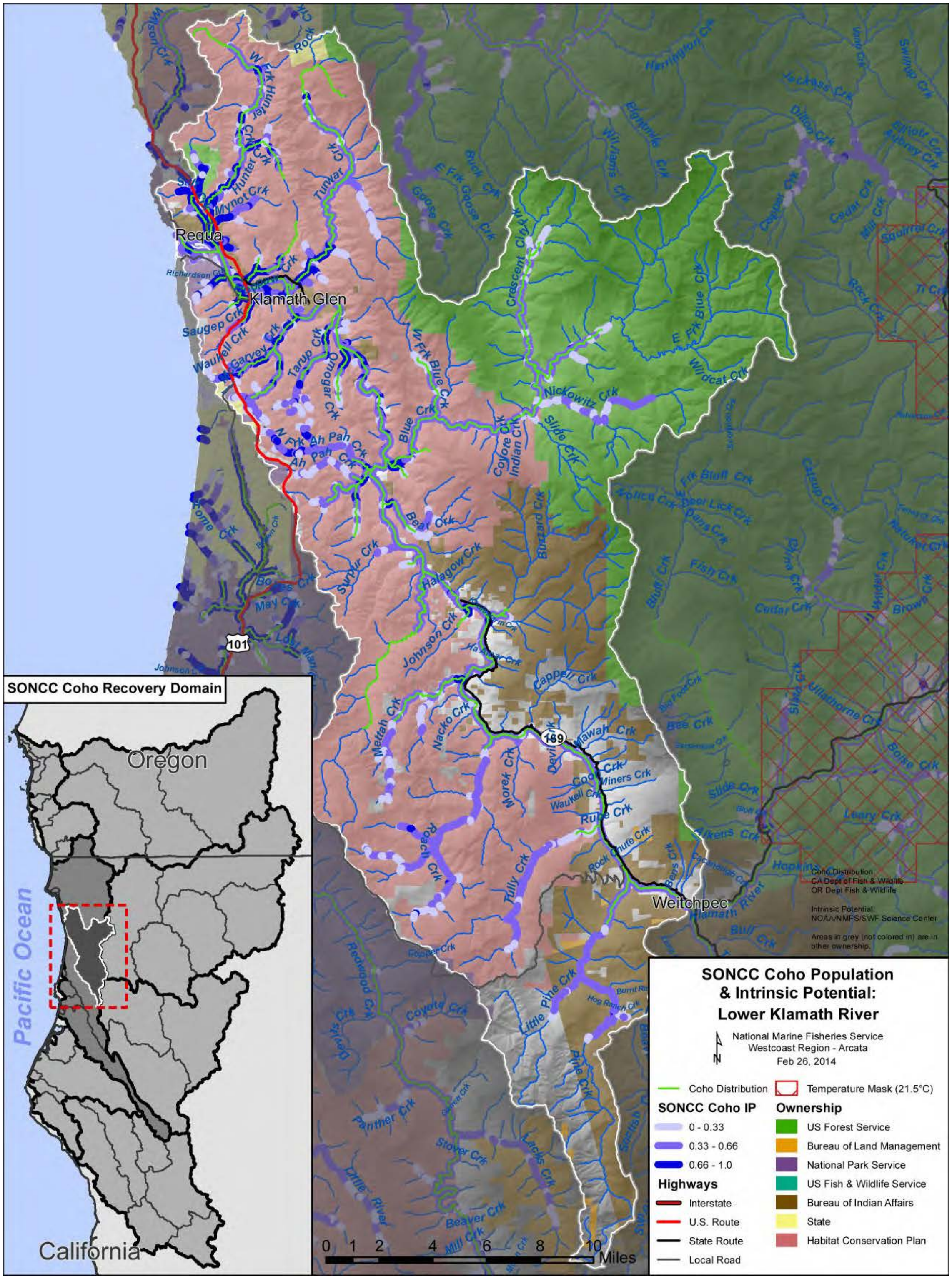

Figure 18-1. The geographic boundaries of the Lower Klamath River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

18.2 Historic Fish Distribution and Abundance

There is little information on the historic size of the LKR coho salmon population. The commercial gill-net fishery in the LKR caught 11,162 coho salmon (83,836 pounds) between late September and late October 1919 (Snyder 1931). The estimated annual sport fishery catch in the LKR was 1,187 coho salmon in 1951 (Gibbs and Kimsey 1955) and 4,000 coho salmon in 1954 (McCormick 1958). The proportion of coho salmon caught in the aforementioned fisheries that originated from the LKR coho salmon population is unknown. The California Department of Fish and Wildlife (CDFW; formerly California Department of Fish and Game [CDFG]) reported that in the 1960s, approximately 8,000 coho salmon returned to the mainstem Klamath River and tributaries (excluding the Shasta, Scott, Salmon and Trinity rivers; Taylor 1978, CDFG 2004b). The percentage of these fish that originated from the LKR coho salmon population is also unknown.

CDFW and U.S. Fish and Wildlife Service (USFWS) records (1945 to 1993) note the presence of coho salmon in Hunter, Hoppaw, Saugep, Terwer, McGarvey, Tarup, Blue, Bear, Tectah, and Roaches creeks (Voight and Gale 1998). Presence and abundance in these streams varied among years and was largely dependent on plantings of coho salmon fingerlings by CDFW. Although most of these plantings were fish from the sub-basin, 20,000 out-of-basin coho salmon from Alsea River, Oregon, were planted in McGarvey Creek between 1962 to 1963 (Voight and Gale 1998). About 150,000 coho salmon fingerlings were planted in Tarup, McGarvey, Hunter, Surpur, and Tectah creeks between 1962 and 1990 (Table 18-1). Planting of coho salmon peaked in the late 1960s and some stocked sub-basins were more successful than others (Voight and Gale 1998). The current population of LKR coho salmon may be partial descendants of these planted fish.

Table 18-1. Number of coho salmon fingerlings planted in Lower Klamath River tributaries (Voight and Gale 1998).

Creek	Number Coho Salmon Fingerlings Planted	Years	Origin	Program
Tarup	50,000	1968-1990	Unknown	CDFW & BIA
McGarvey	20,000	1962-1963	Alsea River, OR	CDFW
Hunter	2,000	1989	Unknown	CDFW & BIA
Surpur	10,000	1969	Unknown	CDFW
Tectah	60,000	1966-1968	Unknown	CDFW

Data on fish rescue in LKR tributaries provide some additional information about the past abundance of coho salmon in the population area. For example, 152 to 25,226 juvenile coho salmon were rescued in Hunter Creek between 1939 and 1945, 380 to 3,537 coho salmon juveniles were rescued in High Prairie Creek from 1950 to 1952, and 10,000 juvenile coho salmon were rescued in Mynot Creek in 1940 (Shapovalov 1941). The number of juvenile coho salmon rescued from Terwer Creek ranged from 318 to 13,685 from the 1940s through the early 1950s (Brown and Moyle 1991). In 1989, juvenile coho salmon were observed during fish surveys in McGarvey, Tarup, Tectah, Roaches and Ah Pah creeks, but there were less than 10 individuals per creek (Brown and Moyle 1991).

Williams et al. (2006) concluded, based on the model results to predict the IP coho salmon habitat, that coho salmon habitat included most LKR tributaries (Figure 18-1; Table 18-2). Further, most of the high IP reaches are in the lower (downstream) tributaries.

Table 18-2. Tributaries with high IP reaches (IP > 0.66), (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Hunter Creek	Richardson Creek	Salt Creek
Mynot Creek	Omagaar Creek	High Prairie Creek
Spruce Creek	Ah Pah Creek	Bear Creek
Panther Creek	N. Fork Ah Pah Creek	Blue Creek
McGarvey Creek	Tarup Creek	Mettah Creek
West Fork McGarvey Creek	Waukell Creek	Johnson Creek
Terwer Creek	Saugep Creek	Hog Ranch Creek
Hoppaw Creek	Junior Creek	Roaches Creek
Pine Creek		

In addition to providing connectivity to tributary watersheds for spawning and rearing, the mainstem LKR provides migratory and rearing habitat for adult and juvenile coho salmon for all Klamath River coho salmon populations. No extensive records exist on the production of coho salmon in this population, but available information indicates that the coho salmon population declined during the 20th century, and remains low (Brown and Moyle 1991, Soto et al. 2008a, Hillemeier et al. 2009, Silloway 2010).

18.3 Status of Lower Klamath River Coho Salmon

Spatial Structure and Diversity

The Yurok Tribe, CDFW, and GDRC conducted fish surveys over the past several decades, which provide data to assess, to some degree, the spatial structure of the LKR coho salmon population. Between 1996 and 2004, coho salmon were found in nearly all surveyed streams, including Salt, High Prairie, Hunter, Hoppaw, Saugep, Waukell, Terwer, McGarvey, Tarup, Omagaar, Blue, Ah Pah, Bear, Surpur, Little Surpur, Pularvasar, One Mile, Tectah, Johnsons, Pecwan, Mettah, Roaches, Cappell, Richardson, and Tully creeks (Table 18-3). Coho salmon were generally not well distributed in tributaries upstream of Blue Creek, although many of these creeks contain moderate to high IP (e.g., Mettah, Roaches, Tully, and Pine creeks; Gale et al. 1998). In general, coho salmon were only observed in the lower reaches of most tributaries, and in some cases the Yurok Tribe noted that their presence appeared to be non-natal rearing (Voight and Gale 1998, Yurok Tribal Fisheries Program [YTFP] 2009b).

Surveys in 1996 did indicate well-distributed coho salmon in McGarvey and Blue creeks, with observed patterns similar to historical reports. However, the distribution of juveniles appeared diminished compared to historical accounts in Hunter, Hoppaw and Tarup creeks (Voight and Gale 1998). Blue Creek was the only tributary where moderate numbers of juvenile and young-of-year (YOY) coho salmon were consistently observed. Three Blue Creek tributaries are important to anadromous salmonid spawning and rearing, including West Fork Blue Creek, Nickowitz Creek, and Crescent City Fork Blue Creek (Gale 2009c), which is the largest and lowest gradient tributary accessible to anadromous fish in the Blue Creek watershed (Figure 18-1). Large numbers of YOY coho salmon were also observed in Ah Pah Creek in 1997, but abundance was variable during subsequent years (Gale and Randolph 2000).

Because of the high incidence of non-natal rearing, juvenile survey data cannot be used to determine the distribution of the LKR population. Spawner distribution data provide more accurate information regarding natal population distribution. Spawning data from a few of the major tributaries in the LKR show moderate spawner densities throughout surveyed reaches of these watersheds. Spawning coho salmon have been found in Blue Creek (mainstem), Crescent City Fork of Blue Creek, Hunter, Waukell, McGarvey, Terwer, Ah Pah, Tectah, and Pine (Gale 2009a, 2009b; Beesley 2010). Blue Creek is the largest and most resilient LKR watershed and correspondingly supports the largest anadromous fish populations in the sub-basin (Gale and Randolph 2000). Habitat surveys in other creeks have shown only marginal habitat suitability for coho salmon spawning, primarily due to the high embeddedness of spawning gravels (Voight and Gale 1998), and lack of channel structure (e.g., fluvial stored wood) required to facilitate necessary gravel sorting and retention dynamics (Beesley and Fiori 2007a, 2008a).

Table 18-3. Tributaries in the Lower Klamath River population with relatively recent coho salmon presence. Based on surveys by CDFW and YTFP 1990 to 2008 (Gale and Randolph 2000).

Stream Name	Stream Name	Stream Name
Salt Creek	Ah Pah Creek	Tully Creek
Hunter Creek	Pularvasar Creek	McGarvey Creek
Mynot Creek	Junior Creek	Omagaar Creek
Hoppaw Creek	Johnsons Creek	High Prairie Creek
Terwer Creek	Richardson Creek	Little Surpur Creek
Tarup Creek	Blue Creek	One Mile Creek
Saugep Creek	Bear Creek	Cappell Creek
Waukell Creek	Surpur Creek	Pecwan Creek
Tectah Creek	Mettah Creek	Roaches Creek

For the LKR coho salmon population to be at low risk for the population size threshold, Williams et al. (2008) estimated that a minimum of 29 coho salmon per IP-km of habitat are needed (5,900 spawners total). The current distribution of spawners is well below this threshold. With the exception of McGarvey and Blue Creeks (Gale and Randolph 2000), coho salmon are not well distributed throughout the Lower Klamath tributaries, and continue to occur at modest to very low densities.

Based on what is known from survey data about the life history and genetic diversity of the LKR population, this population has been affected by out-of-basin stock planting and hatchery influences. The reduced population abundance has likely led to depensation effects in some years (e.g. inbreeding) and reduced genetic diversity. However, compared with other Klamath populations, tributaries in the LKR sub-basin may support some of the healthiest wild coho salmon in the basin. The population has a relatively high capacity for life history plasticity based on the diversity of unique habitat features and that historically, the population could have had a wide array of life history strategies that utilized diverse tributary and estuary habitats during various times of the year.

Population Size and Productivity

Coho salmon have a wide distribution throughout the Lower Klamath, but almost always low abundances, based on the results of juvenile surveys, spawner surveys, and outmigrant trapping (Voight and Gale 1998, Gale and Randolph 2000, GDRC 2006, YTFP 2009a). Moderate densities of coho salmon are found in Blue, McGarvey and Ah Pah creeks. Age 1+ coho salmon have also been captured or observed in the Lower Klamath River and overwintering survival has been estimated at between 27 and 76 percent with an average of 47 percent (Ackerman et al. 2006, Voight and McCanne 2006).

Surveys have been conducted on many LKR tributaries and the results indicate a low, but relatively constant abundance of juveniles (Voight and McCanne 2002, Mohr and Hankin 2005, GDRC 2009). Juvenile coho salmon abundance in Hunter Creek and East Fork Hunter Creek has fluctuated widely (from 0 to 6,000 individuals) from year to year throughout the last decade. Average estimated abundance is approximately 2,000 individuals per year in Hunter Creek (GDRC 2009). Ah Pah Creek had an estimated average of 3,500 juveniles between 2007 and 2008 (GDRC 2009). Juvenile coho salmon abundance was estimated by Ackerman et al. (2006) to be between 15 and approximately 46,200 individuals from 2002 to 2006.

Consistent spawner data are only available from Blue Creek, but these data provide a relatively long period of productivity and abundance information for the population (Gale et al. 1998, Gale 2009c). Between 1995 and 2008, 2,562 adult coho salmon were observed (Figure 18-2). Observed numbers of spawners ranged from 4 in 1995 to 1,040 in 2002. Approximately two percent of observed returns were jacks during this period. Although these surveys did not sample the full run of coho salmon, they can provide some indication of coho salmon production from Blue Creek.

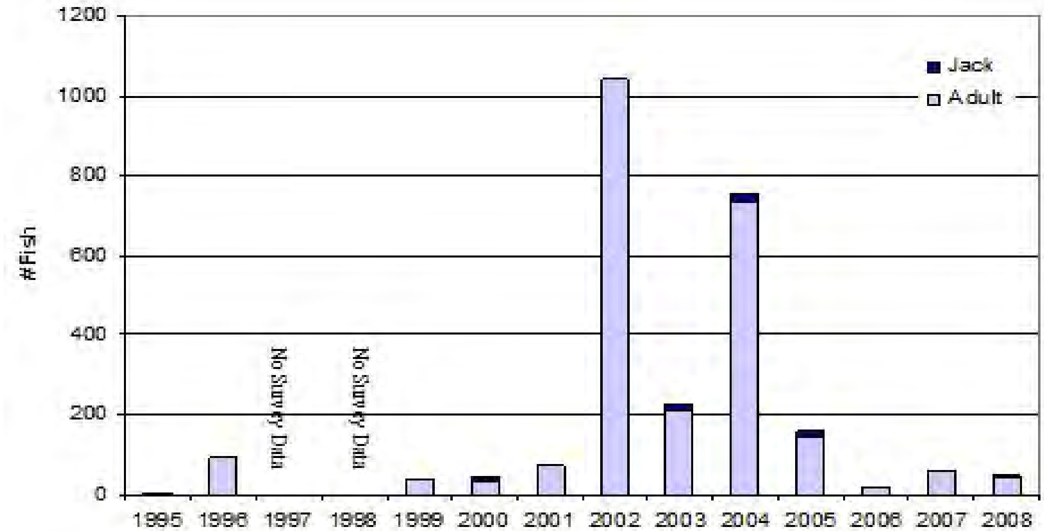

Figure 18-2. Coho salmon observed spawning in the Blue Creek watershed of the Lower Klamath River sub-basin between 1995 and 2008. Data are from YTFP snorkel surveys (Gale et al. 1998, Gale 2009c).

Adult coho salmon population abundance, estimated by Ackerman et al. (2006), ranged from 14 to approximately 1,500 spawners between 2002 and 2006, based on juvenile coho salmon abundance in the Lower Klamath River (Table 18-4) and an assumed 10.2 percent marine survival. There does not appear to be a significantly strong or weak year class based on these estimates, which is supported by the Blue Creek spawner data.

Table 18-4. Estimates of sub-yearling and adult coho salmon abundance in Lower Klamath River tributaries (Voight and McCanne 2002, 2006; Ackerman et al. 2006). Juvenile abundance estimates are for two years prior to the adult return year.

Adult Return Year	Mean Juvenile Abundance	95% CI Juvenile Abundance	Mean Adult Abundance	95% CI Adult Abundance
2001	--	--	512[1]	--
2002	322	15 – 628	14	1 – 28
2003	13,089	8,062 – 18,115	574	354 – 795
2004	33,812	21,433 – 46,191	1,483	940 – 2,026
2005	21,188	10,529 – 31,847	929	462 – 1,397
2006	7,188	499 – 13,877	315	22 – 609

[1] Estimate assumed based 2.89 recruits per spawner in Trinity for 2001 brood.

Williams et al. (2008) determined at least 205 coho salmon must spawn in the LKR sub-basin each year to avoid effects of extremely low population sizes. Based on criteria established by Williams et al. (2008), the Lower Klamath River population is at high risk of extinction because the spawner abundance has likely been below the depensation threshold of 205 (Figure 18-2).

The productivity of the population, based on the juvenile and adult abundance estimates, appears to be declining. Historical data indicate that the Lower Klamath coho salmon population was more abundant as recently as 50 years ago (Brown and Moyle 1991) and results of recent data suggests that this population has experienced low, highly variable abundances over the past decade (Voight and McCanne 2004, Garwood 2012). The population has likely experienced negative population abundance over the past 50 years and even recent strong returns in some tributaries have not sustained any positive population growth in the population. Because the productivity of the population appears negative, the population is at increased risk of extinction.

Extinction Risk

The Lower Klamath River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role of Population in SONCC Coho Salmon ESU Viability

The Lower Klamath River population is a core, Functionally Independent population within the Central Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). Though strays have minimal influence on the LKR population, this sub-basin facilitates straying because of its downstream location in the Klamath River and the number of independent populations in close proximity along the coast. In addition to spawning and rearing habitat, the Lower Klamath River is important for populations throughout the Klamath and Trinity sub-basins. Coho salmon juveniles and smolts from upstream populations use the Lower Klamath River sub-basin during the summer and winter for rearing and acclimation, and adults use thermal refugia for holding prior to migrating upstream (Voight and Gale 1998, YTFP 1999, Belchik and Turo 2002, Soto et al. 2008a, YTFP 2009a, Hillemeier et al. 2009, Silloway 2010).

To contribute to stratum and ESU viability, the Lower Klamath River core population should have at least 5,900 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Lower Klamath River population may serve as a source of spawner strays for nearby coastal populations as well as upstream populations in the Klamath basin. At present, the capacity of the Lower Klamath River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from nearby rivers may enhance recovery of the Lower Klamath River population.

18.4 Plans and Assessments

U.S. Forest Service- Orleans District

Watershed Condition Framework

http://www.fs.fed.us/publications/watershed/Watershed_Condition_Framework.pdf

The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands, including the Lower Klamath River. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales.

State of California

Recovery Strategy for California Coho Salmon

http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004 and is a guide for recovering coho salmon on the north and central coasts of California, including the Lower Klamath River. The Recovery Strategy emphasizes cooperation and collaboration at many levels, and recognizes the need for funding, public and private support for restorative actions, and maintaining a balance between regulatory and voluntary efforts.

Yurok Tribe

Yurok Tribal Fisheries Program – Lower Klamath Division - Restoration Plans

Lower Klamath River Sub-basin Watershed Restoration Plan.

The Lower Klamath River sub-basin watershed restoration plan (Gale and Randolph 2000) prioritizes upslope restoration and identified tributary specific restoration objectives for a majority of Lower Klamath tributaries. Since 2000, YTFP and the Yurok Tribe Watershed Restoration Program (YTWRP) have been working cooperatively with restoration partners to revise and implement the sub-basin restoration plan and meet program objectives.

Restoration Planning in Lower Blue Creek, Lower Klamath River: Phase 1.

The Restoration Planning in Lower Blue Creek report (Beesley and Fiori 2008a) describes factors currently limiting salmonid production in lower Blue Creek and presents site-specific restoration strategies that address identified limiting factors.

Geomorphic and Hydrologic Assessment and Restoration Planning in the Salt Creek Watershed, Lower Klamath River Sub-basin, California.

The geomorphic and hydrologic assessment report (Beesley and Fiori 2007a) describes factors currently limiting salmonid production in the Salt Creek watershed and presents several potential restoration options for improving watershed function and salmonid productivity.

Cooperative Restoration of Tribal Trust Fish and Wildlife Habitat in Lower Klamath River Tributaries.

The cooperative restoration report (Beesley and Fiori 2008b) describes factors currently limiting salmonid production in several priority Lower Klamath tributaries and presents site-specific restoration strategies that address identified limiting factors.

Yurok Tribe Environmental Program - Restoration Plans

Klamath River Estuary Wetlands Restoration Prioritization Plan.

The Klamath River estuary wetlands restoration plan (Patterson 2009) applies the California Rapid Assessment Method (CRAM) to assess the ambient condition of wetland complexes in the Klamath River Estuary. The method provides a standardized numerical scoring system for wetland attributes that was used to prioritize sites for wetland mitigation and restoration projects.

Green Diamond Resource Company

Habitat Conservation Plan

About 65 percent of the LKR sub-basin is private land; the majority of which is owned by Green Diamond. The Aquatic Habitat Conservation Plan (HCP), finalized in 2006 and valid through 2056, was developed in accordance with the ESA section 10 and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized taking of aquatic species that may occur incidental to Green Diamond's activities; to ensure that any authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of aquatic species; and contribute to efforts to reduce the need to list currently unlisted species under the ESA in the future by providing early conservation benefits to those species. The plan has a number of provisions designed to protect coho salmon and salmon habitat throughout the Lower Klamath. More information about HCPs in the Lower Klamath River can be found in Section 3.2.5.

Redwood National and State Parks

Watershed Rehabilitation Plan (1981)

Management Alternatives of the Redwood Creek Estuary (1983)

Redwood National and State Parks, Humboldt and Del Norte Counties: Final General Management Plan/General Plan, environmental impact statement/environmental impact report - USDI National Park Service and California Department of Parks and Recreation (1999)

Road Strategy: Access and Treatment Priorities for Parkland in the Redwood Creek Watershed (2005)

Planning and strategy documents from RNSP focus on ecosystem restoration, especially road removal and forest restoration efforts. Between 1978 and 2010, RNSP removed 266 miles of roads from Park lands, with 114 miles of road remaining to be treated.

18.5 Stresses

Table 18-5. Severity of stresses affecting each life stage of coho salmon in the Lower Klamath River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Sediment Supply[1]	High	Very High	Very High[1]	Very High	High	Very High
2	Lack of Floodplain and Channel Structure[1]	High	Very High	Very High[1]	Very High	High	Very High
3	Degraded Riparian Forest Conditions	High	High	High[1]	High	High	High
4	Impaired Estuary/Mainstem Function	-	Low	High[1]	High	High	High
5	Altered Hydrologic Function	Medium	Medium	High[1]	High	High	High
6	Impaired Water Quality	Low	Medium	High[1]	Medium	Medium	Medium
7	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
8	Increased Disease/Predation/Competition	Low	Low	High	High	Medium	High
9	Barriers	-	Low	Medium	Medium	Medium	Medium
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low

[1]Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are altered sediment supply and lack of floodplain and channel structure, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking for the population. Juvenile summer rearing habitat is impaired mostly from subsurface flow conditions in the tributaries and poor water quality of the mainstem Klamath River (e.g., high water temperatures resulting from degraded riparian conditions and water withdrawals upstream). Winter rearing habitat is severely lacking because of channel simplification, disconnection from the floodplain, degraded riparian conditions, poor large wood availability, and an estuary which has been altered and reduced in size due to development, channelization, and diking. Large wood has been removed and is not naturally replacing at the rates required to maintain key components of habitat complexity. An altered sediment supply in many tributaries has hindered fish passage, resulted in poor summer survival, poor spawning and incubation habitat suitability, and the loss and degradation of stream and off-channel habitat. Most potential spawning reaches have excessively embedded and armored substrate, making redd construction more challenging for adults and reducing permeability in constructed redds. The combination of high rates of sedimentation, lack of channel structure (e.g., LWD) and resilient riparian forests, and impaired hydrologic function have led to subsurface flows in many LKR tributaries during periods of low to no precipitation, resulting in high stranding and mortality rates and reduced growth (Hillemeier et al. 2009). Channel sedimentation and lack of channel structure (e.g., LWD) have caused significant loss to overwintering and summer rearing habitat as well (Gale and Randolf 2000, Beesley and Fiori 2007b). In many streams, the dewatering of tributary reaches substantially reduces summer and even winter (e.g., during periods of low or no precipitation) rearing habitat and can occur so quickly that juveniles are unable to relocate. YTFP has documented substantial anadromous fish mortality associated with seasonal tributary drying events (Beesley 2010).

In terms of floodplain and channel structure, the cumulative cascading effects from high rates of sedimentation, lack of fluvial recruited/deposited wood, and changes in run-off processes (as a result of road building and timber harvest activities) have altered floodplain formation processes. Repeated channel avulsion and valley mobilizing events and subsequent long-term channel incision has resulted in coarsening of floodplain and instream sediments, decreased floodplain hydrologic connectivity, and chronic riparian forest dysfunction. Long-term channel incision in the lower reaches of many tributaries has resulted from a lack of channel structure and has led to a coarsening of bed materials and likely reduced the amount of suitable salmonid spawning gravels. Off-channel habitat (e.g., backwaters, alcoves, or inundated floodplains) used as refugia also become increasingly limited and hydrologically disconnected during periods of long-term channel incision.

Channel simplification (primarily lack of channel structure and LWD from the loss of riparian resiliency) and the lack of floodplain and off-channel habitat availability result in most tributary stream reaches having minimal refuge habitat from elevated winter flows, turbidity, or both. This in turn causes fish to be either flushed downstream and out into the mainstem river, to have greatly reduced growth rates due to excessive energy expenditure in the increased velocities, or to perish. This also puts increased demand on river and estuary off-channel habitat as fish pushed into the mainstem search for suitable low-velocity rearing habitat. Additionally, increased turbidity in many tributaries during high flow likely hinders winter/spring feeding potential and growth (Sigler et al. 1984).

In many tributaries, repeated aggradation and degradation has also led to floodplain conditions that preclude the establishment of viable and resilient riparian forests, which results in poor LWD recruitment that perpetuates these conditions. LWD serves many different and critically important functions in a watershed. Channel stored wood can alter sediment storage and delivery dynamics, dampen peak flows, facilitate the formation and maintenance of critical salmonid habitats (e.g., spawning beds and pools), and provide cover for fish and other aquatic dependent species. Accumulations of large wood have been observed to be a significant component in floodplain and terrace deposits and help maintain complex instream and floodplain habitat. Fluvial deposited wood has also been attributed to the development of viable and resilient riparian forests.

While all life stages are affected by stresses, the most limited is the juvenile life stage. Summer rearing is inhibited by the lack of complex instream habitat (e.g., deep pools and LWD) and the loss of summer habitat due to low and subsurface flow conditions in tributaries. Overwinter rearing is inhibited by the lack of complex instream habitat (e.g., deep pools and LWD) and lack of off-channel habitat. The loss of suitable rearing habitat is a key limiting factor for this population and contributes to low productivity. In addition, the lack of channel structure (e.g., LWD) contributes to low spawning gravel from the lack of gravel retention and sorting.

The primary limiting habitat types for the LKR population are high quality spawning and rearing habitat. While the areas that provide valuable rearing habitat can be different from those areas that may provide spawning habitat, a few key tributaries in the Lower Klamath provide the majority of these habitats to the population. These important tributaries include Tectah, Terwer, Salt, Waukell, Hunter, McGarvey, and Blue creeks. Small pockets of high quality spawning and rearing habitat also exist in Ah Pah, Mettah, Johnsons, High Prairie, Hoppaw, and Surpur, and Tarup creeks. For non-natal populations and for some natal fish, the mainstem, estuary, and lower reaches of several Lower Klamath tributaries offer refugia areas that also provide vital habitat for growth and survival (Table 18-6).

As the largest and most intact tributary in the Lower Klamath, Blue Creek is an area where extensive vital habitat exists and therefore an essential area for recovery. Although the lower reaches of Blue Creek have been heavily impacted, the majority of the upper watershed and Crescent City Fork is protected on National Forest lands as wilderness or Late Successional Reserve. The upper Blue Creek drainage contains the highest quality habitat and riparian conditions of all the Lower Klamath tributaries. The Blue Creek wild coho salmon stock represents an important genetic stronghold for the LKR coho salmon population (Gale et al. 1998).

Summer rearing habitat in many LKR tributaries and off-channel areas is also important for coho salmon (Hillemeier et al. 2009, Silloway 2010). Because of seasonally elevated water temperatures in most of the mainstem Klamath River, these tributaries and off-channel areas can serve as thermal refugia during the summer, which can be important for juveniles that have been displaced from other habitat and are forced to rear in the mainstem or estuary or migrate through these habitats to reach the ocean. Refugia are also used by adult fish that enter the Klamath early in the spawning season. Because many tributaries go subsurface, the majority of available thermal refugia are at tributary mouths. Thermal refugia are important for non-natal coho salmon in the mainstem Klamath River. Low velocity refugia are important for non-natal and natal juvenile coho salmon that get flushed out of or actively leave their natal creeks (Soto et al. 2008a, Hillemeier et al. 2009, Hiner et al. 2011, Silloway and Beesley 2011, Pagliuco et al. 2011, Fiori et al. 2011a, Fiori et al. 2011b, YTFP 2012).

Table 18-6. Potential vital habitat within the geographic boundaries of the Lower Klamath River sub-basin.

Stream Name	Stream Name	Stream Name
Hunter Creek[1,2]	Morek Creek[2]	Waukell Creek[1,2,3]
Mynot Creek[1]	Ah Pah Creek[1,2]	Saugep Creek[1,2,3]
Spruce Creek[1,2,3]	N. Fork Ah Pah Creek[1]	Junior Creek[1,2,3]
Panther Creek[1,2,3]	Tarup Creek[1,2]	Salt Creek[1,2,3]
McGarvey Creek[1,2,3]	Tectah Creek[1,2]	High Prairie Creek[1]
West Fork McGarvey Creek[1]	Blue Creek[1,2]	Bear Creek[1]
Terwer Creek[1,2]	Crescent City Fork[1,2]	Roaches Creek[2]
Hoppaw Creek[1]	East Fork Blue[1,2]	Mettah Creek[1]
Richardson Creek[1,2,3]	West Fork Blue[1,2]	Johnsons Creek[1]
Pine Creek[1,2]	Estuary Sloughs[1,2,3]	Cappell Creek[2]
East Fork Hunter[1]	South Fork Ah Pah[1]	Nickowitz[1,2]
East Fork Terwer[1]	Surpur[12]	
[1]High Quality Spawning and/or Rearing Habitat [2]Thermal refugia [3]Flow refugia		

Altered Sediment Supply

Altered (increased) sediment supply represents one of the greatest stresses to the population due to the high degree of sediment loading and aggradation that occurs in LKR tributaries. Past and ongoing increased sediment supply in the LKR sub-basin reduced quantity and quality of coho salmon habitat for all life stages; therefore, NMFS considers altered sediment supply to be an overall very high stress. Timber harvest, removal of riparian and instream LWD, and road building (when combined with the naturally erodible geology of the area and large floods), have resulted in substantial streambed sedimentation, excessive channel widening, loss of riparian forests, and an overall reduction in the quality and quantity of instream fish habitat. Mass wasting is common in the region and causes more downslope movement of material than any other geologic process—including stream action (Harris and Tuttle 1984). Such a high degree of sedimentation combined with the loss of fluvial stored LWD and resilient riparian forests, hinders successful spawning of adult coho salmon and emergence of fry, limits access to rearing habitats, increases competition and predation, and reduces macroinvertebrate densities (Gale and Randolph 2000, Beesley and Fiori 2007b). In over one-half of surveyed stream pool tailouts, embeddedness (as a percent occurrence) exceeded 50 percent and often reached 100 percent (Gale and Randolph 2000, GDRC 2006, 2009). Of the streams surveyed (in the 1990s) in the LKR sub-basin, the highest incidence of embeddedness (>50 percent) were in Roaches, Pecwan, Cappell, West Fork McGarvey, SF Mettah, Johnsons, and Mynot creeks (GDRC 2006). In 2007 to 2008, the frequency of highly-embedded reaches seemed to decrease and Mynot, Hoppaw, and Ah Pah creeks had the highest incidence of embeddedness. Some reaches within these creeks experience high sedimentation and may have unsuitable gravel for egg incubation and fry emergence.

In addition to reduced quality and quantity of spawning gravels, excessive sedimentation also results in the loss of coho salmon habitat and the loss of connectivity within tributaries due to intermittent periods of subsurface flow during periods of low to no precipitation (Beesley and Fiori 2007b). Subsurface flows in the lower reaches and at the mouths of tributaries are due to the interplay of several physical and hydrologic processes, including the timing of sediment transport in tributaries relative to the surface water elevation of the mainstem Klamath River. Deposition of suspended sediment and bedload originating from tributaries occurs when the water surface elevation of the Klamath River is higher than the elevation of the tributary channel. The majority of LKR tributaries flow subsurface during some part of the year (primarily from March to November). During spring and summer, there is a loss of rearing habitat and access to and from the upper watersheds. During the fall, spawning may be delayed in some tributaries due to a lack of access. Sediment from upstream watersheds is not only deposited in tributaries, but also downstream in the mainstem and estuary, forming point bars (where sloughs historically were present) and filling pools where coho salmon were once able to hold in the lower river (Beesley and Fiori 2007b).

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure in the LKR population area is a high to very high stress for all life stages, and is especially stressful to juvenile coho salmon. Most stream reaches are unstable, have simplified instream structure and habitat diversity, excessive erosion and aggradation, and lack suitable spawning gravels, resulting in reduced quality and complexity of instream habitat (Gale and Randolph 2000, Beesley and Fiori 2004, 2007a, 2007b, 2008a, 2008b, 2009). The index of D50 (a measure of median substrate size) can be used to evaluate floodplain and channel structure. Measurements of D50 from Blue, Terwer, and Hunter creeks show variable sediment characteristics between creeks. Although Terwer Creek had very good sediment characteristics, Blue and Hunter creeks had fair to poor spawning gravels (Beesley and Fiori 2008a). Seventy to ninety percent of the particles measured at riffle crests in lower Blue Creek were larger than the preferred median size range (14.5 – 35 mm; Kondolf and Wolman 1993) for salmonid spawning (Beesley and Fiori 2008a).

Recruitment of high quality LWD to fluvial habitats is critical to channel formation, floodplain connectivity, spawning gravel sorting, retention dynamics, and instream structure. Active removal of fluvial deposited wood and decades of no or low LWD recruitment has simplified stream and riparian forest complexity, reduced floodplain connectivity and productivity, and reduced the amount of off-channel habitat. The distribution and abundance of LWD in LKR tributaries has been surveyed by the YTFP and GDRC. YTFP found that LWD in the LKR tributaries ranged from 34 to 537 pieces/mile (average = 230; Gale and Randolph 2000). LWD is the primary cover type in only about 25 percent of LKR tributaries and the lowest densities of LWD (<100 pieces/mile) occurred in Morek, Cappell, and Slide Creek (Gale and Randolph 2000). Conifers comprise between 1 and 19 percent of the riparian canopy in Lower Klamath tributaries and the riparian forest is dominated almost exclusively by deciduous tree species, such as red alder (*Alnus rubra*). Alders are substantially inferior to conifers for maintaining channel stability and floodplain connectivity, and for creating and maintaining productive fluvial habitats for fish and wildlife. However, alders are still important for ecosystem functions in the riparian zone and as large wood in the stream.

Pool depth and frequency is another important characteristic of streams that provides information about instream habitat quality. Pools were infrequent in most surveyed tributaries (average = 20 percent of total stream length while very good conditions would have >50 percent). Pools were most infrequent in Mynot, Omagaar, Tarup, Bear, and Johnsons (GDRC 2006). Pools throughout LKR tributaries were generally shallow with only about 20 percent of pools >3 ft. deep (Gale and Randolph 2000). The tributaries with the lowest number of deep pools (>3 ft.) include Mettah, Bear, Ah Pah, Omagaar, Saugep, Hoppaw, Mynot, and High Prairie creeks. Shallow pool depths likely limit the rearing capacity in many streams. With respect to pool habitat complexity, the percentage of LWD providing structural shelter in pools reflects the quantity and quality of potential salmonid habitat, and possibly the effects of past management practices (GDRC 2006). Most pools lack LWD, especially in the West Fork Blue, Johnsons, Roaches, and Tully creeks (GDRC 2006). In general, the lack of functional instream and floodplain habitat hinders successful spawning and emergence, limits rearing capacity for juveniles, increases competition and predation, alters food webs, and leads to an overall decrease in growth and survival of coho salmon in the population (Gale and Randolph 2000, Beesley and Fiori 2007b, 2008a, 2008b).

Riparian Forest Conditions

Degraded riparian forest conditions are a high stress for all life stages of coho salmon in this population. Past timber harvest practices have resulted in the removal of nearly all mature conifers from tributary riparian areas (Gale and Randolph 2000). Riparian forests of LKR tributaries have not recovered from these activities, and in many cases, succession from deciduous (e.g., red alder) dominated riparian stands to conifer dominated forests is not occurring. Riparian forests comprised of mature native conifers, especially coastal redwoods, are critically important for creating and maintaining the complex, productive stream and floodplain habitats necessary to support Lower Klamath coho salmon populations. Redwood dominated riparian forests facilitate increased channel stability and stream bank protection, provide a continual supply of high quality LWD to fluvial habitats, filter and sort sediment and capture nutrients, provide substantial shade and instream cover, and support complex, self-maintaining stream and riparian food webs. The lack of mature, conifer dominated riparian forests and fluvial LWD recruitment in Lower Klamath tributaries and the mainstem has resulted in increased water temperatures, poor sediment sorting, storage, and delivery dynamics, simplified stream reaches and floodplain areas with low habitat quality (Gale and Randolph 2000). The poorest channel and riparian conditions have been noted in Waukell, Saugep, Surpur, and Little Surpur creeks (Gale and Randolph 2000); however, these conditions persist in virtually every Lower Klamath tributary, including Blue Creek (Beesley and Fiori 2008a).

Currently, conifers comprise less than one third of the riparian canopy along the mainstem lower Klamath River, and in a majority of the tributaries conifers make up less than 15 percent of the riparian canopy. Live conifers comprise less than 25 percent of the potentially recruitable LWD. Examples of a relatively healthy riparian forest include portions of upper Blue Creek where live conifers comprise between 27 and 77 percent of the total canopy and represent between 40 to70 percent of the potentially recruitable LWD (Gale and Randolph 2000). The lower reaches of Blue Creek, in contrast, exhibit poorly functional riparian areas due to channel incision and concurrent loss of floodplain connectivity, bank instability, and impacts resulting from feral cattle and past timber harvest practices in the watershed (Beesley and Fiori 2008a). The lack of riparian cover and forest regeneration in this area has impacted water quality (see below) and significantly reduced salmonid rearing capacity, especially during winter and spring (Beesley and Fiori 2008a).

Impaired Estuary/Mainstem Function

The Lower Klamath River mainstem and estuary provide migratory and rearing habitat for all populations of salmon in the Klamath Basin. Although the Klamath River estuary is relatively intact and unaffected by urban development, several factors limit its ability to support properly functioning habitat for coho salmon (Hiner and Brown 2004, NMFS 2007b, Beesley and Fiori 2004 and 2008b). This stress is regarded as high for this population of coho salmon in the Klamath Basin. The available rearing habitat has been reduced because of levee construction and channel realignment occurring in the Klamath River estuary and in the lower reaches of all of the off-estuary tributaries (e.g., Hunter-Salt Creek slough, Mynot Creek, Hoppaw Creek, and Waukell Creek slough). Large coastal wetlands in the Lower Klamath have been converted into grass pastures for cattle or farming, and the ability of streams to breach their banks and access floodplain habitats during flood events has been severely minimized, especially on the north side of the estuary (Gale and Randolph 2000, Beesley and Fiori 2004, 2008b). A large levee was also constructed around the Klamath Glen community after the 1964 flood and extends along the lower 0.5 miles of Terwer Creek. This levee and others in the lower river have eliminated juvenile access to floodplains, wetlands, and estuarine and tidally influenced sloughs that provide refugia and abundant food resources for rapid growth and increased survival. Patterson (2009) concluded that wetlands in the Klamath River estuary were degraded by various factors ranging from invasive species to cattle grazing and altered hydrology. Sedimentation in the estuary has also reduced quality of estuary habitat through the filling of pools and simplification of instream habitat. Little deep water or off-channel habitat exists in the estuary to provide refugia for coho salmon from high water temperatures in the summer/fall or high flows in the winter.

Mainstem function is a high stress for the LKR population and for other upstream populations due to the conditions encountered when migrating to and from the ocean and while staging and rearing prior to ocean entry. Water quality in the mainstem Klamath River is generally poor (e.g., high turbidity and stream velocities during winter and high water temperatures in summer/fall), and sedimentation from past and ongoing land use have led to substantial reductions in fluvial habitat complexity and loss of refugia. Water temperatures during summer and fall in the lower mainstem Klamath River often exceed upper tolerable thresholds for salmonids (see below). In addition to water quality, water withdrawals from the Klamath River and its major tributaries (e.g., Trinity, Shasta and Scott rivers) have altered the hydrologic regime and resulted in a lowered water table during summer and fall months. Connectivity with most tributaries in the Lower Klamath is impaired during the late summer and fall, and substantial precipitation is usually necessary before access is reestablished in the LKR tributaries for migrating adult salmonids (Beesley and Fiori 2007b). As juvenile coho salmon migrate downstream, the lack of adequate rearing habitat and refugia decreases opportunities for growth prior to ocean entry, which can ultimately influence ocean survival. Although this population has the shortest stretch of mainstem to pass through and has relatively good mainstem water quality compared to upstream reaches, the degradation of mainstem conditions and loss of estuarine habitat together constitute a high stress for this population.

Altered Hydrologic Function

Altered hydrologic function is a high stress for the population with the greatest impacts to juveniles, smolts, and adults which are impacted by altered hydrologic function in LKR tributaries (e.g., excessive sedimentation that results in subsurface flows) and an altered hydrograph in the mainstem Klamath River. The timing, magnitude and extent of flows in the Lower Klamath River from the confluence of the Trinity River to the estuary are altered compared to historic conditions. Generally, spring and summer flows are lower than in the past, while fall and winter flows in the Lower Klamath River are generally similar to historic conditions. The hydrologic function of tributaries in the Lower Klamath has also been altered, evidenced by lower portions of tributaries going dry from late spring to fall because of sediment aggradation. The removal of mature conifers from throughout the Lower Klamath has likely resulted in a change in the "wet season" stream hydrograph. In particular, this change in vegetative canopy and slope cover has likely resulted in more intense peak discharges of shorter duration following storm events (Beesley and Fiori 2007b).

Seasonal intermittent drying is the most common pattern observed in Lower Klamath tributaries (Gale and Randolph 2000, Beesley and Fiori 2007b). Most creeks begin drying up at the mouth in late spring/early summer and subsurface conditions progressively migrate upstream during summer/fall. Subsurface conditions are largely driven by the timing, duration, and magnitude of rainfall and river/tributary flows, excessive sedimentation emanating from tributaries, and the combination of sediment transport and backwater interactions between tributaries and mainstem Klamath. Lower Klamath tributaries such as Terwer and Hunter creeks, begin drying upstream of the mouth and subsurface conditions progress both upstream and downstream of this location as the dry season progresses. Based on YTFP investigations, tributaries that appear most impacted by subsurface flow conditions and that are critically important to Lower Klamath coho salmon include Hunter, Terwer, Ah Pah, Tectah, and Johnsons creeks. Lower Klamath tributaries such as Hunter, Mynot, Hoppaw, Tarup, Omagaar, Bear, and Johnsons creeks were usually the first to begin drying in the spring, and typically experienced periods of subsurface flow during winter and early spring months in the absence of continued, frequent rain events. All of these creeks experienced a disruption or complete cessation of flow during critical juvenile emigration periods for most if not all of the years monitored (Gale and Randolph 2000, Beesley and Fiori 2007b). Because of alterations in the hydrology of tributaries, the timing and magnitude of rains in autumn is crucial for salmonid spawners attempting to gain access to spawning grounds (Voight and Gale 1998), and for juvenile fish seeking refuge in tributary habitats to overwinter (Soto et al. 2008a, Hillemeier et al. 2009).

Impaired Water Quality

Impaired water quality is a moderate stress for this population and is especially detrimental to juveniles, smolts, and adults. The Lower Klamath is listed as impaired for organic enrichment/low dissolved oxygen, sediment/siltation, and water temperature under the Clean Water Act Section 303(d) (NCRWQCB 2008).

Seasonally high water temperatures in the Lower Klamath River, the estuary, and in lower reaches of some LKR tributaries are a limitation for rearing juvenile coho salmon from the LKR and other Klamath Basin populations. Generally, temperatures near the headwaters of LKR tributaries are very good or good, but water quality decreases in the lower reaches (Bjornn and Reiser 1991). Tributaries such as Roaches, Blue, Pine, and Terwer creeks have localized areas of seasonally high water temperature in their lower reaches. YTFP and GDRC have conducted a water temperature monitoring program in Lower Klamath tributaries since 1995 (YTFP 2009b). These efforts have revealed that tributary water temperatures in the Lower Klamath consistently remain within acceptable tolerances for coho salmon (Gale and Randolph 2000, Bell 1991). From 1995 to 2000, the annual variation in average daily water temperature was less than 10 ºC in most Lower Klamath tributaries, with the summer maximum temperature never exceeding 16 ºC in most of these watersheds. Lower Blue Creek had the highest recorded summer water temperatures of all monitored tributaries; however, water temperatures still fell within acceptable tolerances for salmonids throughout the year.

In the Lower Klamath mainstem, maximum water temperatures at three Lower Klamath gauging stations exceeded 24 ºC at times and regularly report temperatures above the critical 22 ºC threshold for most of July and August (Hiner 2006, Beesley and Fiori 2004, 2008b). Temperatures in the estuary have also been recorded as being above lethal thresholds; however, thermal refugia in tidal areas may exist (Wallace 1998, Bartholow 2005). In general, water temperatures in the Lower Klamath mainstem are below 17 ºC in the fall when adults typically migrate upstream, and temperatures do not increase in the spring until most juveniles have outmigrated. However, early adult migrations and late spring and summer juvenile migrations have likely been eliminated as fish are likely forced to leave the mainstem and estuary early, thereby reducing the life history diversity of the population.

Based on current stream and river sedimentation conditions, seasonally high turbidity levels in the Lower Klamath River, and in a majority of its tributaries, are likely a moderate stress to most life stages of coho salmon. Dissolved oxygen (DO) concentrations and pH within the mainstem, estuary, and in some of the off-estuary tributaries are generally adequate but can reach levels which are stressful to coho salmon during late summer. DO concentrations below 7 mg/L have been noted during summer months but are generally above threshold levels during the spring and fall when coho salmon are most abundant in these areas (Hiner and Brown 2004, Hiner 2006, NMFS 2007a, Beesley and Fiori 2004, 2008b). Estuary and mainstem reaches can experience wide diel fluctuations in pH during the summer and have been found to exceed upper thresholds of 8.5 during late summer months. Ammonia toxicity can also be a concern when pH levels are high; however, this is more of a concern in upstream reaches where pH levels are higher (NMFS 2007b).

Adverse Hatchery-Related Effects

No hatcheries or artificial propagation occur in the Lower Klamath population area, but there are two hatcheries in the Klamath River basin. Iron Gate Hatchery is upstream on the Klamath River, and Trinity River Hatchery is on the Trinity River. Hatchery coho salmon were observed during spawning surveys on Blue Creek, a tributary to the Lower Klamath River (Beesley 2010). The proportion of spawning adults in the Lower Klamath River that are of hatchery origin is unknown. Adverse hatchery-related effects pose a medium risk to all life stages, due to the presence of Iron Gate Hatchery and Trinity River Hatchery in the Klamath Basin (Appendix B).

Increased Disease/Predation/Competition

Increased disease, predation, and competition constitute a high stress for most life stages and can have a localized or seasonal impact on both juvenile and adult life stages. Rearing habitat is generally limited in LKR tributaries and competition within these habitats likely results from high seasonal concentrations of juveniles (both natal and non-natal). Off-channel winter habitat and instream summer habitat in upper reaches of tributaries both likely experience density-dependent competition among natal juveniles and between natal and non-natal juveniles. Competition for thermal refugia in mainstem reaches may also be an issue in this population. Some juveniles may rear in the mainstem and estuary and be limited in their distribution due to scarcity of rearing habitat with adequate water quality. Also, adults may need to hold in the mainstem in refugia areas prior to upstream migration due to hydrologic conditions that inhibit access to tributary spawning groups in the Lower Klamath.

Disease is a significant stress to coho salmon in the Lower Klamath River. Diseases that affect adults in the Klamath Basin are primarily from the common pathogens *Ichthyopthirius multifilis* (Ich) and *Flavobacterium columnare* [columnaris; National Research Council (NRC) 2004]. These pathogens were responsible for the 2002 fish kill on the Klamath River (Guillen 2003, CDFG 2004c, Belchik et al. 2004) although adult mortality from Ich and columnaris are not as common as juvenile mortality from *Ceratonova shasta* or *Parvicapsula minibicornis*. Nichols et al. (2003) identified ceratomyxosis, which is caused by *C. shasta*, as the most significant disease for juvenile salmon in the Klamath Basin. Generally, disease exposure is much lower below the Trinity River confluence, but is exacerbated by poor mainstem water quality and stressful conditions in the Lower Klamath River (Bartholomew 2008). Disease effects become most evident as water temperatures rise above 14º C. As with the impacts of poor water quality in the mainstem, some life history strategies may be eliminated due to disease impacts, thereby reducing the viability of the population.

Predation can also have localized impacts, but is generally a natural process unless facilitated by anthropogenic alterations to habitat or predator populations. In the Lower Klamath River, pinniped predation is often speculated to be significant; however, Williamson and Hillemeier (2001) found that pinniped predation rates on coho salmon in 1998 and 1999 were only 0.2

percent and 1.2 percent of returning adult fish, respectively. Pinniped predation rates near shore and in the open ocean may add to this predation. Predation rates on juvenile coho salmon in freshwater may increase seasonally due to inadequate cover and high densities of juveniles in some habitats. Predation rates, while not high, do contribute to a reduction in the number of juveniles that survive and adults returning to the Klamath Basin.

Barriers

Barriers are a medium stress due to the prevalence of flow barriers in most tributaries and the occurrence of road-related barriers. Most tributaries have formed large, persistent gravel deltas at their mouths and these seasonal barriers interrupt successful juvenile emigration in the spring, block adult immigration in the fall, inhibit immigration of non-natal juvenile salmonids, limit the quality and quantity of rearing habitat, increase competition and predation, and alter composition of available food organisms (Payne and Associates 1989, Beesley and Fiori 2007b). There appears to be extensive mortality of juveniles that occurs each year due to subsurface flows, and over-summer survival of natal coho salmon is often reduced by the occurrence of these barriers (Beesley 2010). The dewatering of tributary reaches is primarily the result of excessive aggradation, and loss of fluvial deposited and recruited LWD, as well as altered hydrologic function. Large gravel bars and deltas at the tributary mouths form barriers which require either high tributary or mainstem flows to allow fish passage.

Important road-related fish passage and water conveyance issues have been identified on McGarvey, Waukell, Blue, Terwer, and Richardson creeks. A grade control structure on West Fork McGarvey Creek blocks access to high IP reaches. An undersized culvert on Saugep, Waukell, and Junior creeks; a grade control structure on Waukell Creek (Klamath Beach Road and Hwy 101); and a partially impassible culvert (except at higher Klamath River flows of around 20,000 cfs or higher when backwatering occurs) on Richardson Creek (Klamath Beach Road) block access to important tributary habitat and inhibit geomorphic function and floodplain connectivity and thereby reduce the quality and quantity of rearing habitat (Taylor 2007). The Hwy 169 bridge over Terwer Creek and the GDRC bridge over Blue Creek also inhibit geomorphic function and limit floodplain connectivity in these creeks. Due to the importance of blocked tributary and estuary habitat to the LKR population and other Klamath River populations, providing fish passage at these identified barriers is needed to ensure recovery of SONCC coho salmon.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

18.6 Threats

Table 18-7. Severity of threats affecting each life stage of coho salmon in the Lower Klamath River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Agricultural Practices[1]	High	High	Very High[1]	Very High	High	Very High
2	Channelization/Diking[1]	Medium	Medium	Very High[1]	Very High	Medium	Very High
3	Roads	High	High	High	High	High	High
4	Timber Harvest	High	High	High	High	Medium	High
5	Dams/Diversions	Low	Medium	High	High	High	High
6	Climate Change	Low	Low	Medium	Medium	Medium	Medium
7	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
8	Urban/Residential/Industrial Dev.	Low	Low	Medium	Medium	Medium	Medium
9	Road-Stream Crossing Barriers	-	Medium	Medium	Low	Low	Medium
10	Invasive Non-Native/Alien Species	Low	Low	Medium	Medium	Low	Medium
11	Mining/Gravel Extraction	Low	Low	Medium	Medium	Low	Medium
12	Fishing and Collecting	-	-	Low	Low	Medium	Low
13	High Severity Fire	Low	Low	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are agricultural practices and channelization/diking.

Agricultural Practices

Agricultural practices in the LKR area pose a high to very high threat to coho salmon due to the overlap between agricultural lands and important tributary, mainstem, and estuary habitat. Agriculture in the LKR sub-basin has resulted in the loss of habitat due to draining, diking, or filling of wetland, estuary, and floodplain habitat, the loss of riparian forest and LWD recruitment, and impacts to bank stability and sedimentation. Only a small portion of the Lower Klamath sub-basin is suitable for agriculture but the impacts from agriculture affect some of the most important tributaries and off-estuary habitats for coho salmon, including Salt, Hunter, Mynot, Spruce, Hoppaw, Terwer, Tarup, Panther, and Blue creeks. Portions of the estuary have also been diked and filled for agriculture, especially near the Salt Creek and Hunter Creek confluences and near Rekwoi. The loss of estuarine and tributary habitat is on the order of hundreds of acres of floodplain and wetland habitat (Patterson 2009).

Cattle are actively grazed on private land in Salt, lower Hunter, Mynot, Spruce, Hoppaw, Panther, and lower Terwer creeks. Most of these pastures (except in lower Terwer Creek) are located within the floodplain of the Klamath River. The Hunter, Mynot, Spruce, and Salt Creek pastures were established through diking and conversion of the Hunter Creek slough. The Terwer Creek pastures were established on a large floodplain near the confluence with the Klamath River. Cattle are also grazed on the Klamath River bar at the confluence of Tarup, Pecwan, and Johnsons Creeks. In addition to these established grazing operations, feral cattle exist throughout the Lower Klamath River, particularly in Terwer, Blue, and Bear creeks. Cattle have slowly extended its range over the past 10 years and now extends upstream to the mouth of Slide Creek (Blue Creek tributary), near the lower boundary of the Siskiyou Wilderness Area. Grazing by these feral cattle has degraded riparian function and has created highly unstable banks and high rates of sedimentation and aggradation. Although cattle on Salt, lower Hunter and Mynot creeks have been excluded from the stream channel, cattle operations in these areas remain a significant limitation and threat to coho salmon. In some areas such as Terwer Creek, the YTFP has been working with landowners to provide benefits to both fish habitat and agricultural uses including the construction of two off-channel wetlands and by conversion of hay fields to riparian forests (Fiori et al. 2011a, 2011b, Hiner et al. 2011, Pagliuco et al. 2011, YTFP 2012).

Channelization/Diking

Channelization and diking pose a medium to very high threat to the population due to the associated loss of habitat in the estuary and along many important tributaries. Salt, High Prairie, Hunter, Mynot, Hoppaw, Waukell, Terwer, Saugep, Spruce, and Johnsons creeks have all been impacted by these activities (Gale and Randolph 2000, Beesley and Fiori 2004, 2008b). The lower two miles of Hoppaw Creek have been subjected to levee construction, channel realignment, and channelization for purposes of flood protection and Waukell Creek was realigned and channelized during the relocation of Highway 101 after the 1964 flood. A levee was constructed around the Klamath Glen housing community following the 1964 flood and this levee extends along the lower 0.5 miles of Terwer Creek, between its confluence with the Klamath and the Highway 169 bridge crossing.

Similarly, levee construction has eliminated estuarine slough habitat near the confluence of Salt and Hunter creeks and both these creeks have been channelized through present day pastureland. Hunter Creek levees extend from its mouth to the Hunter Creek subdivision (2.5 miles), while the Salt Creek levees extend upstream of the Requa Road bridge crossing (0.5 miles). High Prairie Creek has been channelized between the Redwood Community subdivision and the Highway 101 bridge crossing (the lower 3,500 feet). Similarly, levees were built along lower Mynot Creek from its confluence with Hunter Creek to upstream of the Margaret Keeting School (Gale and Randolph 2000).

Levees and the channelization associated with them continue to reduce or eliminate hydrologic connectivity of floodplains, wetlands, and estuarine sloughs that provide essential ecosystem functions and productive juvenile rearing areas.

Roads

The density of unpaved roads (>3 mi. per sq. mi) in the Lower Klamath creates a high threat to the coho salmon population. The highest densities of roads (>9.6 mi. per sq. mi) exist in Ah Pah, Surpur, Waukell creeks (Gale and Randolph 2000). Many streams have over 12 road crossings per square mile and the South Fork Ah Pah watershed has over 25 road crossings per square mile (Gale and Randolph 2000). The cumulative sedimentation that has occurred over the past 50 years of road-building and intensive timber harvest has caused significant impacts to stream habitat. GDRC owns and manages approximately 169,600 square miles of lands below the Trinity River confluence for timber production and a majority of roads in the sub-basin exist on these lands. As part of the GDRC HCP (2006), the company has prioritized road upgrades and decommissioning for 30 sub-basins across its Lower Klamath River holdings. Implementation of these measures will contribute to an overall improvement of ecosystem function, habitat quality and quantity through the watersheds with prioritized sites. Although the impacts from some existing roads may decrease through implementation of the HCP, the dominant land use within the Lower Klamath sub-basin is still timber harvest so a majority of these roads will continue to be used and will continue to deliver sediment to streams.

Another major impact from roads is the impact that Highway 101, Highway 169, and rural roads have on estuary and tributary habitat in the Lower Klamath. Highway 101 passes through or borders approximately 3 miles of estuary wetland habitat. In addition to the direct loss caused by the road footprint, the hydrologic connectivity of off-estuary wetlands located in the vicinity of the highway has been altered by the road and associated infrastructure, dikes, and levees along this route (Beesley and Fiori 2008b). This altered hydrology affects estuarine function, especially during storms. Much of the estuary's ability to convey or store high flows without damage to mainstem and tributary channels has been lost. Altered hydrology has also led to downcutting, further separating the streambed from the floodplain. Smaller highways and roads in the sub-basin have a similar effect. For example, the Hwy 169 bridge over Terwer Creek and the GDRC bridge over lower Blue Creek are undersized and limit geomorphic function (Beesley and Fiori 2008a, 2008b). In addition, the Requa Road crossings in lower Salt and Hunter creeks are undersized and the road acts as a levee.

Timber Harvest

Timber harvest is a high threat for a majority of the coho salmon life stages because of the extent of harvest in the Lower Klamath tributaries and the existing poor habitat conditions. The majority of private timber land in the LKR population area is owned by GDRC, and will continue to be harvested for timber. Within GDRC property, harvest occurs at a moderate to high level and under the direction of the company's HCP (GDRC 2006). This plan lays out goals and objectives to minimize and mitigate effects from timber harvest through measures related to road and riparian management, slope stability, and harvesting activities. Timber harvest is still the dominant land use within the Lower Klamath sub-basin and the impacts of these activities, even when carried out under the HCP guidelines, include the reduction of pool habitat, LWD and stream complexity; altered hydrology and nutrient cycling; and increased sediment loads.

Dams/Diversions

Dams and diversions pose a high threat to the majority of coho salmon life stages and have the greatest impact on juveniles, smolts, and adults. Although there are no large dams or major diversions in the Lower Klamath, the large upstream water diversion and the existence of numerous large dams perpetuate impacts on the mainstem Klamath River. Iron Gate, Copco 2 and 1, JC Boyle and Keno dams create significant stresses in the mainstem river (NMFS 2007c, NMFS 2012). Low dissolved oxygen, elevated summer/fall water temperatures, and high nutrients are some of the water quality issues exacerbated by the five mainstem dams. Poor water quality and changes in hydrology in the mainstem has been shown to affect disease incidence and mortality as well.

There are only a few diversions in the LKR sub-basin, and are assumed minor relative to available water supply. Diversions to the Klamath Project and non-Project users in the Upper Klamath sub-basin, the Trinity River Diversion, and diversions from the Scott and Shasta Rivers, decrease the total volume of water that otherwise would have naturally flowed down the Lower Klamath River reach (NMFS 2009a, NMFS and USFWS 2013). The Klamath Project diverts between approximately 245,000 to 350,000 acre-feet (depending on water year type) each year. The Trinity River Division diverts an average of 53 percent (670,393 AF) of the sub-basin runoff at Lewiston. Together, these major diversions cumulatively decrease the natural mainstem flows of the Lower Klamath River by an average of 915,000 to 1,020,000 acre-feet per year. Reductions in flow and changes in the shape of the hydrograph can exacerbate water quality issues in the mainstem and increase the occurrence and severity of sediment barriers at many tributary mouths in the Lower Klamath. These diversions decrease the quantity of mainstem flows on the Klamath River mostly during the spring and summer months, when juvenile access to cooler tributaries and cooler mainstem water temperatures is essential.

Generally, spring and summer flows are lower than historic conditions, while fall and winter flows in the Lower Klamath are generally similar to those in the past.

Climate Change

Climate change poses a medium threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. Although the current climate is generally cool, modeled regional average temperature show a moderate increase over the next 50 years. Average temperatures could increase by up to 1.8 °C in the summer and by 1 °C in the winter. Recent studies have already shown that water temperatures in the Lower Klamath mainstem have already been increasing at a rate of 0.4 °C/decade since the early 1960s (Bartholow 2005). The season of high temperatures that are potentially stressful to salmon has lengthened by about 1 month (Bartholow 2005). Snowpack in the Klamath Basin will likely decrease with changes in temperature and precipitation and these changes will likely impact mainstem and tributary hydrology (California Natural Resources Agency [CNRA] 2009).

The vulnerability of the estuary and coast to changes in sea level is moderate in this region due to projected sea level rise and local rates of subsidence. Juvenile and smolt rearing and migratory habitat are most at risk to climate change as is adult access to tributary spawning habitat. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function and could impact the duration of barriers at the mouths of tributaries. Factors such as the timing, intensity, and extent of rainfall could either improve accessibility to tributaries or make it more difficult for fish to immigrate and emigrate from tributaries. Rising sea level may also impact the quality and extent of wetland rearing habitat in the estuary. Wetlands would naturally migrate inland with rising sea level but there are few places that are unarmored and would allow for this migration. Overall, the range and degree of variability in temperature and precipitation are likely to increase in all populations. Adults will also be negatively impacted by changes in ocean conditions, such as ocean acidification, and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Hatcheries

Hatcheries pose a medium threat to all life stages in the Lower Klamath River sub-basin. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Urban/Residential/Industrial Development

Currently, urbanization is an overall medium threat. The effects of population growth and related development are localized within the LKR population area. The principal population areas near fish-bearing tributaries are Requa, Klamath, and Klamath Glen in the lower portion of the sub-basin, and Wautek (Johnsons) and Pecwan in the upper portion. Activities in the Lower Klamath associated with development include levee construction, water withdrawal, bank armoring, and vegetation removal. The increased use of off-highway vehicles in and next to Lower Klamath tributaries is also associated with development. The tributaries most impacted include Salt, High Prairie, Hunter, Mynot, Hoppaw, Waukell, and Terwer creeks. Land development in the Lower Klamath often results in the loss and degradation of critical floodplain and wetland habitat, especially in the vicinity of the estuary. The existing towns of Klamath, Klamath Glen, and Requa will continue to grow, though slowly. As these towns continue to expand, more infrastructure will likely be needed to protect private property and floodplains will likely be developed to accommodate more growth. This usually results in more levee construction, more roads, and resultant loss of fisheries habitats. In addition, sewage, pollution, water diversions, and removal of riparian vegetation could increase.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Road-Stream Crossing Barriers

Road-stream crossing barriers are a low to medium threat due to the occurrence of several fish passage barriers (Taylor 2007, CalFish 2009). Possible affected streams include McGarvey, Richardson, Saugep, Waukell, Junior Creek, Blue, and Terwer creeks and a Highway 101 grade control structure barrier on West Fork McGarvey Creek blocks access to high IP reaches.

Another impassable highway grade control structure exists on Waukell Creek, and an undersized culvert exists on Richardson Creek that is impassable most of the time except when backwatering occurs from the mainstem Klamath River at higher flows. Several road crossings in the vicinity of the estuary (e.g., Saugep, Junior, and Spruce creeks) have limited passage for coho salmon (Taylor 2007). Several other total barriers exist in the sub-basin, but are on streams where coho salmon have not been documented and no IP exists (e.g., Burrill, Rube, Mareep, Knulthkarn). The culverts on Waukell and Junior creeks are likely to be addressed in the next few years.

Table 18-8. List of road-stream crossing barriers in the Lower Klamath River population area.

Priority	Stream Name	Barrier Type	Road Name	Barrier	Miles of habitat upstream of barrier
High	Salt Creek	Culvert	Requa Road	Partial	>1
High	Richardson Creek	Culvert	Klamath Beach Rd	Partial	1
High	Junior	Culvert	Unnamed	Partial	>1
Medium	Saugep	Culvert	Klamath	Partial	>1
Medium	Spruce	Culvert	Hwy 101	Partial	>1
Medium	Salt	Culvert	GDRC Road	Partial	<1
Low	Waukell Creek	Grade Control Structure	Hwy 101	Complete	>1
Low	Waukell Creek	Culvert	Hwy 101	Partial	<1
Low	McGarvey Creek	Grade Control Structure	Hwy 101	Complete	<1

Invasive Non-Native/Alien Species

A few non-native invasive species may be affecting this population, having a low to medium effect on coho salmon life stages in the population. Bullfrog, bass, sunfish, and brown trout predation potentially have an effect on juvenile coho salmon in certain areas of the LKR population area. In addition to predation, some tributaries in the vicinity of the estuary (e.g., Junior, Waukell, Salt, and Spruce creeks) are currently overgrown with non-native invasive plant species which impact water quality, inhibit the establishment of native riparian species, and dramatically reduce rearing capacity (Taylor 2007). The most prevalent invasive species are reed canary grass (*Phalaris arundinacea*), Himalayan blackberry (*Rubus procerns, Rubus discolor*), common reed (*Phragmites australis*), and the yellow pond lily (*Nuphar lutea*) (Patterson 2009, YTFP 2009b).

Mining/Gravel Extraction

Gravel extraction poses a medium threat to juvenile and smolt coho salmon and a low threat to the other life stages. In the LKR tributaries, there has been only one commercial gravel mining operation, which has extracted 5,000 to 15,000 cubic yards of gravel each year from different locations in lower Hunter Creek during late summer and early fall. Gravel extraction on the LKR mainstem has been limited overall, but mining on mainstem gravel bars and on lower

Terwer Creek has been proposed (McBride 1990). Gravel extraction has also been proposed to address the delta barriers at the mouths of Lower Klamath tributaries, but no such activities have occurred yet. This would not be a long-term solution to the issue, but the gravel operations on the lower Van Duzen River is a good example of how gravel mining can improve fish passage if done correctly. If not managed or designed properly, gravel extractions could disturb juveniles and degrade instream and riparian habitats.

High Severity Fire

The threat of high severity fire in the Lower Klamath is low because climatic conditions do not favor frequent or high-intensity fires in this area. What fire risks do exist in this area are the result of past timber harvest activities, fire suppression, and climate change.

18.7 Recovery Strategy

Although the Lower Klamath River population is currently depressed in abundance and habitat is degraded in most areas, the potential for coho salmon recovery is very high. Based on what is known about habitat availability and quality, spawning habitat and summer and winter rearing habitat appear to be limited by sediment loading and a lack of floodplain and channel structure. Currently, a few key tributaries support the majority of coho salmon production and provide refugia for the population. These and other important tributaries would benefit from strategic restoration actions targeted at reducing upslope sources of sediment, improving riparian function, and enhancing stream habitat complexity and floodplain connectivity.

Restoring or enhancing floodplain and channel structure is particularly important and can be accomplished by placing complex wood jams and/or engineered log jams throughout Lower Klamath tributaries, and critical mainstem and estuary habitats. Constructing these complex and/or engineered log jams, along with other wood loading activities, will facilitate retention of recruited wood, form pools, and connect creeks to their floodplain, promote development of productive and resilient riparian forests, and sort and meter sediment in ways that support vital processes, such as formation and retention of high quality salmonid spawning gravels and storage of fine-grained materials on floodplains. In addition, constructing off-channel habitats, wetlands, and side-channels, removing or setting back levees, decreasing sediment input, and stabilizing uplands are also high priority recovery actions. The immediate restoration and maintenance of LKR tributary riparian forests, hydrologic function, and floodplain and channel structure for spawning and rearing will help increase productivity, abundance, and distribution of the population.

Recovery actions aimed at improving mainstem water quality, tributary access, and estuary habitat will benefit not only the LKR population, but also upstream Klamath River populations that use the LKR sub-basin for non-natal rearing and as migratory habitat. In addition, constructing off-channel ponds, wetlands, and side-channels, removing or setting back levees, decreasing sediment input, and stabilizing uplands are also high priority recovery actions. These restoration efforts can be complemented by providing for the enhancement of beaver populations and the creation of beaver analogue structures in suitable low-gradient habitat. The removal of four mainstem dams in the Upper Klamath as provided in the Klamath Hydroelectric Settlement

Agreement is also important to the improvement of hydrologic function, water quality, and disease conditions in the mainstem Klamath and estuary.

To improve the viability of this population, addressing these limiting stresses and to improve habitat conditions for these life stages throughout the sub-basin will be imperative. Addressing other stresses and threats and improving habitat for all life stages and life history strategies will also be an important component of recovery for this population. For fish from the population that have a life history that depends on the estuary and mainstem river (and for non-natal populations), creating and enhancing complex off-channel slough and wetland habitat and restoring connectivity to this habitat is imperative. Mainstem habitats should also be enhanced to improve overwinter rearing conditions for all life stages and species. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 18-9 on the following page lists the recovery actions for the Lower Klamath River population.

Table 18-9. Recovery action implementation schedule for the Lower Klamath River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LKR.2.2.8	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Mainstem Klamath River, Klamath River Estuary, Terwer, Klamath Glen, Salt, High Prairie, Hunter, Mynot, Hoppaw, Waukell	1
SONCC-LKR.2.2.8.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-LKR.2.2.8.2	*Remove or setback levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-LKR.1.2.39	Estuary	No	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	1
SONCC-LKR.1.2.39.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-LKR.1.2.39.2	*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*					
SONCC-LKR.1.2.39.3	*Restore estuary and tidal wetland habitat guided by the plan*					
SONCC-LKR.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Mainstem Klamath River, Estuary, lower Klamath River tributaries, and all streams where coho salmon would benefit immediately	2a
SONCC-LKR.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LKR.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-LKR.2.1.60	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-LKR.2.1.60.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LKR.2.1.60.2	*Place instream structures, guided by assessment results*					
SONCC-LKR.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Mainstem Klamath River, Estuary, lower Klamath River tributaries, and all streams where coho salmon would benefit immediately	2a
SONCC-LKR.2.2.2.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LKR.2.2.2.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LKR.2.2.61	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-LKR.2.2.61.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LKR.2.2.61.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-LKR.2.2.6	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Mainstem Klamath River, Estuary, and lower Klamath River tributaries, and all streams where coho salmon would benefit immediately	2a
SONCC-LKR.2.2.6.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-LKR.2.2.6.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-LKR.2.2.6.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-LKR.2.2.63	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2b
SONCC-LKR.2.2.63.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-LKR.2.2.63.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-LKR.2.2.63.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-LKR.2.2.4	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect existing off-channel ponds, wetlands, and side channels	Mainstem Klamath River, Estuary, and lower Klamath River tributaries, and all streams where coho salmon would benefit immediately	2a
SONCC-LKR.2.2.4.1	*Assess instream flow conditions and side channel connectivity and develop a plan to obtain adequate flows for channel connectivity*					
SONCC-LKR.2.2.4.2	*Mechanically alter or install constructed wood jams or engineered wood jams in side channels, off channel ponds, and wetlands to achieve and maintain connectivity*					
SONCC-LKR.2.2.4.3	*Install flow gage to ensure appropriate flows*					
SONCC-LKR.2.2.62	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect existing off-channel ponds, wetlands, and side channels	Population wide	2b
SONCC-LKR.2.2.62.1	*Assess instream flow conditions and side channel connectivity and develop a plan to obtain adequate flows for channel connectivity*					
SONCC-LKR.2.2.62.2	*Mechanically alter or install constructed wood jams or engineered wood jams in side channels, off channel ponds, and wetlands to achieve and maintain connectivity*					
SONCC-LKR.2.2.62.3	*Install flow gage to ensure appropriate flows*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LKR.8.1.11	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All Lower Klamath River Tributaries (especially Waukell, Ah Pah, Surpur, Blue, McGarvey, Hoppaw, Mynot, Hunter, Terwer, Tarup) and all areas where coho salmon would benefit immediately	2a
SONCC-LKR.8.1.11.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-LKR.8.1.11.2		*Decommission roads, guided by assessment*				
SONCC-LKR.8.1.11.3		*Upgrade roads, guided by assessment*				
SONCC-LKR.8.1.11.4		*Maintain roads, guided by assessment*				
SONCC-LKR.8.1.68	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2b
SONCC-LKR.8.1.68.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-LKR.8.1.68.2		*Decommission roads, guided by assessment*				
SONCC-LKR.8.1.68.3		*Upgrade roads, guided by assessment*				
SONCC-LKR.8.1.68.4		*Maintain roads, guided by assessment*				
SONCC-LKR.7.1.14	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Blue, Hunter, Hoppaw, Terwer, McGarvey, Tarup, Omagaar, Ah Pah, Bear, Surpur, Little Surpur, Tully, Waukell, Saugep, Tectah	2b
SONCC-LKR.7.1.14.1		*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*				
SONCC-LKR.7.1.14.2		*Thin, or release conifers, guided by the plan*				
SONCC-LKR.7.1.14.3		*Plant conifers, guided by the plan*				
SONCC-LKR.3.1.57	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2c
SONCC-LKR.3.1.57.1		*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*				
SONCC-LKR.3.1.57.2		*Reduce diversions using a combination of incentives and enforcement measures*				
SONCC-LKR.3.1.64	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-LKR.3.1.64.1		*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*				
SONCC-LKR.3.1.64.2		*Reduce diversions using a combination of incentives and enforcement measures*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LKR.8.1.9	Sediment	Yes	Reduce delivery of sediment to streams	Quantify dominant sediment sources and sinks	All areas where coho salmon would benefit immediately	3c
SONCC-LKR.8.1.9.1	*Complete sediment budget*					
SONCC-LKR.8.1.70	Sediment	Yes	Reduce delivery of sediment to streams	Quantify dominant sediment sources and sinks	Population wide	2d
SONCC-LKR.8.1.70.1	*Complete sediment budget*					
SONCC-LKR.7.1.16	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Revegetate riparian areas	Population wide	2d
SONCC-LKR.7.1.16.1	*Control feral cattle to rehabilitate riparian forests*					
SONCC-LKR.8.1.13	Sediment	Yes	Reduce delivery of sediment to streams	Reduce stream bank erosion	All Lower Klamath Tributaries (especially Blue, Waukell, Ah Pah, Terwer, Hunter, Hoppaw, Tarup, Omagaar), all areas where coho salmon would benefit immediately	3a
SONCC-LKR.8.1.13.1	*Inventory sediment sources, and prioritize for treatment*					
SONCC-LKR.8.1.13.2	*Treat priority sediment source sites, guided by assessment*					
SONCC-LKR.8.1.69	Sediment	Yes	Reduce delivery of sediment to streams	Reduce stream bank erosion	Population wide	3b
SONCC-LKR.8.1.69.1	*Inventory sediment sources, and prioritize for treatment*					
SONCC-LKR.8.1.69.2	*Treat priority sediment source sites, guided by assessment*					
SONCC-LKR.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Revise restoration plan	Mainstem Klamath River, Estuary, and lower Klamath River tributaries	3b
SONCC-LKR.2.2.3.1	*Revise the Yurok Tribe's Lower Klamath Sub-basin Restoration Plan to include updated prioritized, site specific restoration treatments for 1) Lower Klamath tributaries; 2) mainstem river habitats; and 3) the Klamath River estuary and off-estuary slough and wetland habitats*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LKR.5.1.40	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	3b
SONCC-LKR.5.1.40.1		*Evaluate and prioritize barriers for removal*				
SONCC-LKR.5.1.40.2		*Remove barriers, guided by the assessment*				
SONCC-LKR.5.1.65	Passage	No	Improve access	Remove barriers	Population wide	3c
SONCC-LKR.5.1.65.1		*Evaluate and prioritize barriers for removal*				
SONCC-LKR.5.1.65.2		*Remove barriers, guided by the assessment*				
SONCC-LKR.3.1.55	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	3b
SONCC-LKR.3.1.55.1		*Identify and cease unauthorized water diversions*				
SONCC-LKR.3.1.58	Hydrology	No	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	3b
SONCC-LKR.3.1.58.1		*Conduct study to determine instream flow needs of coho salmon at all life stages.*				
SONCC-LKR.3.1.58.2		*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*				
SONCC-LKR.3.1.58.3		*Implement coho salmon instream flow needs plan.*				
SONCC-LKR.7.1.15	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Mainstem Klamath River, Klamath River Estuary, Lower Klamath River tributaries (especially Salt, Hunter, Blue, Terwer Creeks), all areas where coho salmon would benefit immediately	3b
SONCC-LKR.7.1.15.1		*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*				
SONCC-LKR.7.1.15.2		*Develop grazing management plans to improve water quality and coho salmon habitat*				
SONCC-LKR.7.1.15.3		*Plant vegetation to stabilize stream bank*				
SONCC-LKR.7.1.15.4		*Fence livestock out of riparian zones*				
SONCC-LKR.7.1.15.5		*Remove instream livestock watering sources*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LKR.7.1.66	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-LKR.7.1.66.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-LKR.7.1.66.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-LKR.7.1.66.3	*Plant vegetation to stabilize stream bank*					
SONCC-LKR.7.1.66.4	*Fence livestock out of riparian zones*					
SONCC-LKR.7.1.66.5	*Remove instream livestock watering sources*					
SONCC-LKR.7.1.54	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Remove reed canary grass in coho salmon habitat	All streams where coho salmon would benefit immediately	3b
SONCC-LKR.7.1.54.1	*Determine appropriate methods to remove reed canary grass in coho salmon habitat*					
SONCC-LKR.7.1.54.2	*Remove reed canary grass in coho salmon habitat*					
SONCC-LKR.7.1.67	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Remove reed canary grass in coho salmon habitat	Population wide	3d
SONCC-LKR.7.1.67.1	*Determine appropriate methods to remove reed canary grass in coho salmon habitat*					
SONCC-LKR.7.1.67.2	*Remove reed canary grass in coho salmon habitat*					
SONCC-LKR.26.1.56	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	3b
SONCC-LKR.26.1.56.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-LKR.10.7.53	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-LKR.10.7.53.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LKR.10.7.53.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-LKR.10.7.59	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-LKR.10.7.59.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LKR.10.7.59.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LKR.8.1.12	Sediment	Yes	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3d
SONCC-LKR.8.1.12.1		*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*				
SONCC-LKR.8.1.10	Sediment	Yes	Reduce delivery of sediment to streams	Reduce erosion	Population wide	3d
SONCC-LKR.8.1.10.1		*Identify and prioritize upslope sources with excessive sediment loads, and design treatments*				
SONCC-LKR.8.1.10.2		*Implement sediment treatments, guided by assessment results*				
SONCC-LKR.3.1.20	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	3d
SONCC-LKR.3.1.20.1		*Develop an educational program about water conservation programs and instream leasing programs*				
SONCC-LKR.3.1.21	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-LKR.3.1.21.1		*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*				
SONCC-LKR.3.1.21.2		*Implement water dedications to increase instream flows using the streamlined process*				
SONCC-LKR.3.1.22	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-LKR.3.1.22.1		*Establish a categorical exemption under CEQA for water leasing to increase instream flows*				
SONCC-LKR.3.1.23	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-LKR.3.1.23.1		*Establish a comprehensive groundwater permit process*				
SONCC-LKR.7.1.18	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
SONCC-LKR.7.1.18.1		*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan)*				
SONCC-LKR.16.1.25	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LKR.16.1.25.1		*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*				
SONCC-LKR.16.1.25.2		*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LKR.16.1.51	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-LKR.16.1.51.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-LKR.16.1.51.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-LKR.16.1.26	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LKR.16.1.26.1	*Determine actual fishing impacts*					
SONCC-LKR.16.1.26.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-LKR.16.1.52	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-LKR.16.1.52.1	*Determine actual fishing impacts*					
SONCC-LKR.16.1.52.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-LKR.16.2.27	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LKR.16.2.27.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-LKR.16.2.27.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-LKR.16.2.28	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LKR.16.2.28.1	*Determine actual impacts of scientific collection*					
SONCC-LKR.16.2.28.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LKR.10.2.45	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-LKR.10.2.45.1	*Develop a pesticide management plan*					
SONCC-LKR.10.2.45.2	*Implement pesticide management plan and technical assistance program*					
SONCC-LKR.2.2.7	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	BR
SONCC-LKR.2.2.7.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-LKR.7.1.17	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce the risk of catastrophic fires on riparian forests by allowing for natural fire regime by creating fire-safe private lands	All Lower Klamath River Tributaries (e.g. Blue, Ah Pah, Terwer, Hunter, Tectah, Surpur, Mettah, Pecwan, Bear)	BR
SONCC-LKR.7.1.17.1	*Develop educational materials for landowners in the urban/rural interface areas and for USFS distribution*					
SONCC-LKR.7.1.17.2	*Develop a plan for fire break stewardship and defensible space*					
SONCC-LKR.7.1.17.3	*Implement fire-safe community action plans in identified areas*					

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19. Redwood Creek Population

Central Coastal Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

4,900 Spawners Required for ESU Viability

293 mi^2 watershed (41% Federal ownership)

151 IP-km (94 IP-mi) (38% High)

Dominant Land Uses are Timber Harvest and Agriculture

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Impaired Estuarine/Mainstem Function'

Key Limiting Threats are 'Channelization/Diking' and 'Roads'

Highest Priority Recovery Actions

• Address design deficiencies of the Redwood Creek Flood Control Project and improve estuarine, transition zone, and lower river habitat while providing flood protection for public safety and property • Increase riparian vegetation in lower Redwood Creek • Remove structural barriers in Strawberry Creek	• Increase large woody debris (LWD), boulders and other instream structure • Increase cool water and thermal refugia in the mainstem and tributaries • Reconnect floodplains, wetlands, and off channel habitat

19.1 Habitat and Land Use Changes in Redwood Creek

Timber harvest, road building, and the construction of flood control levees are the land uses that have had the most pronounced effect on coho salmon habitat in the Redwood Creek basin. Much of the upper and middle portions of the basin are owned by private timber companies and are used for timber production. In addition, livestock grazing occurs on some private lands, both in the middle and upper portions of the basin and in the lower basin, where flood control levees protect the town of Orick and grazing lands. Much of the lower basin is public parkland, managed for protection and restoration of the old-growth redwood forest ecosystem. However, much of the parkland was heavily logged and roaded prior to National Park Service ownership. The largest community in the basin, Orick, is located near the mouth of Redwood Creek. In this valley bottom, 3.4 miles of flood control levees were constructed in 1968 to protect the Orick community and surrounding farm/ranch lands from a 200-year flood event. While providing flood protection for the community, the levees reduced coho salmon habitat by confining Redwood Creek to a 250-foot wide channel and bisecting the estuary.

These past land uses, especially when combined with large floods, have resulted in impacts that have interacted to reduce available aquatic habitat throughout the basin. Increased sediment production from logged hillslopes and roads, especially during the 1955 and 1964 flood events, have choked Redwood Creek with sediment. However, much of the excess sediment deposited in the upper and middle basin in 1964 has since been flushed out of the upper reaches of Redwood Creek and most of the instream excess sediment is now found in the downstream-most reach of Redwood Creek (downstream of Elam Creek) (Madej and Ozaki 2009).

The loss of riparian vegetation has reduced shading, increased stream temperature, and created a lack of instream large wood.

These land uses have resulted in warm, shallow and wide instream habitat conditions that have severely impacted coho salmon and their habitat (Cannata et al. 2006). Most of the basin is now composed of forest stands of smaller diameter trees, with a greater percentage of hardwoods that provide different ecological functions than those found historically. Fortunately, some remaining late seral conifer stands are found within RNSP, particularly within the lower mainstem corridor of Redwood Creek and the Prairie Creek watershed. Redwood Creek is currently listed as both sediment and temperature impaired under the Clean Water Act (Section 303(d)) and three out of the four salmonid species found in the basin are federally listed as threatened under the Endangered Species Act.

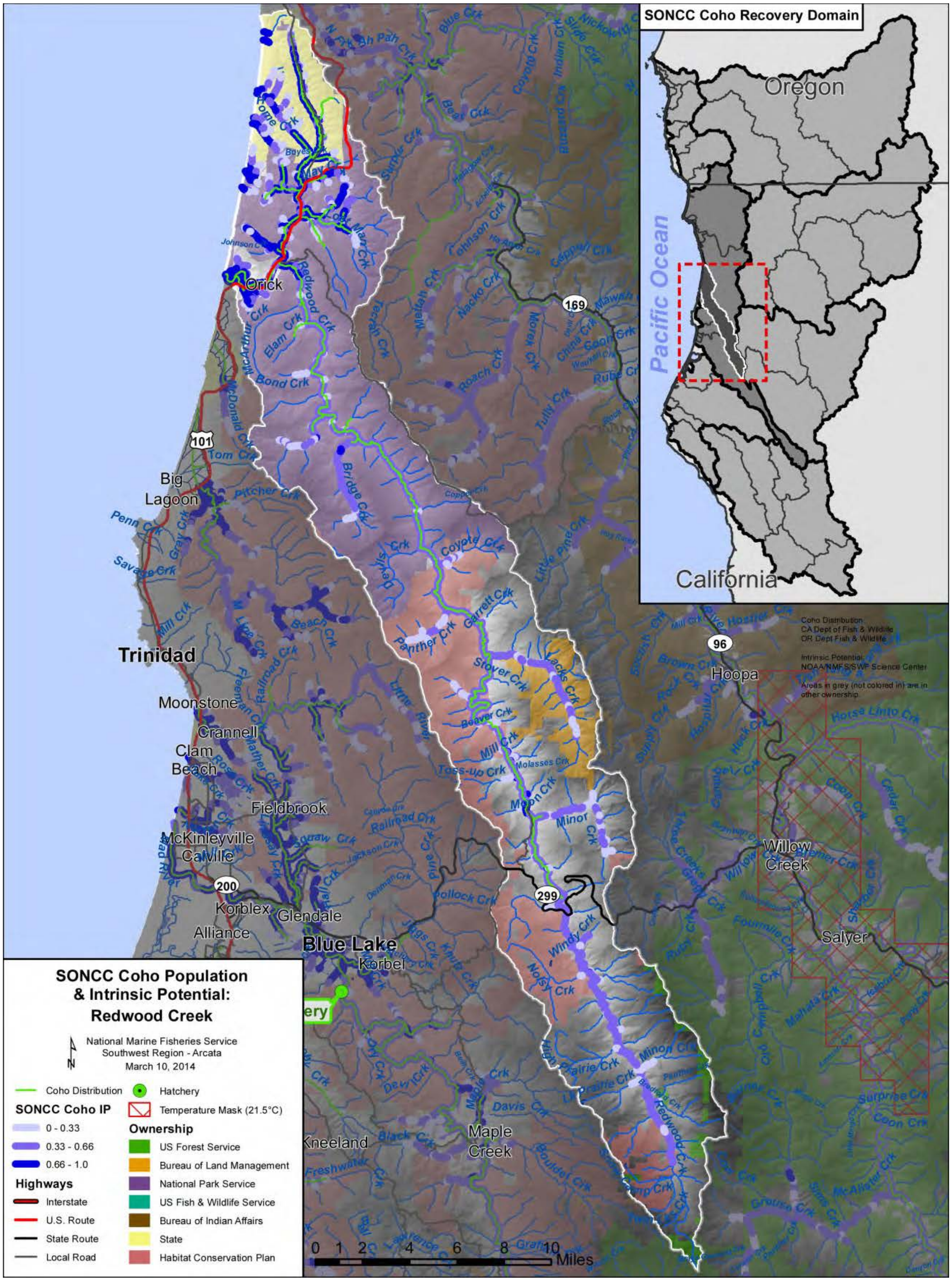

Figure 19-1. The geographic boundaries of the Redwood Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The construction of flood control levees along the most downstream 3.4 miles of Redwood Creek has resulted in loss of estuarine area and habitat value (Cannata et al. 2006). In addition, gravel and riparian vegetation continue to be removed to maintain flood conveyance capacity.

Figure 19-2. Aerial photograph of the Redwood Creek estuary, before levees. This photo, taken in September 1948, prior to the construction of the levees, shows the size of the estuary and amount of riparian vegetation. Note that this photo is not prior to other land use impacts, such as timber harvest. Photo from Klamath River Information System (KRIS).

Figure 19-3. Aerial photograph of the Redwood Creek estuary, with levees. Photo shows the levees and continued gravel and vegetation removal for channel maintenance; note the much-reduced estuary size and reduction in habitat complexity. Redwood Creek estuary in 1988 from KRIS.

19.2 Historic Fish Distribution and Abundance

Aside from the data described in the assessment of population viability detailed further in this section and the IP data shown in Table 19-1, there is limited data that describe the historical coho salmon population in Redwood Creek. Potential coho salmon habitat is distributed throughout the basin. The IP model shows the highest values (IP > 0.66) in Prairie Creek and its tributaries, including Lost Man Creek, and in the most downstream 4 miles of mainstem Redwood Creek, including Strawberry Creek and Sand Cache Creek. The Prairie Creek watershed is almost all park lands managed by RNSP. The downstream 4 miles of Redwood Creek is mostly private land. Table 19-1 shows the areas with high IP. In addition, it is notable that almost the entire length of mainstem Redwood Creek is modeled as having moderate IP (IP between 0.33 and 0.66).

Table 19-1. Mainstem reaches and tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Prairie Creek	Larry Dam Creek	Boyes Creek
Lost Man Creek	All of the unnamed tributaries to Prairie Creek	Brown Creek
Little Lost Man Creek	Middle Mainstem Redwood Creek, near Toss-up Creek	Lower Mainstem Redwood Creek
North Fork and South Fork Lost Man creeks	Godwood Creek	Sand Cache Creek
Streelow Creek	Tom McDonald Creek	Strawberry Creek
Skunk Cabbage Creek	Bridge Creek	
May Creek	McArthur Creek	

Coho salmon have been detected in lower and middle mainstem Redwood Creek, as well as Prairie, Lost Man, Little Lost Man, Streelow, Strawberry, Lacks, Elam, Tom McDonald, Emerald (a.k.a. Harry Weir), McArthur, and Bridge creeks. The historic range includes Coyote, Panther, Minor, Karen (also known as Dolly Varden) and Pilchuck creeks in the Beaver Creek HSA, as well as Sand Cache Creek, tributary to the estuary. Summer dive surveys were conducted in middle mainstem Redwood Creek from 1993 to 1998, and again during 2008 (Weseloh 1996, 2008). These surveys documented juvenile coho salmon rearing in middle mainstem Redwood Creek from Chezem Road Bridge downstream to Stover Creek, although at low densities. Various investigators have found that coho salmon may also use some of the tributaries in the Lake Prairie HSA [Anderson 1988, Brown 1988, Neillands 1990, Pacific Coast Fish, Wildlife and Wetlands Restoration Association 1995, California Department of Fish and Game (CDFG) 2001 surveys, and RNSP unpublished data]. Redwood National and State Parks [RNSP] (2001) described historic presence of coho salmon juveniles and spawning adults in middle and upper mainstem Redwood Creek, including upstream of Highway 299.

Historic estimates of coho salmon abundance in Redwood Creek are scarce. In 1965, CDFG estimated an average run size of 5,000 Chinook salmon, 2,000 coho salmon and 10,000 winter steelhead (CDFG 1965 in Good et al. 2005) for the entire Redwood Creek basin. However, the CDFG report (1965) based the abundance estimates for Redwood Creek on numbers derived from the Eel River, and thus cannot be considered a reliable estimate for Redwood Creek. In addition, the CDFG report (1965) did not include a time period for the estimates of run size. Hallock et al. (1952) seined 9,610 juvenile coho salmon from Prairie Creek and its tributaries in 1951; however, this information does not include seining information from mainstem Redwood Creek and its other tributaries.

19.3 Status of Redwood Creek Coho Salmon

Spatial Structure and Diversity

Currently, except for Prairie Creek, coho salmon have limited distribution in the Redwood Creek basin, most likely due to habitat degradation and high water temperatures in mainstem Redwood Creek (Madej et al. 2006). Although much of the basin is accessible to adult and juvenile coho salmon, high summer water temperatures in the middle portion of mainstem Redwood Creek are believed to limit most of the current juvenile distribution to lower Redwood Creek and its tributaries, and to the Prairie Creek sub-watershed, where summer water temperatures are cooler than in the middle and upper portions of mainstem Redwood Creek (Madej et al. 2006). High summer water temperatures are likely to continue until streamside conifers mature and provide shade that helps to regulate summer water temperatures, and until the mainstem channel condition improves and channel complexity increases so that deep pools could be used as thermal refugia for coho salmon.

During the summer of 2003, RNSP conducted a juvenile coho salmon presence-absence snorkel survey of the lower half of mainstem Redwood Creek. During this survey, no coho salmon were observed in the main channel above river mile 13. A small number of juvenile coho salmon were observed in 9 locations in the section of Redwood Creek between river mile 4.8 and river mile 13 (Ozaki and Anderson 2005).

Additional distribution information is available from Sparkman (2008a, 2008b) who trapped 6 age 0+ coho salmon in mainstem Redwood Creek at river mile 33 in 2007. In addition, Sparkman (2010) trapped 32 age 0+ coho salmon and 7 age 1+ coho salmon at river mile 33 in 2008; the first year in 9 consecutive years of outmigrant trapping in which age 1+ coho salmon were caught in the middle portion of mainstem Redwood Creek. Research is currently ongoing in the Redwood Creek basin to investigate adult abundance and distribution of salmonids, using redds as the population metric. Based on preliminary investigations and professional judgment, coho salmon juveniles and adults are currently present in McArthur, Elam and Bridge creeks, all tributaries to lower to middle mainstem Redwood Creek (Ricker, S., pers. comm. 2011a). Bridge Creek in particular likely contains high quality coho salmon spawning habitat, although the quantity and quality of winter rearing habitat appears limited. Available information suggests limited distribution, particularly in the middle to upper portions of mainstem Redwood, indicating that that the current spatial structure is impaired compared to historic conditions.

Williams et al. (2008) determined that at least 32 coho salmon per-IP-km of habitat are needed (4,900 spawners total) to approximate the historical distribution of Redwood Creek coho salmon and habitat. Although the estimate of historical adult abundance from Williams et al. (2008) includes Redwood Creek and Prairie Creek, the current distribution of spawning adults appears mostly limited to the Prairie Creek sub-watershed. In addition, recent juvenile outmigrant data from Sparkman (2008a, 2008b) suggests that few adult coho salmon are returning to mainstem Redwood Creek each year to spawn.

Regarding life history diversity traits, Redwood Creek is one of the few places in California with documented variation in the period of freshwater juvenile coho salmon rearing. Coho salmon have been generally thought to rear for one year in northern California streams; a two-year rearing period had only been observed farther north (Bell and Duffy 2007). However, Bell and Duffy (2007) observed that 28 percent of outmigrants from Prairie Creek reared in freshwater for two years. This variation in the length of the freshwater rearing period could be critical to coho salmon persistence in Redwood Creek, because it bolsters the population's resilience to environmental disturbance. The more diverse life history traits are expressed (or the more these traits are not restricted), the more diverse a population is, and the more likely that individuals, and therefore the species, would survive and reproduce in the face of environmental variation (McElhany et al. 2000). Bell and Duffy (2007) also found that the size of age 2 smolts from Prairie Creek was not as large as age 1 smolts from other healthy systems (Shapovalov and Taft 1954 *in* Bell and Duffy 2007), indicating that age 2 smolts from Prairie Creek would not mature precociously and return as jacks at any higher rate than age 1 smolts from Prairie Creek.

Population Size and Productivity

Williams et al. (2008) determined at least 151 coho salmon must spawn in the Redwood Creek basin each year to avoid effects of extremely low population size.

The CDFG has trapped outmigrants in mainstem Redwood Creek to provide information on the current viability of salmonid populations in the basin. Sparkman (2011a) has conducted outmigrant trapping in middle Redwood Creek since 2000, with the trap located at river mile 33 (known as the "upper trap"). Since 2004, Sparkman (2011b) has also conducted outmigrant trapping at river mile 4 (known as the "lower trap"), just upstream of where Prairie Creek enters mainstem Redwood Creek. From 2000 to 2006, Sparkman (2007) did not capture any out-migrating coho salmon at the upper trap, suggesting that coho salmon spawning in mainstem Redwood Creek and tributaries upstream of Prairie Creek may have had limited success for about 7 years. However, 6 age 0+ juveniles were captured at the upper trap in 2007 (Sparkman 2008a, 2008b), and 32 age 0+ and 7 age 1+ juveniles were caught at the upper trap in 2008 (Sparkman 2011b).

Low numbers of juvenile coho salmon have been captured at the lower trap during all of the study years. For example, in 2003, 110 age 0+ and 12 age-1+ were captured at the lower trap, in 2004, 202 age 0+ and 69 age-1+ juvenile coho salmon were captured at the lower trap (Sparkman 2004), and in 2010, 6 age 0+ coho salmon and 13 age 1+ coho salmon were captured at the lower trap (Sparkman 2011b). During 2011, Sparkman captured 226 age 0+ coho salmon and 24 age 1+ coho salmon at the lower trap and no coho salmon at the upper trap. Sparkman estimated juvenile population abundances for mainstem Redwood Creek (not including Prairie Creek) of 884 age 0+ coho salmon and 113 age 1+ coho salmon (Sparkman 2011c).

Sparkman (2011c) also began trapping out-migrants from Prairie Creek during 2011 and captured 198 age 0+ coho salmon and 2,449 age 1+ coho salmon at the Prairie Creek trap located at the mouth of Prairie Creek, just upstream from its confluence with Redwood Creek. For 2011, Sparkman estimated juvenile population abundances for Prairie Creek of 726 age 0+ coho salmon and 8,446 age 1+ coho salmon.

Additionally, Duffy (2011) has monitored juvenile and adult coho salmon populations and estimated juvenile and adult abundance in the Prairie Creek sub-watershed since 1998. Duffy

(2011) estimated juvenile abundance using a modified Hankin and Reeves (1988) approach as summarized in Table 19-2.

Using walking surveys to enumerate live fish, redd surveys and carcass mark-recapture studies, Duffy (2011) has also estimated escapement of adult coho salmon to Prairie Creek from 1999 to 2010. These estimates indicate mostly low to occasionally moderate numbers of returning adult coho salmon (Duffy 2011). Numbers of live fish ranged from 680 in 2001-2002 to 28 in 2009-2010 (Table 19-3; Duffy 2011) for the Prairie Creek sub-watershed. Other tributaries to mainstem Redwood Creek contain adult coho salmon (Ricker, S., pers. comm. 2011b) but at unknown abundance levels. Williams et al. (2008) estimated that the historic annual spawner abundance for the entire Redwood Creek population unit was about 4,900. All of the available information suggests that the overall number of coho salmon in the Redwood Creek basin is low compared to modeled historic abundance.

Table 19-2. Estimated abundance of juvenile coho salmon in the Prairie Creek sub-watershed of Redwood Creek (Duffy 2011).

		Pools		**Runs**		**Riffles**		**Total**	
Year	*Month*	*Avg*	*95% CI*	*Avg*	*95% CI*	*Avg*	*95% CI*	*Avg*	*95% CI*
1998	Oct	5080	75	1047	11	0	0	6127	67
1999	Aug	4256	63	1645	23	1229	240	7130	303
1999	Oct	5123	949	1703	27	537	95	7363	850
2000	Aug	2741	138	1733	17	20	0	4494	109
2000	Oct	2622	432	1443	21	22	0	4086	324
2001	Aug	1875	56	728	4	14	0	2617	40
2001	Oct	1588	83	805	8	0	0	2393	62
2002	Aug	4243	886	2919	17	1025	50	8187	657
2002	Oct	4500	2519	2764	32	465	63	7729	1826
2003	Aug	4481	435	2484	24	1699	801	8664	1126
2003	Oct	3709	81	2722	24	686	70	7117	144
2004	Aug	3134	260	1972	24	261	12	5367	231
2005	Aug	1460	93	1391	39	303	30	3154	122
2006	Aug	3870	84	2176	675	701	27	6747	578
2007	Aug	2950	77	1627	72	64	2	4641	107
2008	Aug	3276	217	1698	117	61	1	5035	242
2009	Aug	2465	80	1011	15	565	79	4041	148
2010	Aug	3102	112	1466	17	549	60	5117	153

Table 19-3. Escapement of adult coho salmon to the Prairie Creek sub-watershed during 1999-2011. Estimates are derived from AUC analysis of live fish observations. Year listed is the latter portion of the spawning season (e.g. 1999 = 1998/1999) (Duffy 2011).

Coho Salmon Estimated Adult Abundance		
Year	n	95% CI
1999	56	3.4
2000	84	6.7
2001	212	6.0
2002	680	19.4
2003	542	46.1
2004	268	12.4
2005	643	40.6
2006	349	27.6
2007	165	8.5
2008	466	44.5
2009	127	25.8
2010	28	4.1
2011	218	22.0

Monitoring data and population estimates from Sparkman (2008a, 2008b, 2011a, 2011b, 2011c) and Duffy (2010, 2011) show a negative population trend, as do the apparent long-term declines of coho salmon observed in Redwood Creek. Therefore, the Redwood Creek coho salmon population is at high risk of extinction given its small population size and likely negative trends in numbers of juveniles and adults.

Extinction Risk

The Redwood Creek population is at high risk of extinction because the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Redwood Creek population is a core, Functionally Independent population within the Central Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Redwood Creek core population needs to have at least 4,900 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Redwood Creek population may serve as a source of spawner strays for nearby coastal populations. At present, the capacity of the Redwood Creek coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from nearby rivers may enhance recovery of the Redwood Creek population.

19.4 Plans and Assessments

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. Redwood Creek is described as having periodic high temperatures in the estuary, elevated water temperatures in the mainstem and tributaries, reduction in habitat diversity by channel aggradation and lack of LWD, and high levels of fine sediment and turbidity. Additionally, there is a partial barrier located on Lost Man Creek which was associated with the former Prairie Creek Hatchery.

Redwood Creek Total Maximum Daily Load (TMDL)
http://www.swrcb.ca.gov/northcoast/

NCRWQCB identified Redwood Creek as water quality limited due to its high sediment loads, and designated the basin as a high priority for Total Maximum Daily Load (TMDL) development in accordance with Section 303(d) of the Clean Water Act. The Environmental Protection Agency and the NCRWQCB worked together to complete the sediment TMDL in 1998.

The North Coast Watershed Assessment Program (NCWAP)
http://coastalwatersheds.ca.gov

The NCWAPs Redwood Creek Basin Assessment (Cannata et al. 2006) identified limiting factors for anadromous salmonids including:

- Large reduction in area and habitat quality of the estuary/lagoon;
- Excessive sediment in stream channels, and excessive sediment delivery;
- Lack of large conifer contributions and lack of LWD in stream channels;
- High summer water temperatures; and
- General lack of structural components to create habitat diversity.

Redwood Creek Watershed Group

The Redwood Creek Integrated Watershed Strategy
http://co.humboldt.ca.us/planning/Prop 50/01_RWC_IWS%20Final.pdf

The watershed strategy integrates natural resource considerations with infrastructure needs at the basin scale. The strategy identified restoration of Strawberry Creek, wastewater treatment planning for the community of Orick and sediment source reductions as priority projects.

Redwood National and State Parks

Watershed Rehabilitation Plan (1981)

Management Alternatives of the Redwood Creek Estuary (1983)

Redwood National and State Parks, Humboldt and Del Norte Counties: Final General Management Plan/General Plan, environmental impact statement/environmental impact report - USDI National Park Service and California Department of Parks and Recreation (1999)

Road Strategy: Access and Treatment Priorities for Parkland in the Redwood Creek Watershed (2005)

Planning and strategy documents from RNSP focus on ecosystem restoration, especially road removal and forest restoration efforts. Between 1978 and 2010, the NPS removed 266 miles of roads from Park lands, with 114 miles of road remaining to be treated.

Bureau of Land Management, Arcata Field Office

Lacks Creek Management Area Management Plan

The plan identifies road upgrading and decommissioning opportunities within the Lacks Creek sub-watershed.

Green Diamond Resource Company (GDRC)

Green Diamond Habitat Conservation Plan (HCP)

The GDRC HCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in the Redwood Creek basin. Approximately 25 percent of private land in the middle to upper portions of Redwood Creek basin is owned by GDRC, and managed according to the provisions of their HCP. The HCP has a number of provisions designed to protect coho salmon and salmon habitat on GDRC land. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC's activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of aquatic species. Elements of the HCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. More information about the GDRC HCP can be found in Section 3.2.5.

19.5 Stresses

Table 19-4. Severity of stresses affecting each life stage of coho salmon in Redwood Creek. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Impaired Estuary/Mainstem Function[1]	-	High	Very High[1]	Very High	High	Very High
3	Impaired Water Quality	High	Very High	Very High	Very High	High	Very High
4	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
5	Altered Sediment Supply	Very High	High	High	High	High	High
6	Increased Disease/Predation/Competition	-	Medium	Medium	Medium	-	Medium
7	Altered Hydrologic Function	Medium	Medium	High	Low	Medium	Medium
8	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low
9	Barriers	-	Low	Low	Low	Low	Low
10	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stage, and Habitat

The key limiting stresses for this population are impaired estuarine function and lack of floodplain and channel structure as they have the greatest impact on population productivity. The juvenile life stage is the most limited and high quality winter and summer rearing habitat is lacking for the population. Except for the valuable habitat that the relatively undisturbed Prairie Creek sub-watershed provides (Cannata et. al. 2006), the majority of summer and winter rearing habitat within the basin is in a currently degraded state. Many of the important, high IP tributaries have legacy timber harvest effects, such as large quantities of sediment deposited within stream channels, lack of channel structure and lack of well-distributed large wood, which adversely affect both summer and winter rearing conditions. In mainstem Redwood Creek, high summer water temperatures, increased sediment supply, lack of channel structure, and a lower river and estuary that is disconnected from off-channel floodplain and slough habitat also combine to adversely affect summer and winter rearing habitat.

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure is a very high stress across all life stages. In general, the Prairie Creek sub-watershed contains the best habitat conditions, while the mainstem

Redwood Creek and its other tributaries contain the poorest habitat conditions. The mainstem channel is aggraded, and pool frequency and depth are ranked as poor throughout the mainstem (Cannata et al. 2006). Data on instream wood is limited; however given the poor riparian canopy conditions that exist throughout the mainstem, and based on discussions with RNSP, a lack of instream wood structure is limiting the development of complex habitat throughout much of the basin. The most downstream 3.4 miles of Redwood Creek is disconnected from its floodplain and confined to a channel width of 250 feet by flood control levees, resulting in a lower river channel and estuary that is disconnected from sloughs, wetlands and other low gradient tributaries that once provided important over-wintering rearing habitat. In addition, the lower river channel contains few pools and riffles and generally lacks complexity and structure that is important for rearing juvenile coho salmon.

Impaired Estuary/Mainstem Function

Impaired estuarine function is rated as a high stress for fry and adults, and a very high stress for juveniles and smolts. Prior to the construction of 3.4 miles of flood control levees in 1968, the Redwood Creek estuary was characterized by its size, depth, and complexity, with connected slough channels and estuarine tributaries. The flood control levees cut-off the last meander of Redwood Creek, now known as the south slough, and its tributary, Strawberry Creek. Currently, the estuary covers approximately half of its historic area (Janda et al. 1975). The levees bisect and terminate in the estuary and the estuary is disconnected from much of its historic off-channel rearing habitat. Water quality, water circulation, riparian vegetation, and pool and riffle habitat have all been greatly reduced (Anderson 1995, Cannata et al. 2006). Since the levees created a smaller estuary than what was historically present with less area for coastal processes such as waves and tides to sustain an open estuary, the timing of the closing of the mouth has also changed resulting in a closed lagoon for a longer period of time, which aggravates poor water quality conditions, and can affect juvenile fish passage in the summer and adult fish passage in the fall. The reduction in function of the estuarine system and lower river habitat, which once provided connected sloughs and tributaries for off-channel rearing, is a limiting factor to salmonid production in the basin. Reconfiguration of the levees (i.e., combination of levee setback and/or removal) to restore estuarine and lower river function is critical to recovery of the Redwood Creek coho salmon population (CDFG 2004b).

Impaired Water Quality

Impaired water quality is a very high stress for the fry, juvenile and smolt life stages and a high stress for adults. This stress ranks the severity of water quality issues, except for turbidity and suspended sediment, which are ranked under the altered sediment supply stress. High water temperature in the summer and early fall months stress rearing coho salmon. Redwood Creek is listed as temperature impaired under section 303(d) of the Clean Water Act. High water temperature in mainstem Redwood Creek, including the estuary, is one of the factors limiting coho salmon production in the basin (Sparkman 2006, Cannata et al. 2006). Madej et al. (2006) demonstrated that high summer water temperatures in mainstem Redwood Creek currently limits juvenile coho salmon distribution in the basin and hypothesized that this restriction did not exist historically. Sparkman (2006, 2009) has shown that in some years summer water temperatures are in the lethal range for juvenile coho salmon in the middle section of mainstem Redwood Creek.

Madej et al. (2006) reports that the greatest thermal complexity occurs in lower Redwood Creek upstream of the leveed reach. In this reach, Madej et al. (2006) measured with thermal infrared imaging many cool springs, seeps, side channels and tributaries, and where the water temperatures are influenced by the cooler coastal climate. During the 2003 presence-absence juvenile coho salmon survey (Ozaki and Anderson 2005), 7 of the 9 locations where coho salmon were observed were side pool locations (no coho salmon juveniles were observed upstream of river mile 13). Side pools were separated from the main channel by a gravel bar, but open to Redwood Creek on the downstream end. Many of the pools were influenced by cool seeps and springs, intragravel water flow, groundwater or small tributaries. These pool features were generally cooler than the mainstem of Redwood Creek (Madej et al. 2006). Water quality may also be impaired by pesticides, herbicides and fertilizers, particularly in the middle portion of the basin downstream of Redwood Valley, but the magnitude of this issue in Redwood Creek is currently unknown.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions exist across the basin, and present a high stress to the fry, juvenile, and smolt life stages. Data from RNSP (2006) and the Green Diamond Aquatic Habitat Conservation Plan (GDRC 2006) show that streamside canopy cover conditions vary, with some good to very good conditions (70 percent to 100 percent shade) in tributaries, and poor cover and shade conditions in the mainstem channel of Redwood Creek. However, even where streamside canopy cover is in good condition, many of the riparian areas currently consist of open hardwood, and second-growth dominated forests. Hardwood and small conifer dominated riparian forests provide smaller or short-term large wood recruitment into Redwood Creek compared to historic conditions of large wood supply to the channel from once prevalent old-growth redwood forests. However, while hardwood dominated riparian forests may not contribute as valuable large wood recruitment to stream channels, hardwood riparian forests provide allochthonous contributions, a valuable source of food for salmonids. Hardwood and second growth conifers also provide shade to the stream channel.

Altered Sediment Supply

Altered sediment supply constitutes a high to very high stress across all life stages. Increased sediment delivery has aggraded and widened channels, filled pools and has simplified stream habitat throughout the basin, particularly within mainstem Redwood Creek and its low gradient tributaries. Based on channel surveys, much of this deposited sediment has now moved downstream out of the upper portions of Redwood Creek and has re-deposited in lower Redwood Creek (Madej and Ozaki 2009). Many tributary mouths also had accumulations of sediment that limited access for juveniles and adults (Anderson and Brown 1982), but based on field observations by RNSP, these accumulations or deltas are currently absent or diminished in size. Data from the Prairie Creek watershed suggests that sediment supply may be less of an issue there; for example, measurements suggest that some pools have less fine sediment accumulation than pools in other parts of the basin. However, most data collected on the sediment regime (e.g., high embeddedness) indicate that both stored sediment within the channels, and continued sediment delivery, are critical stresses affecting the population.

High turbidity levels in Redwood Creek are believed to occur more frequently and persist longer than historically (Cannata et al. 2006). RNSP has been measuring turbidity levels in Lost Man Creek at numerous locations since 2002, and has found elevated turbidity from legacy road and stream crossing sediment sources and from first and second year adjustments of recently implemented road removal projects (Klein et al. 2006). In addition, contemporary timber harvest results in elevated turbidity and suspended sediment, particularly with high rates of harvest (Klein et al. 2012). Effects to coho salmon from elevated turbidity include an impaired ability to find food, gill abrasion, food assemblage changes, smothering of eggs and filling of pools with fine sediment.

Increased Disease/Predation/Competition

Increased disease/predation/competition is a medium stress for fry, juvenile, and smolt life stages. Coho salmon are most susceptible to predation in areas that lack cover and channel structure, such as the estuary, particularly when the bar has closed in the summer. Typically, coho have outmigrated prior to the bar closing, however coho using alternative life history strategies may rear in the estuary or outmigrate as smolts later in the season. Because the estuary lacks complexity such as large wood, tidal channels, off channel ponds, or access to the floodplain, coho are vulnerable to predation from birds and possibly larger salmonids. Additionally, the invasive New Zealand mud snail has been documented in the Redwood Creek estuary and lower river (Benson 2011). Since being documented, the population of NZ mud snails has significantly increased and increased their range to the Highway 101 Bridge. New Zealand mud snail colonies disrupt the base of the food chain by consuming algae and competing with native macroinvertebrates (Kerans et al. 2005). A population decline of macroinvertebrates may result from the invasion of New Zealand mud snails, which may in turn reduce the abundance of preferred prey available to coho rearing in the estuary. Further research on *P. antipodarum* is needed to assess the effects of New Zealand mud snails on coho salmon.

Altered Hydrologic Function

Altered hydrologic function is a medium stress for egg, fry, and adult life stages. Low summer stream flows are problematic where increased stored sediment has aggraded the channel, contributed to subsurface flows, and reduced the amount of available rearing habitat. Summer low flows have decreased in Redwood Creek since the 1970s (Madej 2011). This may be due to more water going subsurface in aggraded stream reaches, the re-growth of conifers that use more groundwater, and water diversions.

Reduced hydrologic function (i.e., poor water circulation, changes in the timing of the mouth closing off, low dissolved oxygen) due to the flood control levees also contributes to a significant reduction in available rearing habitat in the lower most 3.4 miles of Redwood Creek. Low fall stream flows can impede adult migrations and low summer stream flows may be aggravated by authorized and unauthorized water diversions, affecting the availability of summer rearing habitat. The high road density in the basin may also be affecting hydrologic function by increasing peak discharges. Another factor in hydrologic function may be the conversion of extensive areas from conifer-dominated to dense hardwood forests (e.g., tan oak). This vegetation change may have influences on summer low flows; however, we are unaware of any studies examining this in Redwood Creek.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Barriers

Physical road and stream crossing barriers are a low stress for all life stages except eggs, which do not require access to other portions of the stream network. RNSP has documented road-related barriers or partial barriers within the park, and is in the process of upgrading or removing these culverts and replacing them with bridges, such as the recently completed opening of access in Streelow Creek and the North Fork of Lost Man Creek. The levees also act as barriers, the south levee allows only partial access to Strawberry Creek and the north levee aggravates sand accumulation at the mouth of the north slough, impeding passage into the slough and Sand Cache Creek (Anderson 1995). Invasive reed canary grass also hampers access in Strawberry and Sand Cache Creeks by choking the stream channel with non-native vegetation. Reed canary grass is currently being removed from Strawberry Creek and native riparian vegetation is being planted that will eventually provide shaded conditions that hamper reed canary grass re-growth. In addition, unnaturally large log jams caused by historic timber harvest practices in tributaries such as Bridge and Lost Man creeks impede coho salmon passage (RNSP 2006, Ricker, S., pers. comm. 2011a).

Adverse Hatchery Related Effects

The Prairie Creek Fish Hatchery produced coho salmon that were stocked into Redwood Creek until 1992. The genetic effect of this hatchery on coho salmon produced in Redwood Creek is unknown. No hatchery fish are currently stocked into Redwood Creek. Hatchery-origin coho salmon may stray into Redwood Creek; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages. (Appendix B).

19.6 Threats

Table 19-5. Severity of threats affecting each life stage of coho salmon in Redwood Creek. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	Very High	Very High	Very High[1]	Very High	High	Very High
2	Channelization/Diking[1]	High	Very High	Very High[1]	Very High	High	Very High
3	Mining/Gravel Extraction	-	High	High	High	Medium	High
4	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
5	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
6	Dams/Diversion	Low	Medium	Medium	Medium	Medium	Medium
7	High Severity Fire	Medium	Medium	Medium	Medium	Medium	Medium
8	Invasive Non-Native/Alien species	Medium	Medium	Medium	Medium	-	Medium
9	Urban/Residential/Industrial Dev.	Medium	Medium	Medium	Medium	Medium	Medium
10	Climate Change	Low	Low	Medium	Medium	Medium	Medium
11	Fishing and Collecting	-	-	-	Low	Low	Low
12	Hatcheries	Low	Low	Low	Low	Low	Low
13	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and channelization/diking.

Roads

Roads are a very high threat across all life stages, except for adult, which is rated as a high threat. Information found in Cederholm et al. (1981) suggests that sediment availability increases in basins with more than three miles of road per square mile of area. As of 2006, Cannata et al. found that the Redwood Creek basin has an average of approximately 4.8 miles of road per square mile of area. Cannata et al. (2006) also found that the road density drops to 2.15 miles of road per square mile of area within the Prairie Creek and lower river sub-basins, and that private lands in the middle and upper portions of the Redwood Creek basin average over 8 miles of road per square mile of area. Although many of the roads in the middle and upper portion of the basin were built prior to current road construction standards, there is an active road improvement program in this area with the goal of reducing sediment delivery to stream channels. Even with active road removal and upgrade efforts, roads, particularly abandoned and unmaintained roads, are a significant source of both chronic and catastrophic sediment input to streams, affecting the quality and quantity of available coho salmon habitat in Redwood Creek and its tributaries. The high road density in Redwood Creek has likely also resulted in an increase in the frequency of road-related landslides in the basin and has increased the sediment yield of landslides. Roads can also affect fish passage where road-stream intersections have not been adequately designed to allow fish passage.

Erosion from roads has been identified by RNSP as the largest controllable source of sediment in the watershed and preventing sediment from reaching the stream is critical. Once sediment is deposited in the stream channels it may take decades to transport out of the stream and can impact many salmonid life-cycles (Madej and Ozaki 2009).

In addition, road building for access to marijuana cultivation sites is common in many areas of the SONCC coho salmon recovery domain. It is likely that many of these roads are unpermitted and contribute excessive amounts of fine sediment to coho salmon streams.

Channelization/Diking

Channelization and diking is a very high threat overall and a very high threat to fry, juvenile and smolt life stages. As previously discussed, the flood control levees and associated channel maintenance activities significantly reduce available habitat in the estuary and lower portion of Redwood Creek. Ecosystem function within the flood control reach will continue to be impaired by the levees and channel maintenance activities until the levees are reconfigured and the design deficiencies of the levees and flood control project are addressed.

Mining/Gravel Extraction

Instream gravel extraction is a high threat to fry, juvenile and smolt life stages, and a medium threat to adult coho salmon. Gravel extraction is not a threat to eggs because gravel extraction does not occur in coho salmon spawning habitat in Redwood Creek. Gravel extraction occurred sporadically between 1968 and 2000, and annually between 2004 and 2010 within the flood control reach of the most downstream 3.4 miles of Redwood Creek. Most gravel extraction occurred as part of Humboldt County's channel conveyance maintenance program required by the Army Corps of Engineers' (Corps) Operations and Maintenance Manual for the flood control levees. Some commercial gravel extraction also occurred prior to 2000 within this reach.

The gravel extraction that occurs as channel maintenance is permitted by the Corps and the permit contains numerous measures to reduce the effects on fish habitat, such as a head-of-bar buffer to provide for channel steering around skimmed gravel bars, and a 2-foot vertical offset from summer low flow water surface elevations to provide low to moderate channel confinement. However, even with minimization measures, gravel extraction reduces overall habitat complexity and reduces the quality and quantity of available pool and velocity refuge habitat. Given the sensitivity of the channel to disturbance (i.e., current lack of floodplain and channel structure), and the potential use of the gravel extraction reach by coho salmon juveniles for summer rearing (e.g., if habitat is restored in this reach) due to relatively cooler summer water temperatures than upstream, gravel extraction is a significant threat to rearing juveniles and a moderate threat to adults who require resting habitat in pools during upstream migration.

Timber Harvest

Timber harvest is a medium threat to the coho salmon population in Redwood Creek. Many of the changes in instream and riparian conditions in Redwood Creek are a result of intensive timber harvest in previous decades. Although current timber harvest practices are more protective of coho salmon habitat than previous practices, timber harvest continues to affect coho salmon in Redwood Creek by increasing sediment yield and by reducing streamside shading and potential large wood recruitment. Approximately half of the basin is in private ownership as industrial timber land, and timber harvest continues in the middle and upper portions of Redwood Creek. In addition, forest lands are being cleared and graded to create new marijuana cultivation sites. In many cases the land disturbance is not regulated, and likely contributes excessive amounts of fine sediment to coho salmon streams.

Agricultural Practices

Grazing occurs in the lowest reaches of Redwood Creek as well as in the middle and upper portions of the basin and may contribute to increased sediment generation and delivery and decreased riparian vegetation. However, specific information on the magnitude of the threat is limited. Water withdrawals for agricultural uses are discussed in the "Dam/Diversions" section, and the effects of the channelization and dikes, which were installed in the lower reaches of Redwood Creek partly to control flooding on agricultural land, are considered in the "Channelization/diking" section of this profile. Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the magnitude in Redwood Creek is unknown, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality.

Dams/Diversions

Dams and diversions are of medium threat to the Redwood Creek coho salmon population. Water withdrawals (authorized and unauthorized) for domestic and agriculture use occur in the Orick area, in Redwood Valley and in the upper basin. The water withdrawals affect stream flow quantity in the summer, affecting the availability of summer rearing habitat. From the 1950s through 2002 summer dams were constructed in the Redwood Valley area, but these dams have been denied permits by CDFG since 2003 and summer dams are not a current threat to passage. However, there may be legacy effects from summer dam construction in the form of fine sediment deposition in stream gravels and reduced invertebrate production at the previous dam sites.

Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the number and magnitude of diversions in Redwood Creek is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (Bauer 2013b).

High Severity Fire

The vegetation characteristics throughout the basin present a moderate threat for high severity fires that could alter the sediment delivery regime as well as riparian vegetation characteristics. Most of the basin contains forests of small diameter trees that are close together. These types of previously logged forests burn with greater intensity than late seral forest stands, and high severity forest fires create an erosion hazard. The increased sediment yield from high severity fires would likely deliver sediment to coho salmon habitat in the basin, filling pools and reducing habitat complexity. Conversion of extensive conifer-dominated forests to dense hardwood stands has also likely increased fire risk. However, the Prairie Creek sub-watershed that offers the best habitat available for coho salmon within the basin contains predominately old growth redwood trees that burn with a lower intensity than the second growth found throughout much of the rest of the basin.

Invasive Non-Native/Alien Species

New Zealand mud snails (NZMS) were discovered within lower Redwood Creek in late 2009. This invasive non-native species has very high secondary production (Hall et al. 2006), may out-compete native invertebrates, and provides little food value for juvenile salmonids (Vinson et al. 2007). In addition, Strawberry and Sand Cache creeks, low gradient tributaries to the estuary, contain reed canary grass that is choking the channel, outcompeting native riparian vegetation and adversely affecting water quality, passage and access for coho salmon (Love 2008).

Urban/Residential/Industrial Development

Rural population growth will continue to present a medium threat to coho salmon in Redwood Creek. Such growth can result in removal of vegetation, increased sediment generation and delivery, introduction of exotic species, water withdrawals from stream channels and inadequate septic facilities and pesticide use that affect water quality. Some of the rural growth is in the middle to upper basin, and much of the rural growth is in the Orick area, with some of the growth planned for the floodplain in the flood control levee reach of lower Redwood Creek.

Climate Change

Climate change poses a medium threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles and adults. The current climate is generally cool near the coast and moderately hot inland. Modeled regional average temperature shows a moderate increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 1.6 °C in the summer and by up to 1 °C in the winter. Annual precipitation in this area is predicted to change little over the next century. The vulnerability of the estuary and coast to sea level rise is moderate in this population. Juvenile and smolt rearing and migratory habitat is most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation will affect water quality and hydrologic function in the summer and winter. Rising sea level will affect the quality and extent of estuarine rearing habitat for juveniles and smolts. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, as with all populations in the ESU, adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008). In addition, the frequency and distribution of coastal fog, which is important for maintaining the redwood ecosystem, may be reduced with climate change (Johnstone and Dawson 2010).

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Redwood Creek population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Road-Stream Crossing Barriers

Road-stream crossing barriers are a low threat to the population. Most of the existing road-stream crossing barriers occur in high gradient tributaries upstream of coho salmon habitat.

19.7 Recovery Strategy

Coho salmon in the Redwood Creek basin are severely depressed in abundance, and restricted in spatial distribution. Recovery activities in the basin should promote increased spatial distribution, particularly in the mainstem of Redwood Creek and tributaries such as Bridge Creek, as well as increased productivity and abundance. Efforts to increase distribution will also likely yield increases in diversity, abundance and productivity. Secondly, preservation of observed life history diversity (i.e., two years of freshwater rearing) should be encouraged.

Activities should occur basin-wide, with a focus on Prairie Creek and its tributaries, and lower mainstem Redwood Creek and its tributaries, where much of the low gradient habitat exists. Top priorities in the basin include restoring estuarine function and river connectivity to sloughs, wetlands, tributaries and floodplain habitat through levee reconfiguration, reducing summer stream temperatures in mainstem Redwood Creek by the addition of channel complexity features that will promote pool development and thermal refuge (such as large wood), especially near cooler tributaries, springs and cool seeps, and reducing sediment sources that have a high risk of delivering sediment to stream channels. Road removal and upgrades, improvements in riparian vegetation, reduction of effects from timber harvest, and improvement in channel structure are priorities in the upper basin.

Other important actions include restoring wetlands, low gradient channels, off-channel habitat, sloughs and tributaries in lower Redwood Creek, including Strawberry Creek, and the north slough channel (Sand Cache Creek), reducing gravel removal that is associated with design deficiencies of the levees, and vegetation removal associated with levee maintenance, and minimizing timber harvest impacts on riparian corridors to promote large wood delivery to stream channels. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 19-6 on the following page lists the recovery actions for the Redwood Creek population.

Table 19-6. Recovery action implementation schedule for the Redwood Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-RedC.1.2.5	Estuary	Yes	Improve estuarine habitat	Address the Corps' design deficiencies of the Redwood Creek Flood Control Project and improve estuarine, transition zone, and lower river habitat while providing flood protection for public safety and property.	3.4 miles each side of Redwood Creek from mouth upstream to end of levees	1
SONCC-RedC.1.2.5.1	*Develop a plan to address the design deficiencies of the flood control project, modify or reconfigure the levees, and restore the estuary and natural stream channel habitat*					
SONCC-RedC.1.2.5.2	*Obtain authorization (including Congressional authorization, if needed) to modify or reconfigure the flood control project in order to address design deficiencies, reduce levee maintenance, and improve estuarine, transition zone, and lower river habitat. Modification or reconfiguration could include a new flood protection level, and a modified Operations and Maintenance Manual.*					
SONCC-RedC.1.2.5.3	*Acquire land or conservation easements from willing sellers/owners to support levee reconfiguration or modification*					
SONCC-RedC.1.2.5.4	*Implement reconfiguration or modification of the levees to restore the form and function of the estuary, transition zone and lower river habitat, and to connect the channel with tributaries, sloughs, wetlands and other off-channel habitat, while still providing flood protection.*					
SONCC-RedC.1.2.5.5	*Improve instream habitat after levee modification with additional channel structure, such as LWD and boulders*					
SONCC-RedC.7.1.38	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase riparian vegetation	Lower Redwood Creek, 3.4 miles each side	1
SONCC-RedC.7.1.38.1	*Assess the influence of vegetation on the Redwood Creek levees for levee structural integrity*					
SONCC-RedC.7.1.38.2	*If needed, develop a variance to the Army Corps policy that provides for levee structural integrity and habitat improvement*					
SONCC-RedC.7.1.38.3	*Maintain and/or improve riparian vegetation in lower Redwood Creek, which could include implementation of a variance to the typical Army Corps vegetation on levees policy, or alteration of other Army Corps standards*					
SONCC-RedC.1.2.32	Estuary	Yes	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	2a
SONCC-RedC.1.2.32.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-RedC.1.2.32.2	*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*					
SONCC-RedC.1.2.32.3	*Restore estuary and tidal wetland habitat guided by the plan*					
SONCC-RedC.2.1.4	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2a
SONCC-RedC.2.1.4.1	*Assess habitat to determine beneficial location and amount of instream structure needed, focus assessment on stream locations impaired by past land use practices and/or floods*					
SONCC-RedC.2.1.4.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-RedC.2.1.58	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-RedC.2.1.58.1	*Assess habitat to determine beneficial location and amount of instream structure needed, focus assessment on stream locations impaired by past land use practices and/or floods*					
SONCC-RedC.2.1.58.2	*Place instream structures, guided by assessment results*					
SONCC-RedC.2.2.36	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-RedC.2.2.36.1	*Assess habitat to determine where potential exists for floodplain connection. Prioritize sites and determine best means for improving floodplain connection or increasing off-channel habitat at each site*					
SONCC-RedC.2.2.36.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-RedC.2.2.59	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-RedC.2.2.59.1	*Assess habitat to determine where potential exists for floodplain connection. Prioritize sites and determine best means for improving floodplain connection or increasing off-channel habitat at each site*					
SONCC-RedC.2.2.59.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-RedC.2.2.40	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Modify the operation of the diversion structure located at mouth of Strawberry Creek/South Slough to increase access to off-channel and tributary habitat.	Strawberry Creek	2a
SONCC-RedC.2.2.40.1	*Assess the timing and operation of the diversion structure to determine impacts to coho salmon*					
SONCC-RedC.2.2.40.2	*If needed, modify the timing and operation of the diversion structure to increase the connectivity between Strawberry Creek and Redwood Creek*					
SONCC-RedC.5.1.10	Passage	No	Improve access	Remove structural barriers	Known barriers (5) in Strawberry Creek	2a
SONCC-RedC.5.1.10.1	*Assess culverts and develop a plan to provide passage at all life stages through the upgrade of the culverts*					
SONCC-RedC.5.1.10.2	*Upgrade culverts, guided by the plan*					
SONCC-RedC.8.1.13	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	Population wide	2a
SONCC-RedC.8.1.13.1	*Update sediment source inventories as needed, include abandoned and unmaintained roads*					
SONCC-RedC.8.1.13.2	*Prioritize the sediment sources that have the most potential to deliver sediment to Redwood Creek, such as Lacks, Minor and Toss-Up creeks, and also prioritize based on the likelihood of successfully controlling the sediment source (e.g., reducing sediment generated from road related landslides is difficult, whereas sediment from unmaintained roads is easier to treat and control).*					
SONCC-RedC.8.1.13.3	*Implement sediment treatments, guided by assessment and prioritization results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-RedC.10.1.41	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Mainstem Redwood Creek and its tributaries, and all streams where coho salmon would benefit immediately	2a
SONCC-RedC.10.1.41.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-RedC.10.1.41.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-RedC.10.1.41.3	*Increase riparian vegetation and shading at sources of cool water*					
SONCC-RedC.10.1.56	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Population wide	2b
SONCC-RedC.10.1.56.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-RedC.10.1.56.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-RedC.10.1.56.3	*Increase riparian vegetation and shading at sources of cool water*					
SONCC-RedC.27.2.35	Monitor	No	Track habitat condition	Determine best indicators of estuarine condition	Estuary	2a
SONCC-RedC.27.2.35.1	*Determine best indicators of estuarine condition*					
SONCC-RedC.2.1.6	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase conifer riparian vegetation	Population wide	2b
SONCC-RedC.2.1.6.1	*Assess riparian zone for size and distribution of conifers and hardwoods, include assessment of canopy closure over stream channels*					
SONCC-RedC.2.1.6.2	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-RedC.2.1.6.3	*Where current near-stream forest canopy is dominated by hardwoods and conditions are appropriate, consider cautious thinning of hardwoods, or small crowded conifers, to hasten the development of larger conifers and more extensive conifer canopy and large wood recruitment. Plant riparian vegetation as needed.*					
SONCC-RedC.2.1.6.4	*Pursue land conservation tools (e.g., easements) in Redwood Creek and tributaries to protect near-stream areas and to retain large conifers in the riparian zone*					
SONCC-RedC.2.1.6.5	*Use THP review process or other planning processes to promote growth of riparian conifers and recruitment to the stream channel*					
SONCC-RedC.5.1.11	Passage	No	Improve access	Increase passage by reducing invasive species	Within mainstem Prairie Creek and its tributaries, and within the channels, tributaries and sloughs in Strawberry, Dorance, and Sand Cache creeks.	2b
SONCC-RedC.5.1.11.1	*Eradicate reed canary grass*					
SONCC-RedC.5.1.11.2	*Plant, or encourage growth of, native vegetation to shade out emergent reed canary grass*					
SONCC-RedC.5.1.11.3	*Monitor treatment areas to ensure eradication was successful*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-RedC.5.1.61	Passage	No	Improve access	Increase passage by reducing invasive species	Population wide	2d
SONCC-RedC.5.1.61.1	*Eradicate reed canary grass*					
SONCC-RedC.5.1.61.2	*Plant, or encourage growth of, native vegetation to shade out emergent reed canary grass*					
SONCC-RedC.5.1.61.3	*Monitor treatment areas to ensure eradication was successful*					
SONCC-RedC.7.1.14	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2b
SONCC-RedC.7.1.14.1	*Apply best management practices for timber harvest*					
SONCC-RedC.7.1.14.2	*Assess and track the rate of timber harvest in the Redwood Creek basin*					
SONCC-RedC.7.1.14.3	*Generate a map of harvest rates by sub-watershed to use in timber harvest planning and evaluation*					
SONCC-RedC.26.1.55	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-RedC.26.1.55.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-RedC.8.1.16	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	2b
SONCC-RedC.8.1.16.1	*Develop grading ordinance for maintenance and building of private and County roads that minimizes effects to coho salmon*					
SONCC-RedC.8.1.12	Sediment	No	Reduce delivery of sediment to streams	Reduce risk of catastrophic fire	Population wide	2b
SONCC-RedC.8.1.12.1	*Identify forested stands for fire hazard reduction*					
SONCC-RedC.8.1.12.2	*Based on assessment, apply appropriate management techniques (e.g. thinning, burning) to reduce risks of high severity fire while also minimizing the risk of sediment delivery associated with the fuels management technique.*					
SONCC-RedC.8.1.15	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Focus in mainstem Redwood Creek and its tributaries, and all streams where coho salmon would benefit immediately	2b
SONCC-RedC.8.1.15.1	*Continue to assess, update, and prioritize road-stream connection, and identify appropriate treatment to meet objective*					
SONCC-RedC.8.1.15.2	*Decommission roads, guided by assessment*					
SONCC-RedC.8.1.15.3	*Upgrade roads, guided by assessment*					
SONCC-RedC.8.1.15.4	*Maintain roads, guided by assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-RedC.8.1.64	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2d
SONCC-RedC.8.1.64.1		*Continue to assess, update, and prioritize road-stream connection, and identify appropriate treatment to meet objective*				
SONCC-RedC.8.1.64.2		*Decommission roads, guided by assessment*				
SONCC-RedC.8.1.64.3		*Upgrade roads, guided by assessment*				
SONCC-RedC.8.1.64.4		*Maintain roads, guided by assessment*				
SONCC-RedC.7.1.54	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase riparian vegetation	Lower Redwood Creek, 3.4 miles each side	2c
SONCC-RedC.7.1.54.1		*Exclude livestock from riparian areas*				
SONCC-RedC.7.1.7	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	3a
SONCC-RedC.7.1.7.1		*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*				
SONCC-RedC.7.1.7.2		*Develop watershed-specific guidance for managing riparian vegetation, and limiting removal of wood from stream channels*				
SONCC-RedC.7.1.9	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Private, non-HCP lands	3a
SONCC-RedC.7.1.9.1		*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan).*				
SONCC-RedC.10.2.42	Water Quality	No	Reduce pollutants	Reduce water pollutants not described in TMDLs	Population wide	3a
SONCC-RedC.10.2.42.1		*Assess current water quality and develop a plan to improve water quality as needed*				
SONCC-RedC.10.2.42.2		*Implement the plan to improve water quality and reduce pollutants*				
SONCC-RedC.10.1.45	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Develop and implement TMDLs	Population wide	3a
SONCC-RedC.10.1.45.1		*Develop temperature TMDL for water bodies listed under Clean Water Act Section 303(d)*				
SONCC-RedC.10.1.45.2		*Implement sediment TMDL for water bodies listed under Clean Water Act Section 303(d)*				
SONCC-RedC.10.1.45.3		*Implement temperature TMDL for water bodies listed under Clean Water Act Section 303(d)*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-RedC.5.1.37	Passage	No	Improve access	Improve access to habitat	Known barriers in Prairie Creek, Skunk cabbage creek, all streams where coho salmon would benefit immediately	3b
SONCC-RedC.5.1.37.1		*Assess and prioritize barriers. Develop a plan for removal*				
SONCC-RedC.5.1.37.2		*Remove barriers, based on evaluation*				
SONCC-RedC.5.1.62	Passage	No	Improve access	Improve access to habitat	Population wide	3d
SONCC-RedC.5.1.62.1		*Assess and prioritize barriers. Develop a plan for removal*				
SONCC-RedC.5.1.62.2		*Remove barriers, based on evaluation*				
SONCC-RedC.3.1.39	Hydrology	No	Improve flow timing or volume	Assess water diversions and effects to instream flows	All streams where coho salmon would benefit immediately	3b
SONCC-RedC.3.1.39.1		*Assess the effects of water diversions on instream flows*				
SONCC-RedC.3.1.39.2		*Using regulatory mechanisms, modify water diversion practices to ensure adequate instream flows*				
SONCC-RedC.3.1.60	Hydrology	No	Improve flow timing or volume	Assess water diversions and effects to instream flows	Population wide	3c
SONCC-RedC.3.1.60.1		*Assess the effects of water diversions on instream flows*				
SONCC-RedC.3.1.60.2		*Using regulatory mechanisms, modify water diversion practices to ensure adequate instream flows*				
SONCC-RedC.3.1.46	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	3b
SONCC-RedC.3.1.46.1		*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*				
SONCC-RedC.3.1.46.2		*If needed, develop plan to reduce effects of marijuana cultivation*				
SONCC-RedC.3.1.46.3		*Implement plan*				
SONCC-RedC.7.1.8	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	All areas where coho salmon would benefit immediately	3b
SONCC-RedC.7.1.8.1		*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*				
SONCC-RedC.7.1.8.2		*Develop grazing management plans to improve water quality and coho salmon habitat*				
SONCC-RedC.7.1.8.3		*Plant vegetation to stabilize stream bank*				
SONCC-RedC.7.1.8.4		*Fence livestock out of riparian zones*				
SONCC-RedC.7.1.8.5		*Remove instream livestock watering sources*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-RedC.7.1.63	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-RedC.7.1.63.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-RedC.7.1.63.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-RedC.7.1.63.3	*Plant vegetation to stabilize stream bank*					
SONCC-RedC.7.1.63.4	*Fence livestock out of riparian zones*					
SONCC-RedC.7.1.63.5	*Remove instream livestock watering sources*					
SONCC-RedC.16.1.19	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3b
SONCC-RedC.16.1.19.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-RedC.16.1.19.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-RedC.16.1.20	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3b
SONCC-RedC.16.1.20.1	*Determine actual fishing impacts from freshwater and ocean fisheries*					
SONCC-RedC.16.1.20.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-RedC.16.2.21	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3b
SONCC-RedC.16.2.21.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-RedC.16.2.21.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-RedC.16.2.22	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3b
SONCC-RedC.16.2.22.1	*Determine actual impacts of scientific collection*					
SONCC-RedC.16.2.22.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-RedC.10.7.53	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-RedC.10.7.53.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-RedC.10.7.53.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-RedC.10.7.57	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-RedC.10.7.57.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-RedC.10.7.57.2	*Supply marine-derived nutrients to streams guided by the plan*					

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20. Maple Creek/Big Lagoon Population

Central Coastal Stratum

Dependent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

46.9 mi^2 watershed (1% Federal ownership)

19 IP-km (12 IP-mi) (61% High)

Dominant Land Use is Timber Production

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Altered Sediment Supply'

Key Limiting Threats are 'Roads' and 'Timber Harvest'

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, and other instream structure • Re-connect existing off-channel ponds, wetlands, and side channels • Reduce road-stream hydrologic connection	• Install bridges at Highway 101 to increase tidal and riverine exchange, reduced channelization, reduce upland conversion, and increase flushing flows to Big Lagoon • Assess estuary and tidal wetland habitat • Remove Gray Creek dam

20.1 History of Habitat and Land Use

Timber harvest has been the single most disturbing activity in the Maple Creek basin. Intensive timber harvest took place between the 1940s and 1960s and effects of the removal of riparian canopy can still be seen in several stream reaches where the alders dominate. Historic timber harvest practices often made use of mill ponds. Gray Creek still has a remnant dam in place and an associated remnant mill pond.

Currently, timber harvest remains as the dominant land use with over 98 percent of the basin owned by Green Diamond Resource Company (GDRC). Current timber harvest regulations and an Aquatic Habitat Conservation Plan (AHCP) help protect the river from the destructive practices that originally took place. Many roads have been constructed throughout the basin including for residential development on the south end of Big Lagoon and for access to timberland. Timber management roads, which are often built alongside streams and have many stream crossings, have contributed to erosion, runoff, and excess sediment in streams. Increases in sediment supply have left streams wider and shallower, creating more simplified habitat. In addition, sediment accumulating in Big Lagoon contributes to wetland accretion. Marshland increase is documented including the appearance of alluvial islands downstream of the highway where deeper waters previously existed (Parker 1988).

Other large changes affecting sedimentation rates in the estuary and overall estuarine function include the building of Highway 101 and the construction of a dam on Gray Creek. Built in the 1920s, Highway 101 is on dredge spoils across most of the mile-long estuarine floodplain of Maple Creek. On either side of the highway, remnant dredge ditches can still be seen. Numerous historic tidal channels are truncated by the highway dike and most (approximately 90 percent) of the historic tidal wetland area has been lost (Figure 20-1). Flow from Maple Creek is impeded by Highway 101 during flood events, and backs up on the south side of the highway. The building of the Gray Creek dam has also altered the hydrology of the estuary. In what was historically the upper extent of tidal exchange, the creek now builds up behind the dam in a large lake. Although a channelized stream flows from the mill pond providing connectivity, tidal exchange has been truncated and a large section of tidally influenced rearing habitat has been lost (Figure 20-2).

Harry A. Merlo State Recreation Area and Humboldt Lagoons State Park almost completely surround Big Lagoon, and the California Department of Fish and Wildlife manages Big Lagoon as a wildlife area. The park includes a campground, day use area, and a boat launch on the south end of the lagoon that is operated by Humboldt County. Recreational use includes camping, kayaking, fishing, and wildlife viewing in the creek and the lagoon.

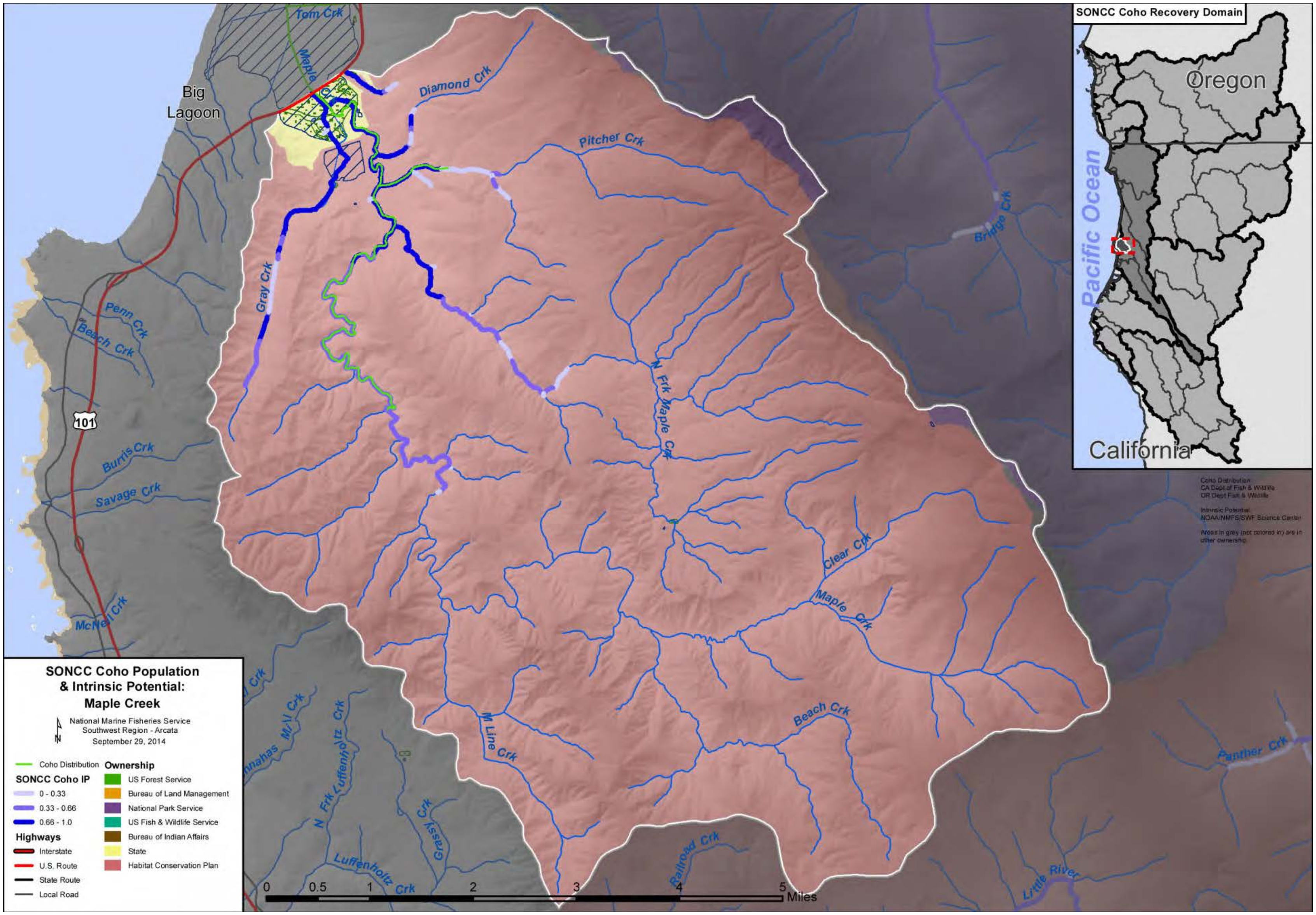

Figure 20-1. The geographic boundaries of the Maple Creek/Big Lagoon coho salmon population (Williams et al. 2006). Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership. Hatched area is included in the Maple Creek/Big Lagoon population area.

Residential development with associated paved or graveled roads is present just off the shoreline of the lagoon next to the park. The Big Lagoon Rancheria owns a nearby 20-acre parcel of land on the south end of Big Lagoon, and there is residential development on this parcel.

Figure 20-2. Photo shows Gray Creek mill pond and channelization of Maple Creek. Note the reduction of tidal exchange as a result of Highway 101.

20.2 Historic Fish Distribution and Abundance

The Maple Creek/Big Lagoon basin has a high potential to support unique life history diversity traits for coho salmon. Maple Creek flows into Big Lagoon, a brackish water body separated from the ocean by a narrow sand spit. Throughout the majority of the year, Big Lagoon is an enclosed lake. Most years, high water levels in the fall and winter cause the lagoon to breach, creating an opening where adult coho salmon can migrate upstream and juvenile salmon can out-migrate to the sea. In low water years when the lagoon does not breach the spit, adult coho salmon cannot enter the basin and juveniles cannot exit the lagoon. Little historic data exists that describes the number of coho salmon in Maple Creek basin or the distribution of fish throughout the basin. The U.S. Fish and Wildlife Service (USFWS) estimated as many as 1,200 coho salmon were present in Maple Creek as late as the 1960s (GDRC 2006).

GDRC, the largest private landowner in the basin, has performed several spawning and juvenile surveys for coho salmon. In the 1998 to 1999 and 1999 to 2000 seasons, no coho salmon redds were observed. Adult coho salmon were not observed in the lagoon or Maple Creek, and one 1+ coho salmon was seen in the summer of 1999 (GDRC 2006). A thorough search of past survey records by CDFG shows that coho salmon have been documented throughout the basin since 1995 (Garwood 2012) (Table 20-1).

Table 20-1. Documented presence of juvenile coho salmon by brood year in the Maple Creek basin. (Garwood 2012).

Stream	BY1995	BY1996	BY1997	BY1998	BY1999	BY2000	BY2001	BY2002
Tom Creek	Y	Y	null	null	null	null	null	null
Maple Creek	null	null	Y	U	Y	U	Y	Y
Pitcher Creek	null	null	Y	U	U	U	U	null
North Fork Maple Creek	null	null	null	U	U	U	null	Y
Y = coho salmon confirmed, U = coho salmon not confirmed, null = not surveyed								

Adult coho salmon have been found lower in the basin during recent spawning and juvenile snorkel surveys (Perry, D., pers. comm. 2009). Adult escapement in streams upstream of the lagoon is likely limited and variable due to the timing of when the lagoon breaches. The absence of 0+ coho salmon during the summer of 1999 and the lack of documented presence for that brood year suggests that Big Lagoon did not breach during the winter of 1998 to 1999, while the presence of 1+ coho salmon indicates that adults were able to enter during the 1997 to 1998 spawning season. The extent to which human activities have changed the timing or frequency of

Accessible habitat with the potential to support rearing coho salmon is distributed throughout most of the basin, with the highest IP values (IP >0.66) in the lower reaches of Maple Creek and its tributaries as well as tributaries to Big Lagoon.

Table 20-2. Tributaries high IP reaches (IP value > 0.66). (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Pitcher Creek	Diamond Creek	Gray Creek
North Fork Maple Creek	Tom Creek	

20.3 Status of Maple Creek/Big Lagoon Coho Salmon

Spatial Structure and Diversity

Spawning, snorkel, and electroshocking surveys have identified coho salmon in the lowest parts of the Maple Creek basin. No juvenile coho salmon were found in Tom Creek, Diamond Creek or Gray Creek in the early 1990s by GDRC. Several natural barriers throughout Maple Creek limit the spatial distribution of coho salmon to the lower reaches of the basin. In addition to the current distribution shown in Figure 20-1, coho salmon also occur in North Fork Maple Creek (GDRC 2006).

The lagoon ecosystem within the Maple Creek basin creates potential for a diversity of life history traits. Because the sand bar does not always breach on an annual basis, emigrating smolts may rear an additional year in the lagoon and adult coho salmon either do not spawn or stray to nearby basins. Diverse life history and gene flow with nearby basins historically increased the overall resiliency of the population and the ESU. Although some of the diverse genetic and life history traits are likely still present, the reduced population abundance diminishes the current diversity of this population.

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 39 coho salmon per-IP-km of habitat are needed (1600 spawners total) to approximate the historical distribution of Maple Creek/Big Lagoon coho salmon and habitat. The currently restricted distribution of coho salmon in Maple Creek/Big Lagoon due to natural barriers, combined with the occurrence of altered bar breach events, further impact this population.

Population Size and Productivity

If a spawning population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 41 coho salmon must spawn in Maple Creek each year to avoid such depensatory effects.

Spawning surveys completed by GDRC documented low abundance of adult coho salmon adults (From 2 in 2003 to 15 in 2011) in 2003, 2005, 2008, and 2011 (GDRC 2013a). The abundance of the Maple Creek/Big Lagoon coho salmon population is depressed. Six coho salmon smolts were captured in late September 2009 near the GDRC Bridge approximately 2.5 miles upstream of Hwy 101 (USFWS 2009a). Productivity of coho salmon within the basin is unknown but assumed to be very low, and population growth is likely neutral or negative.

Extinction Risk

Not applicable because Maple Creek/Big Lagoon is not an independent population.

Role in SONCC Coho Salmon ESU Viability

The Maple Creek/Big Lagoon population is considered dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and likely received sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006). Although such populations may not be fully viable on their own, they do increase connectivity by allowing dispersal among independent populations, acting as a source of colonists in some cases. Historically, the Maple Creek/Big Lagoon population would have interacted with other Central Coastal populations such as the functionally independent Redwood Creek population to the north and the potentially independent Little River population to the south. Any restored habitat in Maple Creek/Big Lagoon provides potential connectivity and increased resiliency in the SONCC coho salmon ESU. An additional factor considered in designating the Maple Creek/Big Lagoon population was the lack of accessibility at the mouth. Because the lagoon does not breach every year, spawners may not be able to enter the watershed, preventing a continuous brood year presence.

There are several populations which may interact with the Maple Creek/Big Lagoon population. Stone Lagoon, which is located just to the north of Big Lagoon, has a similar ecology, where sand spit breaches occur on an annual basis. Adult salmon in some years will not have access to their natal streams when the sand spit remains intact. Those fish must return as strays to other nearby basins. If a breach event were not to occur in Stone Lagoon, but did occur in Big Lagoon, coho salmon may access the Maple Creek basin. Conversely, straying can also occur if returning adults use spawning habitat in adjacent basins when Big Lagoon does not breach. The adjacent basins may also act as potential refugia for this population when Big Lagoon does not breach, thus preventing total loss of that year-class. Because of high straying potential, there is likely a good genetic flow between adjacent basins.

20.4 Plans and Assessments

Green Diamond Resource Company (GDRC)

Green Diamond Aquatic Habitat Conservation Plan (AHCP)

The GDRC AHCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in the Maple Creek/Big Lagoon. Almost all of the 98 percent of private land in the Maple Creek/Big Lagoon basin is owned by GDRC and therefore managed according to the provisions of the AHCP. The plan has a number of provisions designed to protect coho salmon and salmon habitat throughout the Maple Creek/Big Lagoon basin. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC's activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of covered listed aquatic species. Elements of the AHCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. More information about the GDRC AHCP can be found in Section 3.2.5 (Timber Harvest) and Section 3.2.2 (Roads).

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon (CDFG 2004b)was adopted by the California Fish & Game Commission in February 2004. The recommendations developed by CDFG for the Big Lagoon HSA in the Trinidad hydrologic unit address the impacts of timber harvest and restoration of the riparian zone. The strategy identifies recovery actions for the state listed coho salmon.

Maple Creek/Big Lagoon Watershed Inventory and Restoration Planning Project Report

The Maple Creek/Big Lagoon watershed inventory and restoration planning report (Pacific Watershed Associates 2005) identified locations with future road-related sediment delivery, potential projects that could improve in-stream channel conditions for anadromous fish, and a prioritized plan of action for erosion prevention and restoration.

20.5 Stresses

Table 20-3. Severity of stresses affecting each life stage of coho salmon in Maple Creek/Big Lagoon. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	High	High	Very High[1]	Very High	Very High	Very High
2	Altered Sediment Supply[1]	High	High	Very High[1]	Very High	High	Very High
3	Impaired Estuary/Mainstem Function	-	Low	High	Very High	Very High	Very High
4	Altered Hydrologic Function	Low	Medium	High	Medium	Medium	Medium
5	Degraded Riparian Forest Conditions	-	Medium	Medium	Medium	Low	Medium
6	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
7	Impaired Water Quality	Low	Low	Low	Low	Low	Low
8	Barriers	-	Low	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low
10	Increased Disease/Predation/Competition	Low	Low	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are lack of floodplain and channel structure and altered sediment supply. A combination of timber harvest practices and the construction of Highway 101 have significantly reduced the amount and quality of rearing habitat. A large amount of tidal marshland, backwater channels, and wetlands have been converted to dryer uplands due to the highway acting as a dike across the lagoon and an excess of sediment settling in that area. A reduction in large wood simplifies the channel leading to less available refuge during high winter flows and low summer flows. The combined effect of excess sediment filling pools and intertidal rearing areas along with the lack of structure to provide scour mechanisms reduces channel complexity. The juvenile life stage is most limited and quality summer and winter rearing habitat are lacking as vital habitat for the Maple Creek/Big Lagoon population.

The lowest portions of the Maple Creek basin within and just upstream of the estuary contain the highest quality and most connected habitat. There are several small streams that enter the lagoon near the mouth of Maple Creek and tributaries that enter Maple Creek just upstream of the mouth. These tributaries provide the best refuge for coho salmon (Table 20-4), although they are blocked by natural barriers within a half mile. The lower reaches of these small tributaries may still provide refuge from the mainstem Maple Creek or Big Lagoon. Though connectivity has been reduced, the remaining connected habitat between the tidal wetlands and the freshwater tributaries provide a diversity of habitat types and refugia sites. Several of these tributaries have no documented use by coho salmon, but the streams could still potentially provide refugia for juveniles rearing in the lower basin. The lagoon provides prolonged rearing habitat for juveniles, which increases life history diversity for the ESU since the lagoon does not usually breach during the late spring and summer when most other smolts outmigrate to the ocean.

Table 20-4. Potential refugia areas within the Maple Creek/Big Lagoon basin.

Stream Name	Stream Name	Stream Name
Big Lagoon	Tom Creek	North Fork Maple Creek
Maple Creek	Pitcher Creek	Diamond Creek

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure is a high to very high stress across all life stages of coho salmon. Simplified channel and floodplain structure are primarily the result of a lack of large wood in the Maple Creek basin, and an overabundance of fine sediment. Although no surveys of large wood structures are available, the history of intensive timber harvest in the area suggests the basin likely experiences low wood recruitment. Large wood is required to sort sediment, scour pools, and facilitate floodplain connectivity. Surveys in the upper basin indicate pool habitat has been filling with sediment. The oversimplified stream channel and floodplain can no longer provide refugia and rearing habitat for juveniles and lacks habitat features, such as deep pools and side channels.

Altered Sediment Supply

Altered sediment supply presents a high to very high stress for all life stages of coho salmon in the Maple Creek/Big Lagoon basin. Surveys indicate that excess sediment has filled pools, widened channels, and simplified stream habitat throughout the basin, including the lagoon. The input of fines also increases embeddedness of the spawning gravel and can suffocate eggs during development. In addition to negative stream impacts in the basin, the increased sediment supply accumulates upstream of the bridge and downstream into the mouth of the lagoon (Figure 20-3), reducing the size of the lagoon and rearing habitat.

Impaired Estuary/Mainstem Function

The impaired estuary/mainstem function stress refers to only the estuary conditions in Maple Creek/Big Lagoon since this is a single population basin. Mainstem conditions are addressed through other stresses, such as floodplain and channel structure, riparian condition, and hydrologic function. Estuary function is important to the population because of its unique role in the life history and survival of coho salmon

Big Lagoon is one of the few coastal lagoons that is managed by California Department of Fish and Wildlife. Big Lagoon is a brackish lake that is enclosed by a sand spit the majority of the year. Most years, the lagoon breaches, providing adult coho salmon access to the basin from the ocean. For the most part, the lagoon habitat provides opportunities for rearing in wetland areas. However, the overall estuarine function has been degraded by sediment accretion and Highway

101. Elevated sediment accretion in the lagoon and in lower Maple Creek has led to a shallowing of tidal channels and conversion of open water to marsh and uplands. An increase of marshland at the rate of 0.23 ha/year was observed between 1931 and 1978 (Parker 1988). Figure 20-3 shows the conversion of lagoon habitat to upland marsh habitat between 1931 and 1978.

The dike supporting Highway 101 effectively blocks hydrologic connectivity between Big Lagoon and Maple Creek. Numerous large historic tidal channels and tidal wetland have been blocked by the dike. Without tidal exchange, accretion upstream of the highway is converting formally brackish wetland habitat to freshwater wetland, mudflats, and uplands. The conversion from brackish to freshwater wetland has decreased the productivity and rearing potential of wetland areas. Big Lagoon also likely experiences changes due to a loss of exchange with Maple Creek. Riverine flushing is dampened by the dike, potentially impacting salinities, sediment accretion in the lagoon, and breach events at the spit. Based on his work in the small coastal lagoons in Humboldt County, Kraus et al. (2002) found that both riverine and ocean processes can affect breach events in these basins. For the barrier spits, small streams and runoff during the rainy season gradually raise the water level and cause breaching from lagoon to ocean by seepage and failure. The pooling of water upstream of the highway can clearly interfere with this process.

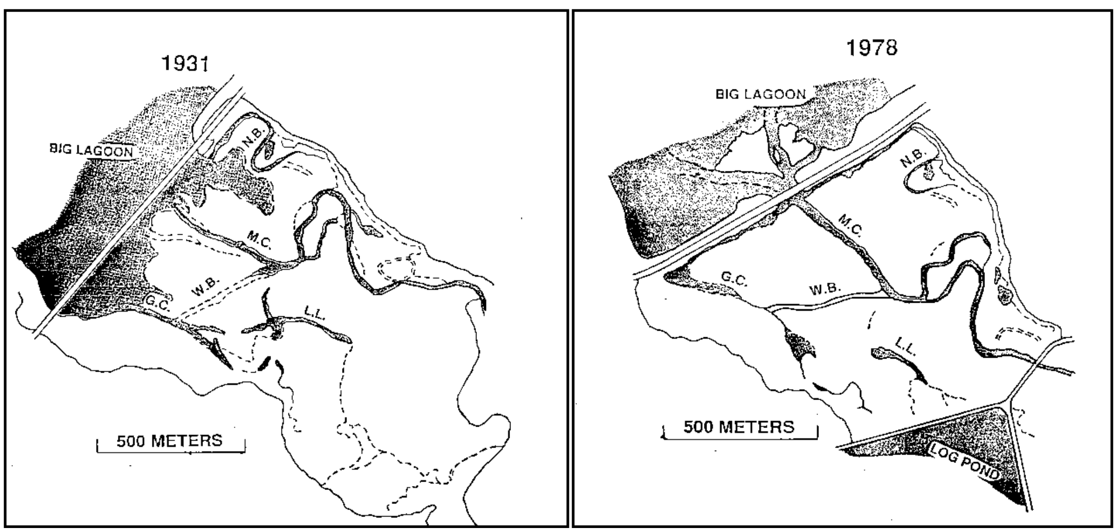

Figure 20-3. Line drawing showing the changes in Big Lagoon between 1931 and 1978. Stippled pattern represents permanent water; dashed lines indicate indefinite banks, dry paleochannels or subaqueous channel banks (Parker 1988). Note the increase in upland marsh habitat and creation of Gray Creek mill pond.

Altered Hydrologic Function

Altered hydrologic function within the Maple Creek basin poses a high risk to juvenile and smolt life stages, a medium risk to fry and adults, and a low risk to the egg life stage. Flows remain intact with few diversions. However, the estuary has been significantly modified by Highway 101 impeding hydrologic exchange between the lagoon and Maple and Gray Creeks. Satellite images show historic tidal channels that have been truncated by the highway. Additionally, flows from the upper basin pool behind the highway, accumulating sediment there. The accumulation effectively converts tidal wetland to freshwater marshes, which reduces the diversity of habitat and quality of rearing habitat for juveniles.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions represent a low to medium stress on sub-adult life stages of coho salmon in Maple Creek and Big Lagoon. Early timber harvest resulted in the removal of large trees from the riparian zone and the construction of roads alongside streams, so there is a lack of old growth conifers in these areas and many reaches are now dominated by alders. Riparian vegetation should have a diversity of age classes and species that provide a continuous source of large wood input to the stream.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Impaired Water Quality

Impaired water quality is a low to medium stress for all the life stages of coho salmon in Maple Creek/Big Lagoon. The 7 day maximum average water temperature ranged from 14 to 15 °C (GDRC 2006) and there are no apparent sources of excessive nutrient or pollutant runoff.

Barriers

Barriers represent a low stress for coho salmon in the Big Lagoon and Maple Creek basin. A dam on Gray Creek is a complete barrier to all life history phases of coho salmon. The sand spit at the outlet of Big Lagoon is a barrier in years when the lagoon doesn't breach. Numerous natural barriers exist in the basin (D. Perry, pers. comm., 2009, CalFish 2009).

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into Maple Creek and Big Lagoon; however, the proportion of adults that are of hatchery origin is likely less than five percent. Therefore, adverse hatchery-related effects pose a low risk to all life stages.

Increased Disease/Predation/Competition

There is no documented increase in disease, predation, or competition within the Maple Creek/Big Lagoon basin. Disease, predation, or competition is considered a low stress to the population. Predation from bass and rainbow trout in the old mill pond at Gray Creek may be a concern. Bass and trout prey upon juvenile salmonids and could prevent coho salmon from utilizing the high IP habitat in this creek.

20.6 Threats

Table 20-5. Severity of threats affecting each life stage of coho salmon in Maple Creek/Big Lagoon. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	High	High	High[1]	High	High	High
2	Timber Harvest[1]	High	High	High[1]	High	Medium	High
3	Channelization/Diking	Medium	Medium	Medium	Medium	Medium	Medium
4	Dams/Diversion	Low	Medium	Medium	Medium	Medium	Medium
5	High Severity Fire	Medium	Medium	Medium	Medium	Medium	Medium
6	Fishing and Collecting	-	-	Low	Low	Medium	Low
7	Climate Change	Low	Low	Low	Low	Medium	Low
8	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
9	Agricultural Practices	Low	Low	Low	Low	Low	Low
10	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low
12	Invasive Non-Native/Alien Species	Medium	Medium	Medium	Medium	-	Medium

[1]Key limiting threats and limited life stage
[2]Mining/Gravel Extraction is not considered a threat to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and timber harvest.

Roads

Roads are a high threat across all life stages of coho salmon in the Maple Creek basin. Road density is very high with an average of 9.6 miles per square mile of basin and road networks consist primarily of un-paved roads built on unstable Franciscan soils. The high density of roads is the most significant source of increased sediment in the creeks and the lagoon. As described previously, increased amounts of sediment are contributing to the loss of lagoon habitat. Additionally, roads interfere with tidal exchange, increasing channelization and limiting tidal rearing habitat. Roads often parallel the stream channel and have multiple crossings, increasing runoff and sediment input. Therefore, roads are one of the most serious threats for this population. The GDRC AHCP describes a road maintenance plan to reduce this threat. Roads in the tidally influenced region and along stream corridors should be prioritized for decommissioning.

Timber Harvest

The GDRC manages the basin for timber harvest under an AHCP (GDRC 2006) that includes minimization and mitigation measures consisting of road and riparian management, slope stability, and harvesting restrictions. The impacts of timber harvesting, even if carried out under the AHCP, may result in the loss of pool habitat, loss of large wood and stream complexity, altered hydrology and nutrient cycling, and increased sediment loads. Adverse changes in habitat conditions will have a negative effect on all life stages of coho salmon utilizing those areas (NMFS 2007a). GDRC's recent wood additions to streams and their assessment and reduction of erosion and sedimentation sources such as roads, will help mitigate the impacts of future timber harvest in Maple Creek.

Channelization/Diking

Channelization and diking, a medium threat across all life stages, is not widespread throughout the basin but has localized impacts. In the upper basin, there are some reaches where roads parallel the stream, confining the channel and reducing floodplain connectivity and function. Channelization and diking is primarily a problem associated with Highway 101. The highway dike prevents hydrologic connectivity between Maple Creek, Gray Creek, and Big Lagoon, channelizing flows into a single thread channel that must pass under a single bridge constriction. Future impacts upstream of the dike include increased accretion in channel and floodplain habitat, the conversion of open water to mudflats, and wetlands to uplands. Without proper connectivity to Maple Creek and Gray Creek, Big Lagoon will also undergo changes in accretion and estuarine habitat.

Dams/Diversions

Dams and diversions present a medium threat across all life history stages of coho salmon. There is only one dam and associated diversion within the basin. The dam is located near the mouth of Gray Creek and forms a 70 acre pond once used as a mill pond. The unnatural lake is providing habitat for non-native predatory fishes, has converted tidally influenced land to freshwater, and is potentially harboring contaminants from its historic use as a log pond. Coho salmon have not been found in Gray Creek likely because of one or more of these issues associated with the pond.

High Severity Fire

Fire is listed as a medium threat for coho salmon in the Maple Creek basin. The management of the timberlands by GDRC can alter the natural fire regime. Densely wooded and even-aged stands can have increased potential for fire, whereas thinning and prescribed burning can reduce the potential for high severity fire. The GDRC AHCP prioritizes units for low intensity, controlled burns to reduce the buildup of excess fuels and reduce the risk of high severity fire. When fires occur in the basin, the effects could be detrimental, potentially creating excessive amounts of erosion, loss of riparian vegetation, and degraded water quality.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Climate Change

Climate change poses a low threat to this population due to its cooler climate, low risk of temperature increase and precipitation change over the next 50 years (see Appendix B for modeling methods). Also, as with all populations in the ESU, adult coho salmon will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Urban/Residential/Industrial Development

Development presents a low threat for coho salmon in the Maple Creek/Big Lagoon basin. The Maple Creek basin is almost entirely owned by GDRC and if it remains as such, should have a minimal threat of development. The lagoon is primarily surrounded by public land and also has no threat of development. The Big Lagoon Rancheria Tribe owns 20 acres on the south side of the lagoon and contains a small amount of residential development.

Agricultural Practices

Because 98 percent of the basin is managed for timber harvest by GDRC, there is only a low threat from agricultural practice within the Maple Creek/Big Lagoon basin. The lagoon is protected from agriculture by the state parks that surround the sensitive environment. There are 20 acres of tribal land on the south side of the lagoon that may have the potential for small scale agriculture, but currently are dominated by eight households, roads, and a community water facility.

Road-Stream Crossing Barriers

Road-stream crossing barriers in the Maple Creek basin pose a low to medium threat for coho salmon. Road-stream crossings that have been evaluated as potential barriers are not accessible to coho salmon or they are on tributaries too small to provide coho salmon habitat (Perry, D., pers. comm., 2009). However, road crossings present a major threat through their contribution to high sedimentation rates. Altered sediment supply is ranked as the most significant stress in the basin. Crossings should be regularly evaluated and either maintained, improved or decommissioned to prevent chronic erosion or wash-outs.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Maple Creek/Big Lagoon population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Invasive/Non-Native Species

Invasive, non-native species is considered a medium stress in the Maple Creek basin. New Zealand mud snails have been detected in Big Lagoon, Gray Creek, and mainstem Maple Creek. New Zealand mud snails quickly colonize benthic habitats, becoming high in density. Due to their small size, they are a low quality prey item for juvenile SONCC coho and thus disrupt prey assemblage diversity. Predation from largemouth bass in the old mill pond at Gray Creek may be a concern. Bass prey upon juvenile salmonids and could prevent coho salmon from utilizing the high IP habitat in this creek.

20.7 Recovery Strategy

Coho salmon in the Maple Creek/Big Lagoon basin are severely depressed in abundance and have a restricted distribution because of degraded habitat quality. The recovery criterion for the population is that coho salmon must occupy 80% of available IP habitat in years following spawning of brood years with high marine survival. Recovery actions should focus on habitat restoration to enhance survival and growth of juveniles as well as increase spatial distribution by connecting high quality habitat. Activities that reduce sediment delivery and increase the large wood component of streams would increase habitat complexity and quality of water and substrate. Activities that reduce sediment will also be beneficial to the lagoon/estuary. The effects of fishing on this population’s ability to meet its viability criteria should be evaluated.

Table 20-6 on the following page lists the recovery actions for the Maple Creek/Big Lagoon population.

Table 20-6. Recovery action implementation schedule for the Maple Creek/Big Lagoon population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MapC.8.1.4	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	2b
SONCC-MapC.8.1.4.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MapC.8.1.4.2	*Decommission roads, guided by assessment*					
SONCC-MapC.8.1.4.3	*Upgrade roads, guided by assessment*					
SONCC-MapC.8.1.4.4	*Maintain roads, guided by assessment*					
SONCC-MapC.8.1.34	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2c
SONCC-MapC.8.1.34.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MapC.8.1.34.2	*Decommission roads, guided by assessment*					
SONCC-MapC.8.1.34.3	*Upgrade roads, guided by assessment*					
SONCC-MapC.8.1.34.4	*Maintain roads, guided by assessment*					
SONCC-MapC.1.2.21	Estuary	No	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	2b
SONCC-MapC.1.2.21.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-MapC.1.2.21.2	*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*					
SONCC-MapC.1.2.21.3	*Restore estuary and tidal wetland habitat guided by the plan*					
SONCC-MapC.1.3.6	Estuary	No	Increase tidal exchange of water	Install bridges	Highway 101 dyke at Big Lagoon	2b
SONCC-MapC.1.3.6.1	*Develop a plan to install bridges on Highway 101 that will increase tidal and riverine exchange, reduces channelization, reduce upland conversion, and increase flushing flows to Big Lagoon*					
SONCC-MapC.1.3.6.2	*Install bridges, guided by the plan*					
SONCC-MapC.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Big Lagoon, estuary, mainstem Maple Creek, and all streams where coho salmon would benefit immediately	2c
SONCC-MapC.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MapC.2.1.1.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MapC.2.1.31	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-MapC.2.1.31.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MapC.2.1.31.2	*Place instream structures, guided by assessment results*					
SONCC-MapC.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Mill/Pitcher Creek, and all streams where coho salmon would benefit immediately	2c
SONCC-MapC.2.2.2.1	*Assess habitat and develop a plan to restore the historic floodplain through reconnection of side channels and off channel habitat*					
SONCC-MapC.2.2.2.2	*Restore the historic floodplain, guided by the plan*					
SONCC-MapC.2.2.32	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Population wide	2d
SONCC-MapC.2.2.32.1	*Assess habitat and develop a plan to restore the historic floodplain through reconnection of side channels and off channel habitat*					
SONCC-MapC.2.2.32.2	*Restore the historic floodplain, guided by the plan*					
SONCC-MapC.2.2.29	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2c
SONCC-MapC.2.2.29.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MapC.2.2.29.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MapC.2.2.33	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-MapC.2.2.33.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MapC.2.2.33.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MapC.1.3.7	Estuary	No	Increase tidal exchange of water	Remove dam	Gray Creek Mill Pond	3b
SONCC-MapC.1.3.7.1	*Develop a plan to remove Gray Creek dam that will restore tidal wetland habitat and improve hydrologic connectivity*					
SONCC-MapC.1.3.7.2	*Remove Gray Creek dam, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MapC.14.3.9	Invasive, Non-native Species	No	Reduce competition	Reduce abundance of New Zealand mud snail	Big Lagoon, Lower Maple Creek	3b
SONCC-MapC.14.3.9.1	*Investigate New Zealand Mud Snail presence in Big Lagoon and Maple Creek. Assess the risk to coho salmonids and determine a strategy for control if necessary*					
SONCC-MapC.14.3.9.2	*Control New Zealand Mud Snails guided by assessment results*					
SONCC-MapC.14.2.8	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of warm-water, non-native fish species	Gray Creek Mill Pond	3b
SONCC-MapC.14.2.8.1	*Assess the different exotic species and the abundance of each species in the mill pond behind Gray Creek dam. Develop a plan to eradicate exotic species in conjunction with dam removal*					
SONCC-MapC.14.2.8.2	*Eradicate or suppress exotic species, guided by assessment results*					
SONCC-MapC.7.1.3	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Big Lagoon, estuary, lower Maple Creek	3c
SONCC-MapC.7.1.3.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MapC.7.1.3.2	*Thin, or release conifers, guided by the plan*					
SONCC-MapC.7.1.3.3	*Plant conifers, guided by the plan*					
SONCC-MapC.26.1.28	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	3c
SONCC-MapC.26.1.28.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-MapC.10.7.27	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-MapC.10.7.27.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MapC.10.7.27.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MapC.10.7.30	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MapC.10.7.30.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MapC.10.7.30.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MapC.16.1.11	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MapC.16.1.11.1		*Determine actual fishing impacts*				
SONCC-MapC.16.1.11.2		*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*				
SONCC-MapC.16.2.12	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MapC.16.2.12.1		*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*				
SONCC-MapC.16.2.12.2		*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*				
SONCC-MapC.16.2.13	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MapC.16.2.13.1		*Determine actual impacts of scientific collection*				
SONCC-MapC.16.2.13.2		*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*				
SONCC-MapC.8.1.5	Sediment	Yes	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	BR
SONCC-MapC.8.1.5.1		*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*				
SONCC-MapC.16.1.10	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	BR
SONCC-MapC.16.1.10.1		*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*				
SONCC-MapC.16.1.10.2		*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*				

21. Little River Population

Central Coastal Stratum

Non-Core 1, Potentially Independent Population

Moderate Extinction Risk

Population likely above depensation threshold

140 Spawners Required for ESU Viability

45.9 mi^2 watershed (0% Federal ownership)

34 IP-km (21 IP-mi) (46% High)

Dominant Land Uses are 'Agriculture' and 'Timber Harvest'

Key Limiting Stresses are 'Altered Sediment Supply' and 'Lack of Floodplain and Channel Structure'

Key Limiting Threats are 'Agricultural Practices' and 'Roads'

Highest Priority Recovery Actions

• Reduce road-stream hydrologic connection • Increase large woody debris (LWD), boulders, and other instream structure • Remove barriers	• Restore estuarine habitat • Assess estuary and tidal wetland habitat • Remove, setback, or reconfigure levees and dikes in the estuary

21.1 History of Habitat and Land Use

Historic timber harvest practices severely degraded habitat throughout the basin. The first sawmill opened in 1909, and the town of Crannell was built soon after on the coastal plain near the mouth of the Little River. The basin was intensely harvested throughout the early 1900s. The river was modified for sawmill use and timber harvest operations. Crannell had its own railroad with 18 miles of railway, which was used for hauling timber to and from the mill. Large-scale clear cuts, road construction, skid trails, and landings occurred on the highly erodible Franciscan soils that are dominant throughout the basin. These practices led to many slope failures, delivering sediment into the stream and severely aggrading the system. During the years of intense harvest, the river likely flowed with high amounts of turbidity, severely affecting development and behavior of all fish species. Additionally, trees were cut in the riparian zone, removing potential for instream wood recruitment and exposing the stream to increased solar radiation. Increased sediment and removal of large wood led to a disturbed basin with highly degraded fish habitat conditions.

The flat coastal plain near the mouth of the Little River is now occupied by a few farm houses and large agricultural fields with virtually no remnants of the mill or town that once dominated the valley. Agriculture is now the primary land use, specifically grazing livestock and cranberry farming.

While the effects of grazing are less disturbing to salmonids and their habitat than the previous timber harvest practices, adverse effects are still present. Livestock that are not properly fenced out of riparian zones are degrading the sensitive vegetation in these areas and contributing to bank instability and erosion. This further exacerbates the issue of excess sediment in the lower basin. Other agricultural practices, such as construction of cranberry bogs, have destroyed riparian and seasonal wetlands next to Little River. High IP reaches occur where agricultural lands dominate, which decreases rearing habitat quality and limits coho salmon production potential.

An extensive road system (road density >3 mi./sq. mi.) contributes to runoff of surface material and increases sediment delivery to streams. Gibbons and Salo (1973) concluded that sediment input per unit area from roads is usually greater than input from all other timber harvesting activities. Erodible geology in combination with timber harvest and road building has led to mass wasting events and sediment delivery into Little River. The majority of the basin in the uplands is managed for timber production under Green Diamond Resource Company (GDRC)'s Aquatic Habitat Conservation Plan (AHCP). Management under the AHCP helps reduce the negative effects associated with timber harvest. Cafferata (2013) concluded that field observations made on August 29-30, 2013, along with GDRC monitoring data, support GDRC's internal analysis that the current rate of harvest in Maple Creek and Little River is not increasing cumulative watershed effects, as measured in turbidity and suspended sediment values.

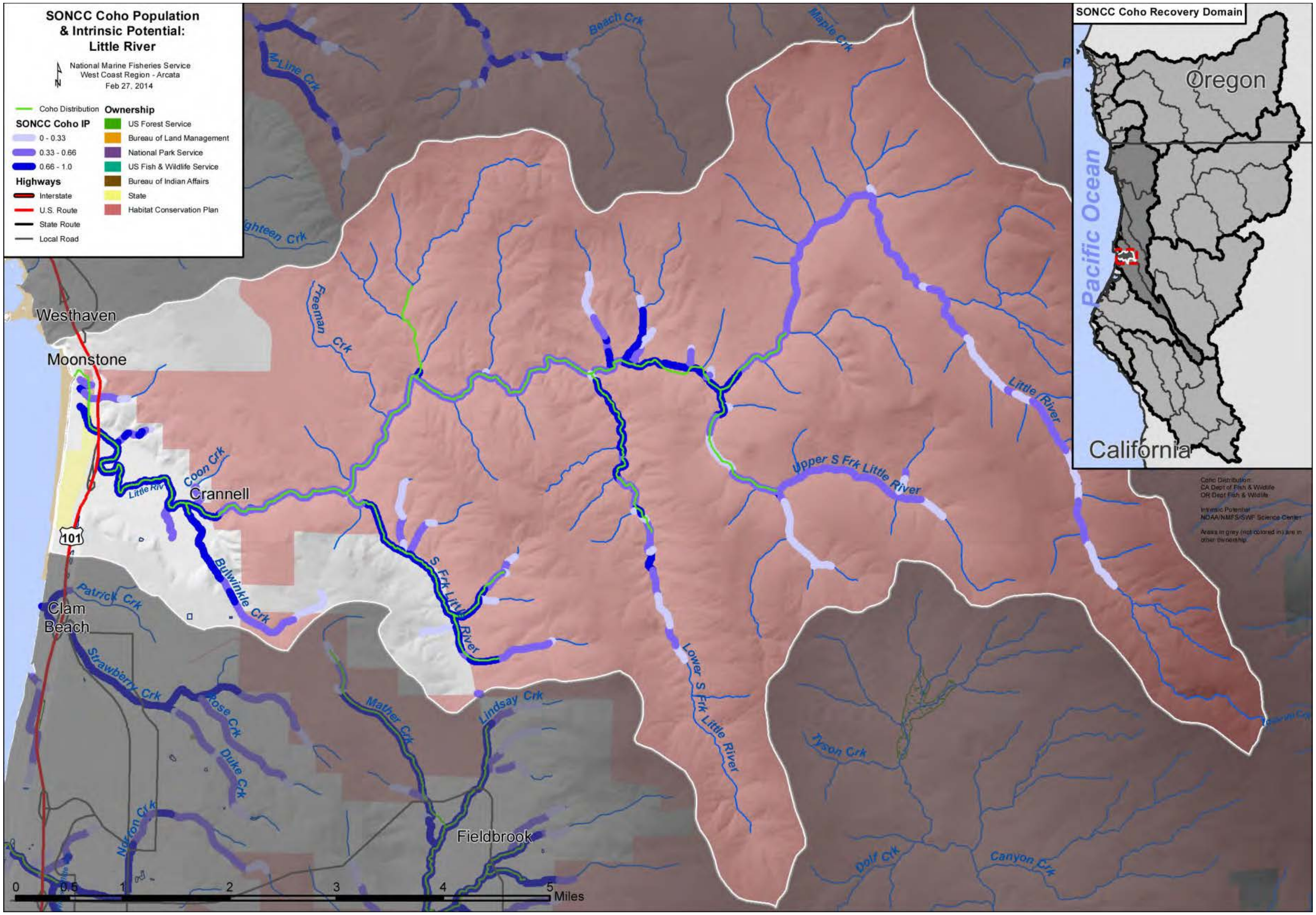

Figure 21-1. The geographic boundaries of the Little River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

21.2 Historic Fish Distribution and Abundance

Historic coho salmon abundance data in the Little River prior to development in the basin is unavailable to infer trends, however recent data suggest the system can support, and likely has supported in the past, substantial numbers of coho salmon for its size. The IP model suggests that the areas with the highest potential for coho salmon production occur in the lower reaches of the Little River and its tributaries (Table 21-1). The Lower South Fork and mainstem Little River near its confluences with the Lower South Fork and Upper South Fork also provide high production potential.

Table 21-1. Tributaries with high IP reaches (IP value > 0.66). (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Bullwinkle Creek	Railroad Creek	Lower South Fork Little River
Carson Creek	South Fork Little River	Upper South Fork Little River

Currently, coho salmon are distributed throughout the mainstem and in lower portions of the major tributaries. Coho salmon consistently spawn and rear in these areas, and occur in generally moderate abundance. This conclusion is supported by spawner survey and juvenile monitoring data. Since 1998, Green Diamond Resource Company (GDRC) has monitored juvenile out-migration in four tributaries (Lower South Fork, Upper South Fork, Carson Creek, and Railroad Creek). Combining results from all tributaries between 1999 and 2009, out-migrant population estimates for Little River are highly variable and fluctuate between 200 and 5,800 smolts (Figure 21-2). The average annual out-migrant production over this time was 3,156, with the highest production in Carson Creek (1,596) and the lowest in Railroad Creek (71).

CDFW, NMFS, and GDRC have collected coho salmon presence-absence data in additional tributaries. Coon Creek, Water Gulch, C-Line Creek, and Pattie's Creek have no records of coho salmon presence. Bullwinkle Creek, Freeman Creek, Railroad Creek, Danielle Creek, and Heightman Creek show coho salmon presence from Green Diamond records only (GDRC 2006 and 2009, Perry, D., pers. comm., 2009). Production varies by tributary and by year, but the basin is able to consistently produce coho salmon smolts.

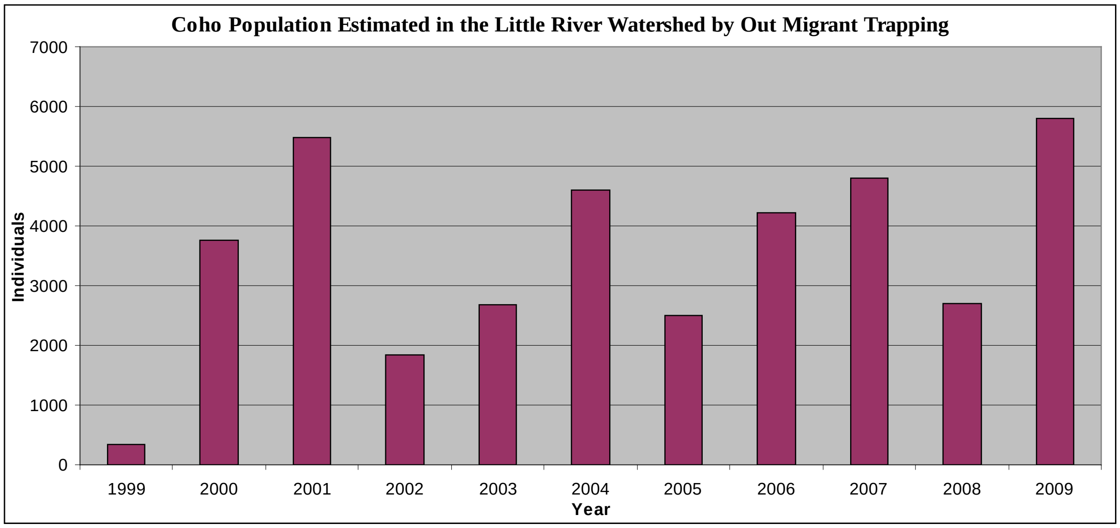

Figure 21-2. Coho salmon out-migrant population estimates. Estimates are from Little River tributaries 1999 to 2009 (Carson Creek trap was added as a trapping location in 2000).

Young-of-the-year snorkel surveys in three major tributaries (Lower South Fork, Railroad Creek, and Upper South Fork) were conducted to estimate the summer juvenile coho salmon population over this same time period (1999 to 2009). Outmigrant trapping data was then used in combination with fry population estimates from the previous year to estimate overwintering survival in each of the tributaries. The calculated overwinter survival rates varied greatly, but provide good estimates of rearing potential in the system. Outmigrant trapping only documents fish that are moving through the system in the spring. It is assumed that many fish may move out of the tributaries earlier to rear in the mainstem or estuary. Because early outmigrants are not captured, the overwinter survival rate is probably underestimated. Additionally, in some years, Railroad Creek had an outmigrant population estimate that was greater than the fry population estimate. This may simply be observer error, but could also be an indication of a life history strategy where fry from other tributaries are moving into Railroad Creek to seek refugia. Based on available data, Railroad Creek and Upper South Fork show the highest overwintering survival rates between 1999 and 2009 (average 27.6 and 26.2 percent, respectively); while Lower South Fork had substantially lower survival rates (average of 17.0 percent). Studies in other basins have shown survival rates between 1.2 and 1.7 percent between the fry and smolt life stage (Godfrey 1965) so this basin appears to have very good rearing conditions in these creeks (GDRC 2006).

Spawning surveys were conducted in seven spawner reaches within the Little River HPA from 1999 through 2013 by GDRC, Figure 21-3.

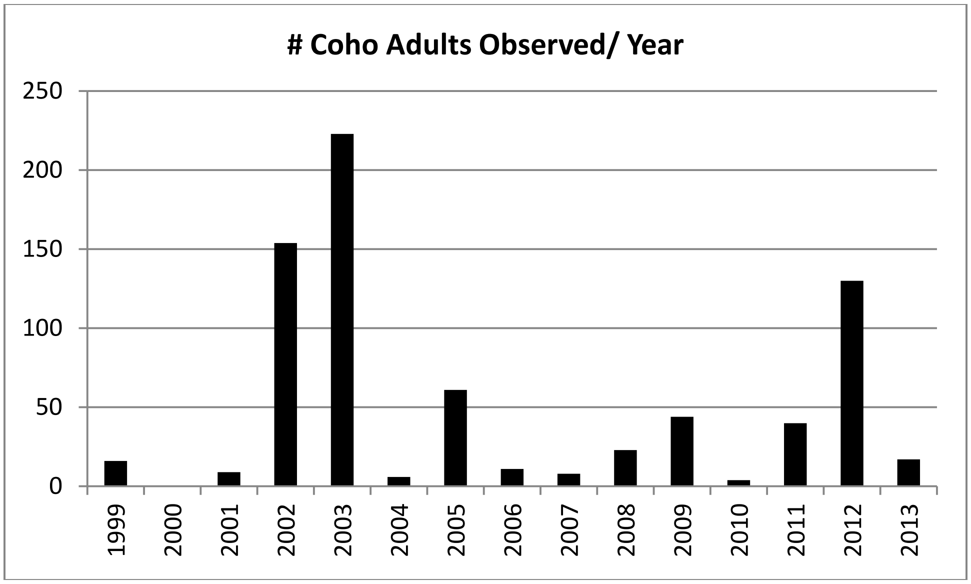

Figure 21-3. GDRC Little River spawner survey results (1999-2013) (Data source: Bourque 2013).

21.3 Status of Little River Coho Salmon

Spatial Structure and Diversity

Although coho salmon maintain some spatial diversity by using select tributaries, many tributaries appear to be underutilized. Only a few known unnatural barriers exist within the basin, which allows coho salmon to access different watersheds and improves the overall connectivity and diversity of the population. The major tributaries of the Lower South Fork, Upper South Fork, Carson Creek, and Railroad Creek are all proven coho salmon producing tributaries within the Little River basin. Underutilized areas include Coon Creek, Water Gulch, C-Line Creek, and Pattie's Creek, which have no records of coho salmon presence. These creeks have moderate and high IP values, suggesting coho salmon likely occupied habitat in these areas. The low numbers of coho salmon and minimally known unique life history traits suggest an overall low diversity within the population.

Carson Creek contains high IP habitat and surveys have shown this tributary to be the greatest producer of juvenile coho salmon. Lower South Fork Little River and Carson Creek have much higher production than any other tributaries in the Little River. Lower South Fork also had the highest average overwintering survival rate for coho salmon. High production and overwintering data suggest that these creeks contain high quality habitat.

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historic conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 41 coho salmon per-IP-km of habitat are needed (1,400 spawners total) to approximate the historical distribution of Little River coho salmon and habitat. Currently, coho salmon appear to have access to most historically occupied habitats in the basin but are limited by habitat quality in some areas.

Population Size and Productivity

The population of coho salmon in Little River is depressed from historic levels modeled by Williams et al. (2006); however, the last decade of monitoring suggests the juvenile coho salmon population may be somewhat stable with no recognizable downward trends (GDRC 2009). Current data suggest that the population produces approximately 2,000 to 6,000 smolts per year from various tributaries throughout the basin. Although spawning estimates are unknown, considering that the basin produces over 16,000 fry a year then there are likely at least 66 spawning pairs on average in any given year. Currently, the population likely contains less than 200 adults. This is based on an average of 2,000 eggs per female and an egg mortality rate of 88 percent (Neave 1949, Crone and Bond 1976). Based on the biological data collected in the last decade, it appears the Lower South Fork Little River and Carson Creek have much higher production than any other tributaries in the Little River. The Lower South Fork also had the highest average overwintering survival rate for coho salmon.

Extinction Risk

The Little River population is at moderate risk of extinction because estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one, but the ratio is less than the minimum required spawner density (both criteria described in Williams et al. 2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk. NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria are related to reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Little River population is a non-core, Potentially Independent population within the Central Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, but strongly influenced by immigration from other populations such that they did not exhibit independent dynamics (Williams et al. 2006). The Little River population is strongly influenced by nearby coastal populations such as Redwood Creek and the Mad River. Adult strays from these populations spawn and interact with coho salmon in the Little River. To contribute to stratum and ESU viability, the Little River non-core population should have at least 140 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Furthermore, the Little River population will contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to nearby populations.

21.4 Plans and Assessments

California Department of Fish and Game

Recovery Strategy for California Coho Salmon

Coho salmon north of San Francisco are listed as threatened under the California Endangered Species Act, and this document describes a recovery strategy for the species in California. The Little River HSA is included in the Trinidad HU, and the strategy contains specific recommendations for the restoration of Little River and its major tributaries. Most recommendations address the impacts of timber harvest and agriculture in the lower river basin. Restoration actions focus on the rehabilitation of the riparian zone and estuary.

Green Diamond Resource Company (GDRC)

Green Diamond Aquatic Habitat Conservation Plan (AHCP)

The GRDC AHCP (GDRC 2006) outlines a plan for the conservation of aquatic species in select watersheds in the Little River. The majority of the roughly 99.4 percent of private land in the Little River is owned by Green Diamond and therefore managed according to the provisions of the AHCP. The plan has a number of provisions designed to protect coho salmon and salmon habitat throughout the Little River. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to Green Diamond’s activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of covered listed aquatic species. Elements of the AHCP are expected to reduce the need to list currently unlisted species under the ESA in the future by providing early conservation benefits to those species.

Under the provisions of the GDRC AHCP, the company conducted an initial assessment of salmon populations and habitat, and conducts ongoing monitoring of certain physical and biological metrics. Initial channel and habitat typing assessments as well as LWD surveys, and juvenile presence/absence and spawning surveys were conducted on tributaries on Green Diamond land between 1994 and 1998 (GDRC 2006). Green Diamond also conducts long-term monitoring of instream habitat, water quality, mass wasting and slope stability, LWD, summer juvenile salmon population estimates, and out-migrant salmon abundance. Juvenile fish surveys and outmigrant trapping is conducted on the Little River. A report summarizing the results of these monitoring efforts is submitted to NMFS every two years. More information about the GDRC AHCP can be found in Section 3.2.5.

21.5 Stresses

Table 21-2. Severity of stresses affecting each life stage of coho salmon in the Little River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses [2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Sediment Supply[1]	Very High	Very High	Very High[1]	Very High	High	Very High
2	Lack of Floodplain and Channel Structure[1]	High	High	High[1]	High	High	High
3	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
4	Impaired Estuary/Mainstem Function	-	Low	High	High	Medium	High
5	Impaired Water Quality	Medium	Medium	Medium	Medium	Medium	Medium
6	Barriers	-	Medium	Medium	Low	Low	Medium
7	Altered Hydrologic Function	Low	Medium	Medium	Low	-	Medium
8	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.
[2] Increased Disease/Predation/Competition is not considered a stress for this population.

Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are altered sediment supply and lack of floodplain and channel structure. Filling of pools by excess sediment combined with lack of wood to sort and meter out sediment or provide complex habitat has degraded rearing habitat. The juvenile life stage is the most limited life stage due to the degraded quality of rearing habitat that should provide deep pools and complex channels for over wintering and summering juveniles to escape high velocity flows during the winter season and provide cover during the summer season.

Increased channel complexity in the Little River basin would provide vital habitat for juvenile rearing opportunities. Historically, greater habitat complexity existed within the basin, but has been degraded by the long history of intense timber harvest. Currently, the lack of LWD due to past timber harvest practices and the increase in sediment supply reduce complexity by filling in pools and reducing habitat structure. Additionally, a historic network of tidal and backwater channels once existed in the estuary. Highway 101 acts as a dike, channelizing and filling the historic channels that once provided high quality rearing habitat for coho salmon. Carson Creek contains high IP habitat and surveys have shown the tributary to be the greatest producer of juvenile coho salmon. Winter survival rates have been calculated highest in the Lower South Fork Little River. These tributaries should be noted as vital habitat for the population.

Altered Sediment Supply

Altered sediment supply is the highest stress affecting all life history phases of coho salmon, imposing a very high stress on all sub-adult life stages and a high stress on adults. Increased sediment delivery is a result of high road density, timber harvest, and agriculture in the lower Little River. An increase in fine sediment contributes to multiple problems including the simplification of stream habitat, increased turbidity, and increased embeddedness, which reduces survival rates of eggs. Additionally, fine sediment can interfere with gill function, feeding, and other normal behaviors of juvenile coho. The high stress ranking was based on measurements of D50 (particle size) and V* (a measure of pool filling), which were derived from surveys conducted in upper portions of the basin. The D50 of particle sizes was rated as fair, (38 to 50 and 110 to 128) indicating the mean size of substrate is smaller than desired. The V* was rated as poor (>0.35), indicating pools were filled with excess fines.

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure is a high stress across all life stages of coho salmon. Simplified channel and floodplain structure are primarily the result of a lack of large wood in the Little River system, an overabundance of fine sediment, and levees in the lower Little River. Green Diamond completed large wood surveys for the Little River Basin in 2009. Table 21-3 shows the results of the survey. The results of the survey show that South Fork Little River and Railroad Creek have the highest volume of large wood, while the mainstem Little River has the lowest volume (GDRC 2009). It can be assumed that with the history of timber harvest in the area, the basin likely experiences low wood recruitment. Large wood is required to sort sediment, scour pools, and facilitate channel complexity. The V* surveys in the upper basin indicate pool habitat is filling with sediment. The oversimplified stream channel and floodplain provide fewer refugia and less rearing habitat for juveniles, and attributes such as deep pools and side channels are reduced in number.

Table 21-3. Large woody debris observations for Little River and its tributaries. Surveys were done in 1994 and 1995. Volume calculation comes from separate spreadsheet (GDRC 2006).

Stream	Surveyed Length (feet)	Metric (per 100' stream)	Size Classes of In-channel Large Wood; Max Diameter (ft.)					
			1-1.9	2-2.9	3-3.9	≥4	Total Pieces	Total Volume (ft³)
Carson Creek (SF Little River)	12356	Pieces	6	1	0	0	8	1603
Carson Tributary	3021	Pieces	4	2	1	0	8	1767
Little River	14497	Pieces	2	0	0	0	3	1000
Lower South Fork Little River	9847	Pieces	4	2	0	0	8	2203
Railroad Creek	6877	Pieces	4	2	1	1	8	22669
Upper South Fork Little River	9673	Pieces	3	1	0	0	5	1858

Degraded Riparian Forest Conditions

The degraded riparian forest conditions across the Little River basin are rated as a medium to high stress for coho salmon with the greatest impacts to fry and juvenile life stages. As described above, a healthy riparian forest is essential to the continued input of wood into streams, to riparian shading and hydrologic function, and to the creation of complex fish habitat and stream morphology. Currently, riparian areas lack old growth conifer trees and are now dominated by second growth hardwood species, primarily red alder (GDRC 2006). A diverse age class of conifers is needed to supply a source for future wood recruitment. This stress is especially significant in the lower floodplain, which is dominated by agricultural land and experiences chronic destruction of the riparian vegetation through grazing. The riparian zone in these lowlands is dominated by dense shrubs such as willow and blackberry and provides reduced potential for future large wood recruitment

Impaired Estuary/Mainstem Function

This stress refers to just the estuary conditions in the Little River, since this is a single population basin. Mainstem conditions are addressed through other stresses such as floodplain and channel structure, riparian condition, hydrologic function, etc. Estuary function is important to the population because of its unique role in the life history and survival of coho salmon.

The Little River has a large tidally influenced area for its size. The outlet of the Little River is surrounded by Moonstone Beach County Park and Little River State Park. Approximately 0.75 river miles of mud flat, wetland, and sandbar habitat exist downstream of Highway 101. Upstream, the estuary and many associated tidal channels have been diked, filled, and channelized for agricultural purposes and the riparian vegetation has been cleared or degraded by grazing. Estuarine function is severely hampered by the lack of channel structure and the loss of tidal wetland and tidal channels. Currently only a few off-channel and backwater habitats occur within the estuary. Although the past extent of the estuary is unknown, based on similar coastal systems, the current extent of the estuary is far less than what it was historically. Estuarine habitats are important for juvenile rearing during the summer and historically provided numerous opportunities for growth and refuge for juveniles and smolts. The reductions in estuarine function is considered a high stress for juvenile and smolt life stages because of the lack of quality rearing habitat and the lack of refugia and holding habitat. Impaired estuarine function is considered a medium stress for adults in the population.

Impaired Water Quality

Water quality in the Little River has been rated as a medium stress across all life stages of coho salmon. Water temperature monitoring has occurred since 1994 at 14 different sites in 11 permanent, fish bearing channels. Temperature has been rated as good (14 to 15 °C) throughout the basin, although a few locations in the lower floodplain zone had temperatures readings up to 17 °C. Warmest temperatures (17 to 19 °C) occurred in the lower mainstem Little River and in the Lower South Fork Little River. The coolest of the maximum recorded temperatures (11 to 12 °C) occurred in the upper portions of the mainstem Little River, the upper portions of the Lower South Fork Little River and in Railroad Creek (Hurt 1969, GDRC 2009). Despite inadequate riparian cover, water temperature stays relatively cool due to the basin's location within the summer fog zone. Air temperature remains mild in this region year round.

Barriers

Barriers provide a low to medium stress for coho salmon in the Little River basin. There are no documented artificial barriers in the basin although there are several natural barriers in the form of falls and plunge pools in the upper reaches. There is potential for undocumented barriers on the private land in the upper basin, particularly with the high densities of road (e.g., >3 mi. /sq. mi. of basin) that are present there. Barriers primarily affect fry and juvenile coho, limiting access to summer and winter rearing areas.

Altered Hydrologic Function

Altered hydrologic function is described as a low to medium threat for coho salmon. There are three water diversions present in the basin. The quantity of water that is withdrawn from these diversions and their overall impact on stream flows in the basin is unknown. In addition to diversion withdrawals, the dense road network in the basin (e.g., >3 mi. /sq. mi. of basin) contributes to altered hydrologic function by disconnecting many small streams from their natural courses. Inboard ditches can divert water out of its natural drainage, spilling it overland outside of a natural channel.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into the Little River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages.

21.6 Threats

Table 21-4. Severity of threats affecting each life stage of coho salmon in the Little River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	High	High	High[1]	High	High	High
2	Agricultural Practices[1]	High	High	High[1]	High	Medium	High
3	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
4	Channelization/Diking	Medium	Medium	Medium	Medium	Low	Medium
5	Dams/Diversion	Medium	Medium	Medium	Medium	Low	Medium
6	High Severity Fire	Medium	Medium	Medium	Medium	Low	Medium
7	Urban/Residential/Industrial Dev.	Medium	Medium	Medium	Medium	Low	Medium
8	Fishing and Collecting	-	-	Low	Low	Low	Low
9	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
10	Climate Change	Low	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low

[1] Key limiting threats and limited life stage
[2] Mining/Gravel Extraction, and Invasive Non-Native/Alien Species are not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and agricultural practices.

Roads

Roads represent the most significant threat across all life stages of coho salmon in the Little River population. Road density is very high (>3 mi. /sq. mi. of basin) throughout the basin and most roads are unpaved. The high density of roads is the most significant contributor of sediment delivery within the basin. Sediment from roads results from road-related landslides, chronic erosion of native road surface and cut and fill slopes, and road-stream crossing failures. Roads can lead to landslides and mass wasting events where the entire roadbed can become saturated and fail, creating major sediment and diversion issues. Road maintenance can also contribute gravel spoils to the stream during grading or re-surfacing. Chronic sediment from surface runoff delivers silt to the stream, increasing water turbidity.

Roads interfere with the stream network by increasing sediment delivery at crossings and often diverting water away from natural drainages via inboard ditches. Basin-wide, an average of 30 percent of the road network in the Little River basin is estimated to be hydrologically connected to the stream network (GDRC 2006). On private property in the upper basin, inventory data described in the Green Diamond AHCP stated 74 percent of the road network on Green Diamond land, or approximately 218 miles, is hydrologically connected (GDRC 2006). Overall, the degree of connectivity varies greatly across the basin, but is potentially high in many areas (NMFS 2007a). Hydrologic connectivity to roads increases the amount of sediments delivered to streams and the channelization and diversion that occurs as a result of road surface. Without proper upgrading and decommissioning of roads in the basin, impacts are likely to continue in the future and increase in magnitude as more roads become degraded and more roads are built.

Timber Harvest

GDRC manages the basin for timber harvest under an AHCP (GDRC 2006) that includes minimization and mitigation measures consisting of road and riparian management, slope stability, and harvesting restrictions. Timber harvesting, even when carried out under the AHCP, may result in the loss of pool habitat, loss of large wood and stream complexity, altered hydrology and nutrient cycling, and increased sediment loads. Adverse changes in habitat conditions will have a negative effect on all life stages of coho salmon utilizing those areas (NMFS 2007a). GDRC's recent wood additions to streams and their assessment and treatment of erosion and sedimentation sources will help mitigate the impacts of future timber harvest in Maple Creek.

Agricultural Practices

Next to timber harvest, agriculture is the predominant land use in the lower Little River basin and represents a high threat, especially for sub-adult life stages. The land is used for grazing livestock, hay operations, and also a minor amount of cranberry bogs. There is little to no livestock exclusion from the river and animals often trample streambanks and overgraze the riparian vegetation. The grazing of livestock adjacent to the stream leads to eroded banks and an excess of sediment and nutrients entering the water. In addition, diversions and ditches associated with agriculture in the area contribute to degraded habitat conditions and poor hydrologic connectivity. The reduction of estuarine function in the Little River is primarily the result of conversion of lowland estuarine habitat to agricultural land and the agricultural practices that occur in the estuarine floodplain.

Channelization/Diking

Most channelization and diking occurs in the lower Little River and is associated with flood protection and agriculture. Ditches and dikes occur in the lower two miles of the Little River, constraining flow and off-channel access for juvenile rearing. Channelization limits habitat complexity and diversity as well as altering the stream hydraulically. A channelized stream has a greater velocity and can erode banks as the stream tries to attain sinuosity. Juvenile fish depend on off channel areas and sinuous channels for rearing. The lower part of the basin where most of the channelization has occurred, in its natural state would form the most complex channels, providing the greatest value to rearing coho salmon. The loss of such complex habitat is a great detriment to the system.

Dams/Diversions

There are no dams in the basin; however, a few water diversions occur on Little River and Bullwinkle Creek that withdraw unknown amounts of water. As described above in the roads section, diversions also occur as roadside ditches. Diversions affect hydrologic connectivity and function through the loss and alteration of flow. Diversions pose a moderate threat to coho salmon in this population. Juveniles are especially vulnerable to the impacts from unscreened diversions as they are often entrained in such features.

High Severity Fire

Vegetation and climate conditions in the basin make it naturally prone to low intensity, infrequent fire. However, unnatural fuel loads and changing climate could make this a greater threat if not fully addressed. The management of the timberlands by Green Diamond and other private timberland owners can alter the natural fire regime. Densely wooded and even-aged stands can have increased potential for fire, whereas thinning and prescribed burning can reduce the potential for large-scale fire. Green Diamond's AHCP prioritizes units for low intensity, controlled burns to reduce the buildup of excess fuels and reduce the risk of high severity fire. The effects of high severity fire could be severely detrimental, creating excessive amounts of erosion, loss of riparian vegetation, and degraded water quality.

Urban/Residential/Industrial Development

Historically, the town of Crannell presented a very high threat to all coho salmon life stages due to industrial and residential development, railroad construction, and extensive road systems. Currently, urban, residential, and industrial development is listed as a medium threat due to the low levels of development in the area. Development is limited to the few homes and ranches in the lower basin. Residential development could pose a greater threat in the future due to the close proximity of the basin to the large urban centers of McKinleyville and Arcata, California. As these communities grow, it is possible that the area could be rezoned and developed.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Road-stream Crossing Barriers

Road-stream crossing barriers are defined as a low threat. There are currently no documented barriers created by road stream crossing within the basin. GDRC and local restoration groups continue to decommission roads and upgrade crossings in the upper basin, which in turn lessens this threat. Working with landowners in the lower basin will be important in the future to prevent any barriers from being created in this important rearing area.

Climate Change

Climate change poses a low threat to this population due to its cooler climate and low risk of average temperature increase and precipitation change over the next 50 years (see Appendix B for modeling methods). Also, with all populations in the ESU adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Little River population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress

21.7 Recovery Strategy

Coho salmon abundance in the Little River basin is depressed, but appears to be fairly stable. Juvenile outmigrant trapping and juvenile snorkeling surveys have shown good rearing productivity within the Little River basin. Most encouraging is the documented generally high juvenile survival. Recovery activities should focus on habitat restoration aimed at increasing the quality of habitat over a wider range within the basin, encouraging greater spatial diversity and increased production potential. Restoration should particularly focus on the high IP tributaries such as Carson Creek, Bullwinkle Creek and the South Fork Little River, as well as restoring habitat to benefit summer rearing. Activities that reduce sediment delivery and increase large wood will help increase habitat complexity, water quality, and channel and floodplain structure. Excluding livestock from the riparian corridor and re-establishing riparian vegetation adjacent to the river are important recovery actions for all coho life stages in the lower basin. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 21-5 on the following page lists the recovery actions for the Little River population.

Table 21-5. Recovery action implementation schedule for the Little River population. Recovery actions for monitoring and research are listed at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LitR.2.1.2	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Estuary and Bullwinkle, Lower & Upper South Forks, Railroad, Carson Creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-LitR.2.1.2.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LitR.2.1.2.2	*Place instream structures, guided by assessment results*					
SONCC-LitR.2.1.33	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-LitR.2.1.33.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LitR.2.1.33.2	*Place instream structures, guided by assessment results*					
SONCC-LitR.8.1.1	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All streams where coho salmon would benefit immediately	2a
SONCC-LitR.8.1.1.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-LitR.8.1.1.2	*Decommission roads, guided by assessment*					
SONCC-LitR.8.1.1.3	*Upgrade roads, guided by assessment*					
SONCC-LitR.8.1.1.4	*Maintain roads, guided by assessment*					
SONCC-LitR.8.1.37	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2b
SONCC-LitR.8.1.37.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-LitR.8.1.37.2	*Decommission roads, guided by assessment*					
SONCC-LitR.8.1.37.3	*Upgrade roads, guided by assessment*					
SONCC-LitR.8.1.37.4	*Maintain roads, guided by assessment*					
SONCC-LitR.2.2.30	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-LitR.2.2.30.1	*Assess habitat to determine where potential exists for floodplain connection. Prioritize sites and determine best means for improving floodplain connection or increasing off-channel habitat at each site*					
SONCC-LitR.2.2.30.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LitR.2.2.34	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-LitR.2.2.34.1	*Assess habitat to determine where potential exists for floodplain connection. Prioritize sites and determine best means for improving floodplain connection or increasing off-channel habitat at each site*					
SONCC-LitR.2.2.34.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-LitR.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Estuary	2b
SONCC-LitR.2.2.3.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-LitR.2.2.3.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-LitR.1.2.4	Estuary	No	Improve estuarine habitat	Restore estuarine habitat	Estuary	2b
SONCC-LitR.1.2.4.1	*Assess tidally influenced habitat and develop a plan to restore tidal channels*					
SONCC-LitR.1.2.4.2	*Restore natural tidal channel form and function, guided by the plan*					
SONCC-LitR.26.1.29	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2d
SONCC-LitR.26.1.29.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-LitR.5.1.8	Passage	No	Improve access	Remove barriers	Lower mainstem, estuary, and all streams where coho salmon would benefit immediately	3b
SONCC-LitR.5.1.8.1	*Assess road crossing barriers*					
SONCC-LitR.5.1.8.2	*Remove road crossing barriers, guided by the assessment*					
SONCC-LitR.5.1.35	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-LitR.5.1.35.1	*Assess road crossing barriers*					
SONCC-LitR.5.1.35.2	*Remove road crossing barriers, guided by the assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LitR.7.1.7	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Lower mainstem, and all areas where coho salmon would benefit immediately	3b
SONCC-LitR.7.1.7.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-LitR.7.1.7.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-LitR.7.1.7.3	*Plant vegetation to stabilize stream bank*					
SONCC-LitR.7.1.7.4	*Fence livestock out of riparian zones*					
SONCC-LitR.7.1.7.5	*Remove instream livestock watering sources*					
SONCC-LitR.7.1.36	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-LitR.7.1.36.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-LitR.7.1.36.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-LitR.7.1.36.3	*Plant vegetation to stabilize stream bank*					
SONCC-LitR.7.1.36.4	*Fence livestock out of riparian zones*					
SONCC-LitR.7.1.36.5	*Remove instream livestock watering sources*					
SONCC-LitR.7.1.6	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Lower mainstem	3b
SONCC-LitR.7.1.6.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-LitR.7.1.6.2	*Thin, or release conifers, guided by the plan*					
SONCC-LitR.7.1.6.3	*Plant conifers, guided by the plan*					
SONCC-LitR.10.2.25	Water Quality	No	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	3c
SONCC-LitR.10.2.25.1	*Develop a pesticide management plan*					
SONCC-LitR.10.2.25.2	*Implement pesticide management plan and technical assistance program*					
SONCC-LitR.10.2.31	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-LitR.10.2.31.1	*Develop a pesticide management plan*					
SONCC-LitR.10.2.31.2	*Implement pesticide management plan and technical assistance program*					
SONCC-LitR.10.7.28	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-LitR.10.7.28.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LitR.10.7.28.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LitR.10.7.32	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-LitR.10.7.32.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LitR.10.7.32.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-LitR.16.1.9	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LitR.16.1.9.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-LitR.16.1.9.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-LitR.16.1.10	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LitR.16.1.10.1	*Determine actual fishing impacts*					
SONCC-LitR.16.1.10.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-LitR.16.2.11	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LitR.16.2.11.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-LitR.16.2.11.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-LitR.16.2.12	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LitR.16.2.12.1	*Determine actual impacts of scientific collection*					
SONCC-LitR.16.2.12.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-LitR.1.4.5	Estuary	No	Protect estuarine habitat	Protect tidal wetland habitat	Estuary, downstream of highway 101	BR
SONCC-LitR.1.4.5.1	*Use regulatory mechanisms to provide protection of existing tidal wetland habitat*					

22. Strawberry Creek Population

Central Coastal Stratum

Dependent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

4 mi^2 watershed (0% Federal ownership)

7 IP-km (4 IP-mi) (60% High)

Dominant Land Uses are ‘Residential Development’ and ‘Agriculture’

Key Limiting Stresses are ‘Barriers’ and ‘Impaired Estuary/Mainstem Function’

Key Limiting Threats are ‘Road-Stream Crossing Barriers’ and ‘Channelization/Diking’

Highest Priority Recovery Actions

• Remediate structural road-stream crossing barriers • Prevent damage from vehicular traffic near the estuary and Clam Beach parking area • Construct additional wetland habitat in tidally-inundated stream reaches	• Relocate parking area at Clam Beach and reconnect the adjacent wetland area • Restore natural channel form and function by removing concrete channel in Lower Strawberry Creek • Increase large woody debris (LWD), boulders, and instream structure

22.1 History of Habitat and Land Use

The community of McKinleyville encompasses most of the Strawberry Creek basin, with nearly 100 percent of the land privately owned. About 13.8 percent of the basin is owned by Green Diamond Resource Company (GDRC) as industrial timberlands covered under a Habitat Conservation Plan (HCP). Historically, much of the basin was cleared for rural development, agriculture and timber harvest purposes. Although historically timber harvest and agricultural practices took place within the basin, low-density rural residential and low intensity agricultural land uses now dominate. The foothills, which contain the headwaters, have a more recent history of timber harvest with secondary growth currently dominating the basin.

Highway 101, which crosses Strawberry Creek low in the basin, was established in the 1920s and is responsible for some of the earliest and more significant habitat changes in Strawberry Creek. The highway culvert and the concrete channel immediately upstream are significant impediments to coho salmon passage. Additional partial barriers are present at road crossings upstream on Strawberry Creek. On Patrick Creek, the most downstream tributary to Strawberry Creek, the Highway 101 crossing completely blocks fish passage.

Natural instream structures such as wood were likely removed during road construction to facilitate unimpeded flow through culverts and narrow channels. The original riparian vegetation containing old growth trees was removed during past timber practices. A majority of the basin contains second growth mixed conifer, redwood, Sitka spruce, and other riparian vegetation maintaining relatively complex channel conditions. Large trees are found embedded in the banks throughout much of the basin and cool water with good stream flow exists throughout most of the area.

Strawberry Creek is subject to increased storm water runoff in areas adjacent to the impervious surfaces of the Arcata/Eureka Airport in the lowest part of the basin. Low-density rural residential development in the Strawberry Creek basin, and associated impervious surfaces such as roads, has also increased storm water runoff and associated pollutants.

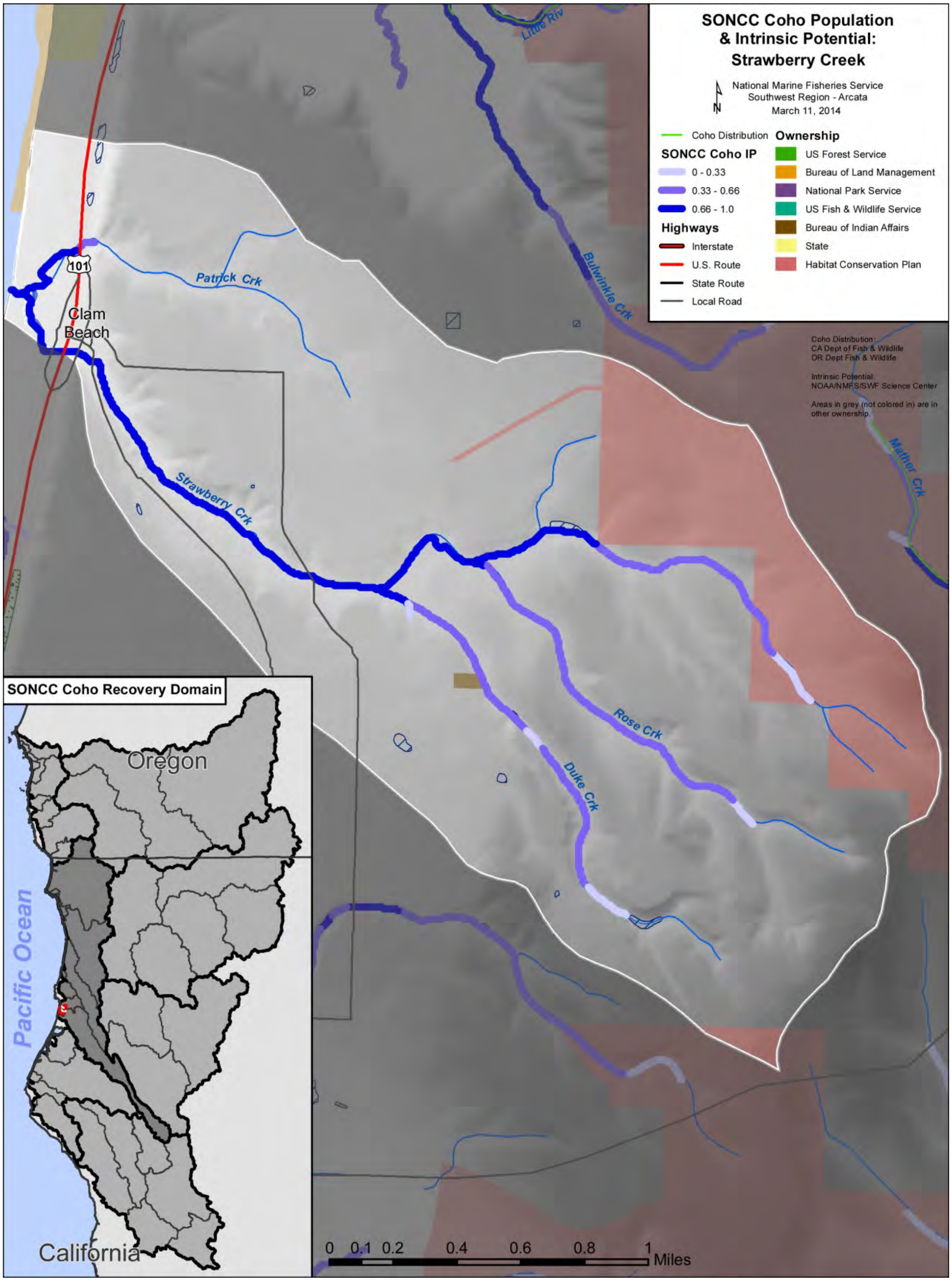

Figure 22-1. The geographic boundaries of the Strawberry Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

22.2 Historic Fish Distribution and Abundance

Potential coho salmon habitat is distributed throughout the Strawberry Creek basin, which comprises about four square miles. The IP modeled results suggest that high value (IP > 0.66) coho salmon habitat occurs in about 50 percent of the basin, particularly in the section of Strawberry Creek from the ocean to the confluence of the tributary Duke Creek. Medium potential coho salmon habitat (IP 0.33 – 0.66) occurs in the upper basin areas of Strawberry Creek and in the Duke Creek and Rose Creek tributaries. The small tributary Patrick Creek contains a small amount of high value coho salmon habitat while the remaining portion contained medium potential habitat.

Although coho salmon have been found historically in Strawberry Creek, no historic data exist to describe run characteristics, fish distribution or population abundance for coho salmon in Strawberry Creek or in its tributaries, Duke Creek, Rose Creek, and Patrick Creek. Surveys did not detect presence of coho salmon for brood years 2000-2002 in Strawberry Creek, although there is a historical record of coho presence for brood year 1967 (Garwood 2012).

Table 22-1. Tributaries with high IP reaches (IP value > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Strawberry Creek	Patrick Creek	Duke Creek

22.3 Status of Strawberry Creek Coho Salmon

Spatial Structure and Diversity

About 50 percent of the Strawberry Creek basin has a high IP value, indicating there is potential for good spatial distribution of coho salmon in the basin. However, in the recent past, fish have been restricted during most years to just the lowest reaches of the basin by partial barriers in Strawberry Creek and many tributaries and a complete barrier on the Patrick Creek tributary near the Pacific Ocean. No stream crossings have been improved in the Strawberry Creek basin and the existing barriers likely inhibit coho salmon recovery in the majority of the basin.

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Although the amount of habitat currently utilized by coho salmon is unknown, it is presumed to be very limited due to the presence of passage barriers and habitat degradation associated with low density rural development.

Population Size and Productivity

There are no data available on the current or historic coho salmon abundance in Strawberry Creek; however, it is designated as a dependent population and likely is dominated by strays from nearby basins. Due to migration barriers and habitat degradation within the Strawberry Creek basin, it is likely that coho salmon numbers are very low, and may even be extirpated from the basin. Sampling efforts have been limited, but coho salmon have not been detected in Strawberry Creek during the past 40 years. Nearby coho salmon populations include the dependent Norton/Widow White Creek population and the functionally independent Mad River and Little River populations. The Mad River and Norton/Widow White Creek populations are severely depressed, and therefore are not likely contributing strays into Strawberry Creek. The Little River population is low but stable, and therefore could be a source of colonists to Strawberry Creek.

Extinction Risk

Not applicable because Strawberry Creek is not an independent population.

Role of Population in SONCC Coho Salmon ESU Viability

The Strawberry Creek population is considered dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and likely received sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006). Although such populations may not be fully viable on their own, they do increase connectivity by allowing dispersal among independent populations, acting as a source of colonists in some cases. Historically, the Strawberry Creek population would have interacted with other Central Coastal populations such as the potentially independent Little River population to the north, the functionally independent Mad River population to the south, or the dependent Norton/Widow White Creek population to the south. Any restored habitat in Strawberry Creek provides potential connectivity and increased resiliency in the SONCC coho salmon ESU.

22.4 Plans and Assessments

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. Strawberry Creek is located in the Trinidad HU. Problems for coho salmon recovery in the Trinidad HU include high levels of fine sediment, stream channel aggradation, lack of instream LWD, insufficient levels of recruitable conifer LWD, poor estuary conditions, and barriers to anadromy.

Green Diamond Resource Company (GDRC)

Green Diamond Habitat Conservation Plan (HCP)

The GDRC HCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in the Strawberry Creek basin. The GDRC owns 14 percent of the Strawberry Creek watershed. The plan has a number of provisions designed to protect coho salmon and salmon habitat on GDRC land in the Strawberry Creek basin. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC's activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of aquatic species. Elements of the HCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. More information about the GDRC HCP can be found in Section 3.2.5.

22.5 Stresses

Table 22-2. Severity of stresses affecting each life stage of coho salmon in Strawberry Creek. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses [2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Barriers[1]	-	High	High[1]	High	Very High	High
2	Impaired Estuary/Mainstem Function[1]	-	Medium	High[1]	High	Medium	High
3	Altered Sediment Supply	High	High	High	High	Medium	High
4	Lack of Floodplain and Channel Structure	Medium	High	High	High	High	High
5	Degraded Riparian Forest Conditions	-	Medium	Medium	Medium	Medium	Medium
6	Altered Hydrologic Function	Medium	Medium	Medium	Medium	Low	Medium
7	Impaired Water Quality	Medium	Medium	Medium	Medium	Low	Medium
8	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Medium
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key stresses and limited life stage.
[2] Increased Disease/Predation/Competition are not considered stresses for this population.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for the Strawberry Creek population are road-crossing barriers in the lower basin and impaired estuary/mainstem function. Barriers limit, if not completely block, all migration into the upper parts of the basin where spawning and rearing habitat occur. If adults are able to migrate through these barriers, smolt outmigration may be hindered. Strawberry Creek estuary is impaired. Tidal freshwater habitat is important for the growth and survival of juvenile coho salmon. Significant amounts of high IP habitat exist in the lower Strawberry Creek, including the tidally influenced areas of Strawberry and Patrick Creek. These high IP habitats may be valuable for winter and summer rearing and should be prioritized for recovery.

Barriers

Barriers pose a very high stress to juveniles, smolts, and adults. At least four barriers have been assessed in the Strawberry Creek basin, which are located at major road-stream crossings. As discussed in more detail in the section below regarding road-stream crossing threats, the crossing on Patrick Creek is a complete barrier to both juvenile and adult coho salmon and there are three other known partial barriers on the mainstem of Strawberry Creek. Additional road-stream crossings also likely occur on private roads and driveways, which have not been surveyed, and the extent of fish passage at these stream crossings is unknown.

Impaired Estuary/Mainstem Function

This stress refers to just the estuary conditions in Strawberry Creek, since this is a single population basin. Mainstem conditions are addressed through other stresses such as floodplain and channel structure, riparian condition, and hydrologic function. Estuary function is important to the population because of its unique role in the life history and survival of coho salmon

The Strawberry Creek basin has a small and narrow estuary that is heavily impacted by Highway 101 and a parking area off Clam Beach Drive. The development of this four-lane stretch of Highway 101 in the estuary has reduced the current extent of habitat to just a few acres downstream of the highway. Patrick Creek, a tributary to the estuary is completely blocked to fish at Highway 101 (CalFish 2009). The Highway 101 culvert on Strawberry Creek is partially filled with sediment, which restricts tidal exchange and estuarine wetland habitat. Currently, the estuary area adjacent to the ocean has large pieces of embedded, old growth wood that probably provide limited function as refugia. Vehicular access to riparian areas on Clam Beach might negatively affect migrating or rearing coho salmon by increasing turbidity at stream crossings or damaging riparian vegetation. There is no evidence that the mouth of Strawberry Creek closes to the Pacific Ocean during even the lowest water years, meaning bar breaching is not an issue. Given the small size of the basin, estuarine habitat could be very important to juvenile coho salmon rearing and therefore the loss of estuarine function is considered a high stress for the population. Juveniles and smolts are most affected since they rely on rearing and holding habitat in the estuary.

Altered Sediment Supply

Altered sediment supply is a medium stress to all life stages. The sediment supply in Strawberry Creek is being altered by the surrounding residential and urban land uses, as well as timber harvest and road building further up in the basin, and sediment supply to the creeks has increased due to these land use practices. This increase in material contributes to the filling in of pools and widening of channels and the input of fines can create high levels of embeddedness, decreasing the quality of spawning gravel. Considering the continued increases in the human population in the areas surrounding Strawberry Creek, this stress is likely to continue into the future, and may become more detrimental over time.

Lack of Floodplain and Channel Structure

Floodplain and channel structure presents a medium stress across most life history stages. No habitat surveys have been conducted in the Strawberry Creek basin but the removal of large wood from stream channels and the removal/depletion of riparian habitat, which is the source of future large wood input, have likely reduced the structural complexity of stream channels. Fine sediment input from land use practices in the upper basin areas has likely filled pools and simplified habitat, limiting rearing and spawning habitat in accessible areas. In addition, just upstream of the Highway 101 culvert, Strawberry Creek is channelized, creating simplified stream habitat with lack of cover or refuge for about 800 feet, and adding to existing passage problems throughout the basin.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions present a medium stress across most life stages. Forests are present in the majority of riparian areas in the basin; however, the size and age of trees is likely much lower than it was historically. The riparian forest conditions have been most altered through timber harvest in the upper Strawberry Creek basin, which is an area that has medium IP potential habitat. Some of the canopy cover has been depleted from road building and timber harvest in riparian areas and streamside corridors. Many of the legacy trees have been removed, leaving low potential for large wood recruitment and adding to existing sediment issues.

Altered Hydrologic Function

Altered hydrologic function represents a medium stress across most life history stages. The McKinleyville Community Services District provides water from the Mad River to residents of the lower Strawberry Creek basin (MCSD 2010) where the majority of the human population is located. No stream diversions were found in the Strawberry Creek basin, although many of the rural residents in the basin may utilize wells, which could contribute to a lowered water table. On the other hand, no sand berm forms during the summer at Strawberry Creek's confluence with the Pacific Ocean, so the basin still has excellent flow volume and cool water temperatures throughout the year. Thus, hydrologic function is not a significant stress in the basin.

Impaired Water Quality

Water quality poses a medium to low stress to coho salmon in the basin. This stress is most likely in the form of temperature and some rural residential pollutants, but it is unknown what, if any, effect this has on the Strawberry Creek coho salmon population. No water temperature data have been collected in Strawberry Creek or its tributaries, but temperature is not likely a limiting factor because the entire basin falls within coastal influences, where cool and moist conditions dominate.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into Strawberry Creek; however, the proportion of adults that are of hatchery origin is likely less than five percent and there is no hatchery in the basin producing other species of salmonids. Therefore, adverse hatchery-related effects pose a low risk to all life stages.

22.6 Threats

Table 22-3. Severity of threats affecting each life stage of coho salmon in Strawberry Creek. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Road-Stream Crossing Barriers[1]	High	High	High[1]	High	Very High	High
2	Timber Harvest	High	High	High	High	Medium	High
3	Channelization/Diking[1]	Low	Medium	High[1]	High	Medium	High
4	Roads	Medium	Medium	Medium	Medium	Medium	Medium
5	Urban/Residential/Industrial Dev.	Medium	Medium	Medium	Medium	Medium	Medium
6	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
7	Climate Change			Low	Low	Medium	Low
8	Fishing and Collecting	-	-	Low	Low	Low	Low
9	Dams/Diversion	Low	Low	Low	Low	Low	Low
10	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage
[2]Invasive Non-Native/Alien Species, High Severity Fire, and Mining/Gravel Extraction are not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are road-stream crossing barriers, and channelization/diking.

Road-stream Crossing Barriers

Road-stream crossing barriers constitute a very high threat to coho salmon population in Strawberry Creek. At least four barriers have been assessed in the Strawberry Creek basin, and all are located at major road-stream crossings (Taylor 2000, Lang 2005). The state Highway 101 culvert is located adjacent to Strawberry Creek's outlet to the ocean and is the lower most barrier to passage, and excludes upstream movement of juvenile coho salmon into the majority of the basin during nearly all flows. Adult coho salmon passage occurs during only about 48 percent of flows (Lang 2005). Just upstream of the Highway 101 culvert is a steep trapezoidal concrete channel paralleling Central Avenue in McKinleyville, presenting the next partial barrier to fish passage in the Strawberry Creek basin. Eight-hundred feet upstream is the Humboldt County road crossing at Central Avenue (Lang 2005). This crossing represents a complete barrier to juvenile coho salmon and a partial barrier to adult coho salmon. Further upstream at the Dows Prairie Road crossing, another culvert is a partial barrier to adult and juvenile coho salmon. The small tributary Patrick Creek meets Strawberry Creek below the 101 Highway culvert at Strawberry Creek near Clam Beach. A complete barrier to fish passage on Patrick Creek occurs upstream of this confluence at Highway 101 (Lang 2005); however there are only a few hundred feet of medium-IP habitat upstream of this barrier.

No efforts have been made to improve these crossings. The culverts under Highway 101 at both Strawberry Creek and the tributary Patrick Creek pose especially significant problems due to their locations low in the Strawberry Creek basin.

Table 22-4. List of prioritized road-stream crossing barriers in the Strawberry Creek population.

IP priority	Stream Name	Road Name	Watershed	County	Miles of upstream habitat
high	Strawberry Creek	Highway 101	Strawberry	Humboldt	>5.2
high	Strawberry Creek	Central Avenue	Strawberry	Humboldt	5.1
high	Strawberry Creek	Dows Prairie Rd.	Strawberry	Humboldt	4.1
high	Strawberry Creek	Highway 101	Patrick Creek	Humboldt	<1

Timber Harvest

Extensive timber harvest likely occurred in the early history of McKinleyville's development, and set the stage for land to be cleared for later agriculture or low-density human settlement. Timber harvest of the basin may have contributed to early degradation of the riparian zone and lack of instream structure. Today, timber harvest is considered a high threat to the Strawberry Creek population.

Thirteen point eight percent of the watershed is owned by GDRC and managed for timber harvest under an aquatic HCP (GDRC 2006) that includes minimization and mitigation measures consisting of road and riparian management, slope stability, and harvesting restrictions. The impacts of timber harvesting, even if carried out under the aquatic HCP, may result in the loss of pool habitat, loss of large wood and stream complexity, altered hydrology and nutrient cycling, and increased sediment loads. Adverse changes in habitat conditions will have a negative effect on all life stages of coho salmon utilizing those areas. GDRC's recent wood additions to streams and their assessments of erosion and sedimentation sources will help mitigate the impacts from future timber harvest in Strawberry Creek.

Channelization/Diking

Channelization and diking is a medium threat to almost all life stages of the Strawberry Creek coho salmon population, but may be a more significant threat in certain areas. In particular, just upstream of the Highway 101 culvert on Strawberry Creek is a steep trapezoidal concrete channel paralleling Central Avenue in McKinleyville. Channelization of the stream, in conjunction with a lack of instream structure, creates a simplified stream habitat with no cover or refuge for about 800 feet. Habitat within the channelized area is unsuitable for coho salmon rearing and presents a barrier to juvenile fish passage and adult passage during some flows.

Roads

Roads pose a medium threat to coho salmon in Strawberry Creek. Many of the roads in the more rural portions of the basin are unpaved and these roads create a significant source of sediment input to the stream. Because these roads are in a rural setting and often in the form of driveways and private roads, they can be difficult to treat, as decommissioning is not an option. In accordance with their aquatic Habitat Conservation Plan, the GDRC intends to maintain or decommission their roads to minimize adverse effects to salmon.

Urban/Residential/Industrial Development

Low-density rural residential development of the area occupied by the Strawberry Creek population of coho salmon contributes to all the stresses affecting this population, and poses a medium threat to all life stages of the Strawberry Creek coho salmon population. This threat is considered medium instead of high because no areas are designated for future medium or high-density residential development, industrial, or mixed use. Further urban development has not occurred in the basin and is not planned. The only industrial-type development is the Arcata/Eureka Airport, which could contribute to runoff of pollutants into the basin due to its impervious surfaces.

Agricultural Practices

Although agriculture may have historically played a larger role in the Strawberry Creek basin, now it presents a medium threat with 5 to 10 percent of the basin affected by agricultural practices. Some of the landowners have a small number of horses or cattle grazing near the stream, and this activity likely contributes to the altered sediment supply seen in many areas of lower Strawberry Creek. Grazing can result in multiple stresses including increased sediment supply, degraded riparian zones, and poor water quality.

Climate Change

There is moderate risk of a change in average precipitation over the next 50 years (Appendix B). Modeled regional average temperature shows a moderate increase over the next 50 years (Appendix B). Average temperature could increase by up to 1°C in the summer and by a similar amount in the winter. The risk of sea level rise is low to moderate (Thieler and Hammer-Klose 2000), which may impact the quality and extent of wetland juvenile and smolt habitat. Adults may be negatively impacted by climate-related ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Fishing and Collecting

California-managed fisheries for species other than coho salmon occur in estuaries, freshwater, and nearshore marine areas. The effects of these fisheries on the continued existence of the SONCC coho salmon ESU have not been formally evaluated by NMFS. As of April 2011, NMFS has not authorized future collection of coho salmon for research purposes in Strawberry Creek.

Dams/Diversions

Aerial photos show the presence of two small ponds on Duke Creek, both likely formed by impoundments. One is about 0.6 miles upstream of the mouth of Duke Creek in an area of medium IP habitat value and other is located an additional 0.8 upstream in an area of low IP habitat value.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Strawberry Creek population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

22.7 Recovery Strategy

Coho salmon have not been detected in Strawberry Creek during the past 40 years, although survey efforts have been quite limited. The Strawberry Creek population is dependent and therefore cannot be viable on its own; however, it is necessary to restore access and habitat within the basin so that it can provide connectivity between other populations in the ESU. The recovery criterion for the population is that 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival.

The most immediate need for coho salmon recovery in the Strawberry Creek basin is to provide adult passage at road-stream crossings barriers in the lower basin. The spatial distribution and diversity of coho salmon is below its potential due to these barriers and the population will not recover without passage improvements. With increased passage, coho salmon would have the opportunity to recolonize most of the basin.

There are no survey data to assess habitat quality quantitatively; however, it is likely that habitats are lacking instream complexity and mature riparian forests. Restoration efforts should focus on the mainstem of Strawberry Creek and the lower portions of Patrick Creek, Rose Creek, and Duke Creek, which all have high IP habitat (Figure 22-1). In addition, eliminating impediments to natural estuarine function would increase the value of this habitat and potentially increase growth and survival of juveniles.

Table 22-5, beginning on the following page, lists the recovery actions for the Strawberry Creek population.

Table 22-5. Recovery action implementation schedule for the Strawberry Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-StrC.5.1.1	Passage	Yes	Improve access	Remove structural barrier	Mainstem Strawberry, Patrick, Duke, and Rose creeks, Highway 101 culvert, and all streams where coho salmon would benefit immediately	2c
SONCC-StrC.5.1.1.1	*Assess road-stream crossing barriers*					
SONCC-StrC.5.1.1.2	*Upgrade County culverts to accommodate fish passage at all life stages, based on assessment*					
SONCC-StrC.5.1.1.3	*Prioritize and resolve passage issues at Highway 101*					
SONCC-StrC.5.1.32	Passage	Yes	Improve access	Remove structural barrier	Population wide	2d
SONCC-StrC.5.1.32.1	*Assess road-stream crossing barriers*					
SONCC-StrC.5.1.32.2	*Upgrade County culverts to accommodate fish passage at all life stages, based on assessment*					
SONCC-StrC.5.1.32.3	*Prioritize and resolve passage issues*					
SONCC-StrC.1.2.8	Estuary	Yes	Improve estuarine habitat	Construct additional wetland habitat in tidally-inundated stream reaches	Lower Strawberry Creek, downstream of highway 101	2c
SONCC-StrC.1.2.8.1	*Assess tidally influenced habitat and wetlands and develop a plan to restore wetland and off channel habitat*					
SONCC-StrC.1.2.8.2	*Construct additional wetland habitat (wetland and off-channel habitat) downstream of the highway on tidally-inundated stream reaches*					
SONCC-StrC.1.2.9	Estuary	Yes	Improve estuarine habitat	Relocate parking area	Lower Strawberry Creek	2c
SONCC-StrC.1.2.9.1	*Relocate the parking area on Clam Beach Drive and expand and connect the adjacent wetland area*					
SONCC-StrC.1.4.7	Estuary	Yes	Protect estuarine habitat	Prevent damage from vehicular traffic	Lower Strawberry Creek	2c
SONCC-StrC.1.4.7.1	*Develop regulatory mechanisms to prevent all vehicular traffic on Clam beach and Strawberry Creek estuary*					
SONCC-StrC.2.1.13	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	3c
SONCC-StrC.2.1.13.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-StrC.2.1.13.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-StrC.2.1.31	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	3d
SONCC-StrC.2.1.31.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-StrC.2.1.31.2	*Place instream structures, guided by assessment results*					
SONCC-StrC.10.7.29	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-StrC.10.7.29.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-StrC.10.7.29.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-StrC.10.7.30	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-StrC.10.7.30.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-StrC.10.7.30.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-StrC.5.1.18	Passage	Yes	Improve access	Remove barrier	Strawberry Creek, Central Avenue culvert	3d
SONCC-StrC.5.1.18.1	*Remediate barrier at Central Avenue to accommodate fish passage for all life history phases*					
SONCC-StrC.2.2.2	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Restore natural channel form and function	Lower Strawberry Creek	3d
SONCC-StrC.2.2.2.1	*Assess concrete channel and develop a plan to restore natural channel form and function*					
SONCC-StrC.2.2.2.2	*Remove concrete channel and restore natural channel, guided by the plan*					
SONCC-StrC.7.1.5	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Middle Strawberry Creek and tributaries	BR
SONCC-StrC.7.1.5.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-StrC.7.1.5.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-StrC.7.1.5.3	*Plant vegetation to stabilize stream bank*					
SONCC-StrC.7.1.5.4	*Fence livestock out of riparian zones*					
SONCC-StrC.7.1.5.5	*Remove instream livestock watering sources*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-StrC.7.1.6	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Middle and Upper Strawberry Creek	BR
SONCC-StrC.7.1.6.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-StrC.7.1.6.2	*Develop watershed-specific guidance for managing riparian vegetation*					
SONCC-StrC.2.1.19	Floodplain and Channel Structure	No	Increase channel complexity	Improve regulatory mechanisms	Population wide	BR
SONCC-StrC.2.1.19.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-StrC.2.2.14	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	BR
SONCC-StrC.2.2.14.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-StrC.2.2.14.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-StrC.8.1.10	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	BR
SONCC-StrC.8.1.10.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-StrC.10.2.12	Water Quality	No	Reduce pollutants	Educate stakeholders	Population wide	BR
SONCC-StrC.10.2.12.1	*Develop an educational program that teaches landowners and businesses about avoiding pollution from septic systems, backyard pesticides, fuels, and nutrients*					
SONCC-StrC.10.2.3	Water Quality	No	Reduce pollutants	Improve regulatory mechanisms	Population wide	BR
SONCC-StrC.10.2.3.1	*Complete sewer system upgrades to achieve Clean Water Act compliance*					
SONCC-StrC.10.2.3.2	*Provide incentives for septic repair and upgrades*					
SONCC-StrC.10.2.24	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	BR
SONCC-StrC.10.2.24.1	*Develop a pesticide management plan*					
SONCC-StrC.10.2.24.2	*Implement pesticide management plan and technical assistance program*					
SONCC-StrC.10.2.4	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	BR
SONCC-StrC.10.2.4.1	*Using regulatory mechanisms, limit impervious surfaces*					

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23. Norton/Widow White Creek Population

Central Coastal Stratum

Dependent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

6.14 mi² (0% Federal ownership)

10 IP-km (6 IP-mi) (62% High)

Dominant Land Uses are Urbanization and Agriculture

Key Limiting Stresses are ‘Degraded Riparian Forest Conditions’ and ‘Lack of Floodplain and Channel Structure’

Key Limiting Threats are ‘Channelization/Diking’ and ‘Roads’

Highest Priority Recovery Actions

• Increase beaver abundance • Increase conifer riparian vegetation • Remove barriers	• Increase large woody debris (LWD), boulders, or other instream structure • Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows • Reduce pesticides

23.1 History of Habitat and Land Use

The community of McKinleyville encompasses most of the Norton/Widow White basin, with nearly 100 percent of the land privately owned. Historically, much of the basin was cleared for farming, agriculture and timber harvest purposes. The majority of the channel meanders through a low-lying coastal plain, and is currently occupied by urban and rural development, and some small-scale agricultural areas. The foothills, which contain the headwaters, have a more recent history of timber harvest with second growth currently dominating the landscape.

Significant habitat changes began in Norton/Widow White Creeks around the 1920s, when Highway 101 was built and created a fish barrier low in the basin. Currently, the long culvert at this location is still a partial barrier, inhibiting movement of juvenile salmonids. Just to the east of the highway, extensive urban development has also contributed to habitat degradation and there are many road/stream crossings, channelized reaches, water diversions, and housing and urban developments all within the riparian corridor. Many of the road crossings have created partial or complete barriers to fish and much of the riparian vegetation has been depleted or altered. Additionally, asphalt and other impervious surfaces replace upland vegetation in many cases, contributing to an altered and flashier hydrograph and decreased water quality throughout the lower basin.

Natural structures such as wood were likely removed during development to facilitate unimpeded flow through culverts and narrow channels, which has contributed to the simplification of the stream habitat. Additionally, the lack of riparian vegetation decreases future recruitment of large wood structures in the channel, further simplifying habitat. The original riparian vegetation containing old growth trees has been removed in many areas and has been replaced with nonnative species that do not provide the same benefits as natives. Many reaches are simplified through landscaping and other urban and residential alterations that do not provide the shade, bank stability, and floodplain structure necessary for functional coho salmon habitat.

Development in McKinleyville is composed primarily of residential neighborhoods, small retail businesses, and a small number of light industrial facilities. The high level of impervious surfaces from these developed areas contributes to increased storm water runoff, increased point and non-point source pollution, and alterations to the hydrology. Pollutants entering the storm water conveyance facilities are expected to consist of sediments and topsoil, oils and greases (petroleum hydrocarbons), organics (mainly from pesticides), nutrients (mainly from fertilizers), heavy metals, and bacterial/viral constituents (Humboldt County 2005), and are likely also entering Norton/Widow White Creek and negatively affecting coho salmon of all life stages.

Today, there are community efforts to restore this basin, particularly along the popular Hammond Trail, which provides a positive interpretive opportunity for the public. The schools that lie along the creeks also provide potential for educational activities related to stream habitat and fish use.

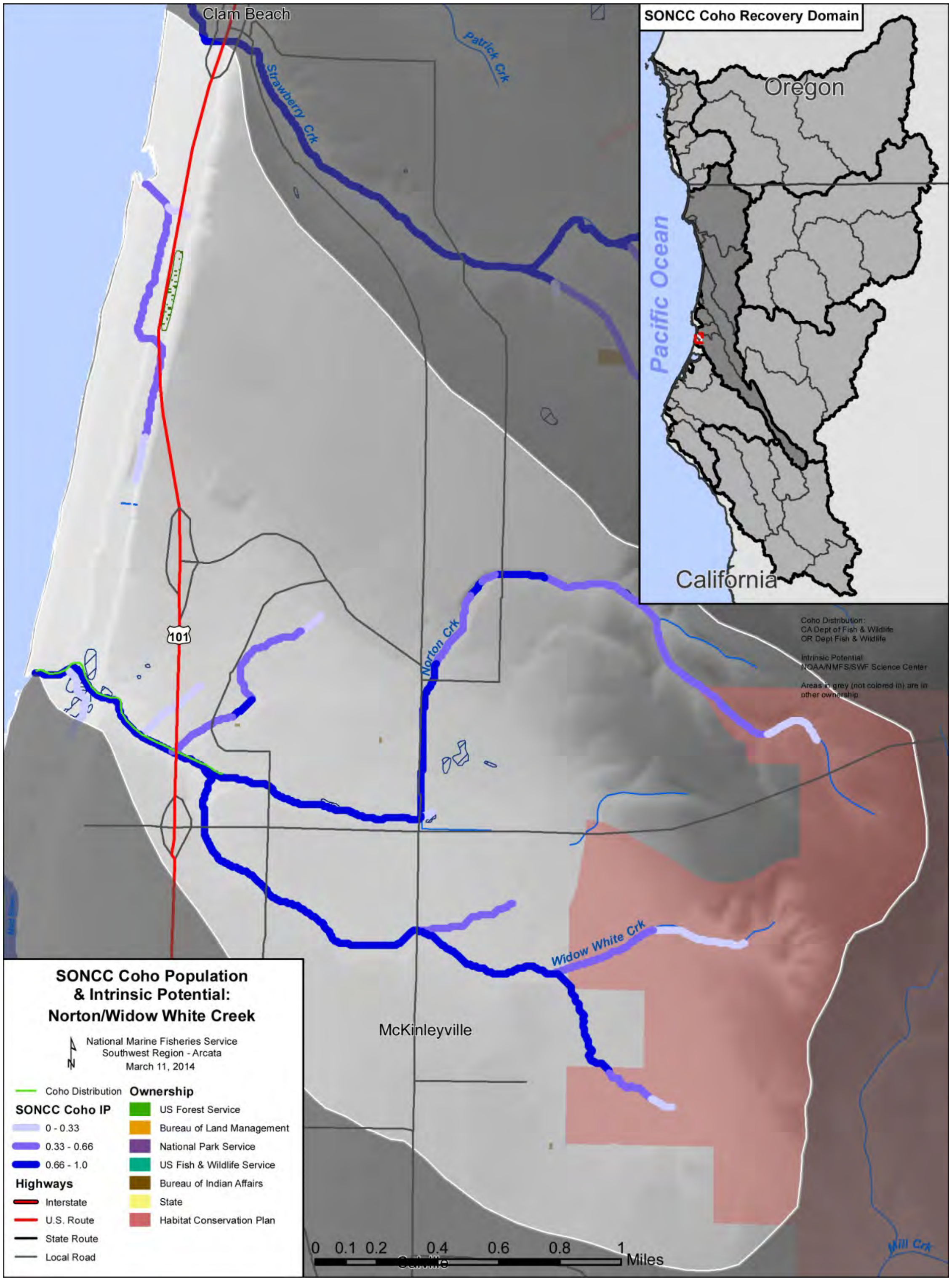

Figure 23-1. The geographic boundaries of the Norton/Widow White coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

23.2 Historic Fish Distribution and Abundance

No data exist on run characteristics or population abundance for coho salmon in Norton Creek or the major tributary, Widow White Creek. Surveys detected presence of coho salmon brood year 2001 in Norton Creek and 2000 in Widow White Creek, but not 2001 in Widow White Creek (Garwood 2012). Additionally, two historical surveys did not detect presence of brood years 1983 in Widow White Creek (Garwood 2012). Potential coho salmon habitat is distributed throughout the 15.9 km^2 basin. The IP model shows 8.54 km of IP habitat, with high values (IP > 0.66) for most (5.94 km) of the basin, and lower values near the upper parts of Norton Creek and some smaller tributaries to Widow White Creek.

23.3 Status of Norton/Widow Coho Salmon

Spatial Structure and Diversity

The majority of both Norton and Widow White creeks have high IP value, indicating there is potential for good spatial distribution of coho salmon in the basin. The current distribution of coho salmon spans from the estuary upstream to just past the confluence of Norton and Widow White creeks (Figure 23-1). In the recent past, barriers limited coho salmon to the lowest reaches of the basin, but recent restoration activities have improved access allowing for the potential recolonization of the upper basin by coho salmon. Although several road/stream crossing barriers have been improved since 2001, the culvert at Highway 101 remains a partial barrier (Lang 2005) and continues to inhibit recovery in the majority of the basin.

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. The amount of habitat currently used by coho salmon is unknown but presumed to be very limited due to habitat degradation associated with urbanization and the presence of barriers.

Population Size and Productivity

There are no data available on the current or historic coho salmon population size or productivity in Norton/Widow White Creek; however, this population is designated as a dependent population and likely is dominated by strays from nearby stream systems. Due to extensive habitat degradation and migration barriers within the basin, population size and productivity are presumably low. Currently, Norton/Widow White Creek shares a mouth with the Mad River, which has a coho salmon population that is identified as functionally independent but is also currently severely depressed, and therefore not providing an abundance of individuals for straying into adjacent populations.

Extinction Risk

Not applicable because Norton/Widow White Creek is not an independent population.

Role in SONCC Coho Salmon ESU Viability

The Norton/Widow White Creek population is considered dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and likely received sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006). Although such populations may not be fully viable on their own, they do increase connectivity by allowing dispersal among independent populations, acting as a source of colonists in some cases. Historically, the Norton/Widow White Creek population would have interacted with other Northern Coastal potentially independent populations, such as the Mad River to the south, or with other dependent populations like the Strawberry Creek to the north. Any restored habitat in Norton/Widow White Creek provides potential connectivity and increased resiliency in the SONCC coho salmon ESU.

23.4 Plans and Assessments

Green Diamond Resource Company (GDRC)

Green Diamond Aquatic Habitat Conservation Plan (ACHP)

The GDRC HCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in the Norton/Widow White Creek basin. The GDRC owns 18 percent of the Norton/Widow White Creek basin. The plan has a number of provisions designed to protect coho salmon and salmon habitat on GDRC land in the Norton/Widow White Creek basin. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC’s activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of covered listed aquatic species. Elements of the AHCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. More information about the GDRC AHCP can be found in Section 3.2.5.

23.5 Stresses

Table 23-1. Severity of stresses affecting each life stage of coho salmon in Norton/Widow White Creek. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses [2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	Very High	Very High	Very High
2	Lack of Floodplain and Channel Structure[1]	Low	High	High[1]	High	High	High
3	Altered Hydrologic Function	Medium	Medium	Medium	Medium	Low	Medium
4	Impaired Water Quality	Medium	Medium	Medium	Low	Low	Medium
5	Altered Sediment Supply	Low	Medium	Medium	Low	Medium	Medium
6	Barriers	-	Medium	Medium	Low	Low	Medium
7	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low
8	Impaired Estuary/Mainstem Function	-	Low	Medium	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.
[2] Increased Disease/Predation/Competition is not considered a stress for this population.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for the Norton/Widow White Creek population are degraded riparian forest conditions and lack of floodplain and channel structure. It is likely that the juvenile life stage is most limited and that quality summer and winter rearing habitat is lacking as vital habitat for the population. Lack of riparian forests and channel structure significantly contribute to the simplification of the channel. Development within the lower basin coupled with timber harvest in the upper, have degraded the riparian forests and limited the availability for LWD recruitment. Simplification of the channel disconnects the floodplain and reduces rearing habitat for juvenile salmon in the summer and winter when fish are seeking either cover in cool, deep pools or off-channel velocity refugia.

The best refuge areas for coho salmon are located within the high IP reaches and outside of highly developed area. The upper reaches of Widow White Creek appear to be upstream of most development, and contain lower road densities and less coverage by impervious surfaces as compared to lower reaches in the watershed. This upper reach is upstream of any diversions and has potential for more complex habitat and riparian diversity. Unfortunately, there are many road crossings and highly channelized areas between the lower basin and the upper basin. The accumulation of partial barriers and low flow areas may limit access to these upper reaches.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions present a very high stress across all life history stages except the egg stage. The high amount of urban/residential development in the lower part of the basin has altered the riparian and upslope landscape, and replaced native vegetation with impervious surfaces and exotic plants. Many of the legacy trees in the upper basin were harvested, resulting in little potential for large wood recruitment, increased sedimentation in spawning areas, decreased food availability, and widespread decreases in bank stability.

Lack of Floodplain and Channel Structure

Floodplain and channel structure presents a high stress across most life history stages of coho salmon. Urbanization has highly altered the floodplain of Norton/Widow White Creek. Changes in land uses affecting the floodplain and channel structure include urban/residential development, timber harvest and a shift from natural vegetation to impervious surfaces. No habitat surveys have been conducted in the Norton/Widow White Creek basin but the removal of large wood from stream channels and the removal/depletion of riparian habitat, which is the source of future large wood input, have likely reduced the structural complexity of stream channels. Fine sediment input from land use practices in the upper basin areas has likely filled pools and simplified habitat, limiting rearing and spawning habitat in accessible areas. .

Altered Hydrologic Function

Altered hydrologic function represents a medium stress across most life history stages. Hydrologic function has been altered through high amounts of impervious surfaces and several diversions. The McKinleyville Community Services District provides water from the Mad River to residents of the lower and middle portions of the basin (MCSD 2010) where the majority of the human population is located; however, there are several water diversions in the upper reaches of Widow White and Norton creeks. The diversions are relatively high in the basin, and it is unknown how much water the users are withdrawing. Additionally, many of the rural residents in the basin use wells that may contribute to a lowered water table.

Impaired Water Quality

Water quality poses a medium to low stress to coho salmon in the basin. This stress is most likely in the form of urban pollutants and surface runoff from impervious surfaces. Norton Creek runs through Humboldt Sanitation and Recycling, which is also the location of a historic auto-wrecking yard. The contribution of pollutants from this site is unknown. No water temperature data have been collected in the Norton/Widow White basin, but temperature is likely not a limiting factor for the Norton/Widow White basin because the entire basin falls within coastal influences, where cool and moist climate conditions dominate.

Altered Sediment Supply

Altered sediment supply is a medium stress to some life stages. Because of the high road density and decreased amount of riparian vegetation in the basin, sediment supply to the creeks has been altered and is likely affecting both rearing and spawning habitat. Many rural residents in the upper basin have gravel or dirt roads and driveways, which can contribute fine sediment to the streams. Additionally, many of the residents have horses or cattle that graze adjacent to the stream and contribute to bank instability and the introduction of fine sediment into adjacent stream reaches. The combination of unpaved roads and erosion associated with livestock increases fine sediment input and contributes to the filling of pools and widening of channels. These fine sediments can also create high levels of embeddedness, decreasing the quality of spawning gravel.

Barriers

Barriers are a medium stress for the Norton/Widow White Creek coho salmon population. Although work has begun to address issues throughout the basin, barriers continue to be an issue. The California Fish Passage Assessment Database lists eight barriers in the Norton/Widow White Creek basin (CalFish 2009). Several partial or complete barriers related to culverts have recently been reconstructed to reduce impediments to fish passage (Lang 2005). Rather than replacing the culverts, jump heights have been reduced through the construction of multiple rock weirs that create a series of pools with one-foot jump heights at the culvert outlet. This method of grade control still poses passage problems for juvenile fish, reducing their ability to seek out refuge habitat. The culvert at Highway 101 is a partial barrier and is a high priority for replacement due to its location low in the basin. One natural barrier exists on Norton Creek at river mile 1.5, and appears to be related to low flows. This barrier is listed as the natural limit to anadromy in the creek (CalFish 2009). It appears restoration efforts to improve fish passage have lowered the severity of this stress. Currently, complete barriers have been removed, allowing adults access to the upper basin, while juvenile fish passage remains to be a problem.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Impaired Estuary/Mainstem Function

Dune dynamics and the migration of the Mad River mouth influence the mouth of Norton/Widow White Creek and its estuary. The Mad River mouth has migrated north over the last several decades, reaching all the way to Clam Beach and consuming the outlet of Norton/Widow White Creek. Currently, the Mad River mouth is moving south and Norton/Widow White Creek continues to flow parallel to the beach until reaching the mouth of the Mad River where it enters the sea. The continued southerly migration of the Mad River will probably isolate the mouth of Norton/Widow White Creek again in the future. There is some functional wetland habitat that is likely used by juveniles and smolts from this population as well as the Mad River coho salmon population. One potential issue may be stranding of juveniles in pools on the beach if the hydrology is such that fish can access these pools at high tide and then are stranded during low tide. These so-called “death traps” can heat up during the day and likely lead to mortality events. The lower part of the creek runs along the beach both north and south of where it meets the beach and there are numerous areas where it pools up and could result in such stranding events. Eliminating such features, which could be the result of anthropogenic changes in the basin, would prevent this from happening. Overall, the availability of access to and from the basin and the availability of habitat make this a low stress for the population.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into Norton/Widow White Creek; however, the proportion of adults that are of hatchery origin is likely less than five percent. Therefore, adverse hatchery-related effects pose a low risk to all life stages.

23.6 Threats

Table 23-2. Severity of threats affecting each life stage of coho salmon in Norton/Widow White Creek. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Channelization/Diking[1]	Medium	Very High	Very High[1]	Very High	Very High	Very High
2	Roads[1]	Medium	Very High	Very High[1]	Very High	Very High	Very High
3	Urban/Residential/Industrial Dev.	Medium	Very High	Very High	Very High	Very High	Very High
4	Road-Stream Crossing Barriers	-	High	High	High	Medium	High
5	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
6	Agricultural Practices	Low	Medium	Medium	Medium	Medium	Medium
7	Dams/Diversion	Low	Medium	Medium	Medium	Low	Medium
8	High Severity Fire	Low	Medium	Medium	Medium	Medium	Medium
9	Fishing and Collecting	-	-	Low	Low	Low	Low
10	Climate Change	Low	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low
12	Invasive Non-Native/Alien Species	Low	Low	Low	Low	Low	Low

[1] Key limiting threats
[2] Mining/Gravel Extraction is not considered a threat to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are channelization/diking, and roads.

Channelization/Diking

Channelization and diking are a very high threat to almost all life history stages of the Norton/Widow White Creek coho salmon population. This threat is tied to the urbanization of the basin, and contributes significantly to all stresses. The channel is restricted by the close proximity to roads and other urban structures, limiting its access to much of the floodplain. Further, habitat within the channelized area is simplified and therefore less suitable for coho salmon. One of the most acutely channelized reaches is Norton Creek along Central Avenue, where the high-IP habitat is confined to a narrow ditch for approximately 2000 feet.

Roads

Roads pose a very high threat to Norton/Widow White Creek coho salmon. Many of the roads in the more rural portions of the basin are unpaved with gravel or dirt surfaces, are not maintained, and contribute to increased sediment loading throughout the basin. Because these roads are in a rural setting and often in the form of driveways and private roads, they can be difficult to treat, as decommissioning or proper maintenance is often not an option. Additionally, the existence of these roads adjacent to the stream channel can contribute to altered hydrologic function, decreased bank stability, disconnected floodplain, and simplification of the channel.

Urban/Residential/Industrial Development

Urban and residential development in the Norton/Widow White Creek basin contributes to all of the stresses affecting this population, and poses a very high threat to almost all life history stages of coho salmon. The basin is almost entirely privately owned with a multitude of land uses including, timber harvest, residential development, light industrial and commercial services. Development has led to more paved roads, which facilitate runoff of pollutants into creeks, degrading water quality. Development has also resulted in other threats to this population, including road-stream crossing barriers and channelization.

Road-Stream Crossing Barriers

Road-stream crossing barriers constitute a low threat to the coho salmon population in Norton/Widow White Creek. There are six major road-stream crossings within the Norton/Widow White basin. Currently, none of these are known to be complete barriers to fish, however the partial barrier from the Highway 101 culvert may decrease distribution into the basin. Surveys by Humboldt State University (Lang 2005) and Ross Taylor and Associates (Taylor 2000) listed five barriers as either temporal and/or partial barriers. The Widow White Creek crossings at McKinleyville Road and Murray Road were modified to lower jump heights but still pose passage problems for juvenile salmon (Lang 2005). Road-stream crossings also occur on private roads and driveways, and the extent of fish passage problems at these stream crossings is unknown.

Timber Harvest

Extensive timber harvest likely occurred in the early history of McKinleyville's development and resulted in clearing the land for later agriculture and human settlement. Timber harvest may have contributed to early degradation of the riparian zone and lack of instream structure, which now are major stresses within the system. Today, timber harvest is considered a medium threat to the Norton/Widow White Creek population.

Today, at least 18 percent of the watershed is owned by GDRC and managed for timber harvest under an AHCP (GDRC 2006) that includes minimization and mitigation measures consisting of road and riparian management, slope stability, and harvesting restrictions. The impacts of timber harvesting, even if carried out under the AHCP, may result in the loss of pool habitat, loss of large wood and stream complexity, altered hydrology and nutrient cycling, and increased sediment loads. Adverse changes in habitat conditions will have a negative effect on all life stages of coho salmon utilizing those areas (NMFS 2007a). GDRC's recent wood additions to streams and their assessments of erosion and sedimentation sources will help mitigate the impacts from future timber harvest in Norton/Widow White Creek.

Agricultural Practices

Agriculture may have once played a more significant role in the Norton/Widow White Creek basin, but now only presents a medium threat. Most of the basin is dominated by urban and rural development; however there are some small-scale agriculture lands further upstream at the base of the foothills. Many of these landowners have a small number of horses or cattle grazing adjacent to the stream. Grazing can contribute to multiple stresses including increased sediment supply, degraded riparian zones, and poor water quality.

Dams/Diversions

Dams and diversions present a medium threat across all life stages. There are no known dams within the Norton/Widow White Creek basin; however, there are at least three diversions. These diversions can contribute to decreased flows, limiting the habitat availability and increasing stream temperatures in the summer. However, given the location of this population on the coast in a cool, wet climate, it is unlikely that the small numbers of withdrawals are having a significant effect on the water quantity and quality in Norton/Widow White Creek.

High Severity Fire

High severity fire poses a medium threat to the coho salmon population in Norton/Widow White Creek. Due to the largely urban and pastoral setting, timber stands do not occupy much of the area and therefore fire is not an imminent threat to the population. If those timber stands that remain, primarily those in the upper basin, were to burn, the resultant sediment delivery to streams would be harmful to the coho salmon habitat found there as well as to individuals living downstream. However, the likelihood of a large catastrophic fire is small given the cool, damp climate and the lack of fuels found throughout the area.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Climate Change

There is moderate risk of a change in average precipitation over the next 50 years (Appendix B). Modeled regional average temperature shows a low increase over the next 50 years (Appendix B). Average temperature could increase by up to 1^{o} C in the summer and by a similar amount in the winter. The risk of sea level rise is low to moderate (Thieler and Hammer-Klose 2000), which may impact the quality and extent of wetland juvenile and smolt habitat. Adults may be negatively impacted by climate-related ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Norton/Widow White Creek population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Invasive and Non-Native/Alien Species

Given the extent of residential development along streams in the Norton/Widow White Creek basin, it is likely that invasive plant species will spread from residential landscaping into riparian areas, particularly if there are pre-existing gaps in the riparian vegetation. Some of these species could impede restoration of riparian forests and wetlands. The extent to which this has already occurred is unknown.

23.7 Recovery Strategy

The greatest need for habitat restoration and threat reduction is in those areas currently occupied by coho salmon in the lower reaches of Widow White and Norton creeks. Unoccupied areas must also be restored to provide enough habitat for coho salmon recovery.

The Norton/Widow White Creek population is considered dependent and therefore cannot be viable on its own; however, it is necessary to restore access and habitat within the basin so that it can provide connectivity between other populations in the ESU. The recovery criterion for the population is that coho salmon must occupy 80% of available IP habitat in years following spawning of brood years with high marine survival. The coho salmon population in Norton/Widow White Creek is severely depressed, with adult salmon only recently regaining access to habitat throughout the basin. The most important factor limiting recovery of coho salmon in the Norton/Widow White Creek basin is a lack of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by increasing habitat complexity within the channel, re-establishing off-channel rearing areas, restoring riparian forests, and reducing threats to instream habitat. Other necessary actions include additional fish passage improvements, particularly at Highway 101, which is a partial barrier to adults, but also several juvenile barriers at county road crossings. Urban development and associated roads and channelization are the largest threats, contributing to most stresses, but remains the most difficult to change. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 23-3 on the following page lists the recovery actions for the Norton/Widow White Creek population.

Table 23-3. Recovery action implementation schedule for the Norton/Widow White Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NWWC.7.1.1	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	2c
SONCC-NWWC.7.1.1.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-NWWC.7.1.1.2	*Develop watershed-specific guidance for managing riparian vegetation*					
SONCC-NWWC.7.1.2	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	2c
SONCC-NWWC.7.1.2.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-NWWC.7.1.2.2	*Thin, or release conifers, guided by the plan*					
SONCC-NWWC.7.1.2.3	*Plant conifers, guided by the plan*					
SONCC-NWWC.2.1.7	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2c
SONCC-NWWC.2.1.7.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-NWWC.2.1.7.2	*Place instream structures, guided by assessment results*					
SONCC-NWWC.2.1.26	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-NWWC.2.1.26.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-NWWC.2.1.26.2	*Place instream structures, guided by assessment results*					
SONCC-NWWC.2.2.8	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Lower Widow White Creek and all streams where coho salmon would benefit immediately	2c
SONCC-NWWC.2.2.8.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-NWWC.2.2.8.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NWWC.2.2.27	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-NWWC.2.2.27.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-NWWC.2.2.27.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-NWWC.5.1.3	Passage	No	Improve access	Remove barriers	Highway 101 culvert and all streams where coho salmon would benefit immediately	2c
SONCC-NWWC.5.1.3.1	*Evaluate and prioritize barriers for removal*					
SONCC-NWWC.5.1.3.2	*Prioritize and resolve passage issues at Highway 101*					
SONCC-NWWC.5.1.3.3	*Upgrade County culverts to accommodate fish passage at all life stages*					
SONCC-NWWC.5.1.29	Passage	No	Improve access	Remove barriers	Population wide	2d
SONCC-NWWC.5.1.29.1	*Evaluate and prioritize barriers for removal*					
SONCC-NWWC.5.1.29.2	*Prioritize and resolve passage issues, based on evaluation*					
SONCC-NWWC.5.1.29.3	*Upgrade County culverts to accommodate fish passage at all life stages*					
SONCC-NWWC.10.2.16	Water Quality	No	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	2c
SONCC-NWWC.10.2.16.1	*Develop a pesticide management plan*					
SONCC-NWWC.10.2.16.2	*Implement pesticide management plan and technical assistance program*					
SONCC-NWWC.10.2.24	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	2d
SONCC-NWWC.10.2.24.1	*Develop a pesticide management plan*					
SONCC-NWWC.10.2.24.2	*Implement pesticide management plan and technical assistance program*					
SONCC-NWWC.2.2.9	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Lower Widow White Creek and all streams where coho salmon would benefit immediately	3c
SONCC-NWWC.2.2.9.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-NWWC.2.2.9.2	*Implement education and technical assistance programs for landowners, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NWWC.2.2.28	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2d
SONCC-NWWC.2.2.28.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-NWWC.2.2.28.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-NWWC.10.7.23	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-NWWC.10.7.23.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-NWWC.10.7.23.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-NWWC.10.7.25	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-NWWC.10.7.25.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-NWWC.10.7.25.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-NWWC.2.2.15	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	BR
SONCC-NWWC.2.2.15.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-NWWC.10.2.4	Water Quality	No	Reduce pollutants	Educate stakeholders	Population wide	BR
SONCC-NWWC.10.2.4.1	*Assess and prioritize point and non-point sources of pollution*					
SONCC-NWWC.10.2.5	Water Quality	No	Reduce pollutants	Educate stakeholders	Population wide	BR
SONCC-NWWC.10.2.5.1	*Develop an educational program that teaches landowners and businesses about avoiding pollution from septic systems, backyard pesticides, fuels, and nutrients*					

24. Mad River Population

Central Coastal Stratum

Non-Core 1, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

540 Spawners Required for ESU Viability

494 mi^2 watershed (36% Federal ownership)

136 IP-km (85 IP-mi) (52% High)

Dominant Land Uses are Timber Harvest, Gravel Mining

Key Limiting Stresses are ‘Altered Sediment Supply’ and ‘Lack of Floodplain and Channel Structure’

Key Limiting Threats are ‘Roads’ and ‘Mining/Gravel Extraction’

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, or other instream structure • Construct off channel ponds, alcoves, backwater ponds, and old stream oxbows • Reduce erosion	• Reduce road-stream hydrologic connection • Improve regulatory mechanisms • Restore natural channel form and function

24.1 History of Habitat and Land Use

Timber harvest, road building, gravel mining, grazing and water diversion/impoundment are the land and water uses that have had the most pronounced effect on coho salmon habitat in the Mad River basin. Much of the North Fork watershed and the lower and middle portions of the Mad River basin are owned by Green Diamond Resource Company (GDRC) and are used for timber production. Grazing occurs on large ranches throughout the Mad River basin, as well as more concentrated grazing along the reaches of the lower river and its tributaries. Most of the upper basin is part of the Six Rivers National Forest and is managed using an ecosystem-based approach that provides for resource protection under the Northwest Forest Plan (Forest Ecosystem Management Assessment Team 1993). The Humboldt Bay Municipal Water District (HBMWD) constructed Matthews Dam in 1961 at river mile (RM) 84 in the upper basin, well upstream of historic coho salmon habitat. The HBMWD also pumps groundwater and diverts surface water for municipal and industrial use at its Essex facility in the lower Mad River.

Extensive instream gravel mining occurs throughout the lower Mad River; mining practices have greatly improved since the 1970s. The majority of large gravel bars on the lower mainstem Mad River between Blue Lake and Highway 299 are mined each year, and annual mining typically removes the estimated mean annual recruitment of gravel coming into the mining reach. Although the Army Corps of Engineers permits gravel mining with numerous mitigation measures, such as a head-of-bar buffer to maintain river flow around the gravel bar and a skim floor elevation that maintains low to moderate channel confinement, gravel mining reduces the availability of complex rearing habitat in the lower Mad River (NMFS 2004). The communities of Arcata, Blue Lake and McKinleyville are located along the lowermost reach of the Mad River, near the mouth. Many of the impacts of urbanization are in the form of development and associated road construction and land clearing, resulting in increased run-off and sedimentation.

The land uses described above have reduced available coho salmon habitat throughout the basin. Increased sediment production from logged hill slopes and roads especially that which occurred during the 1955 and 1964 flood events, have filled the Mad River with sediment, creating chronically high turbidity levels. Although the Mad River basin has naturally high rates of sediment delivery due to unstable hill slopes prone to landslides and high rates of surface erosion, the U.S. Environmental Protection Agency (USEPA) estimated that 64 percent of total sediment delivered to streams was attributed to human and land management related activities, with roads being the dominant sediment source (USEPA 2007a). In the lower Mad River and North Fork areas, total sediment loading is currently five times greater than natural sediment loading (USEPA 2007a).

Compounding the increase in sediment delivery, loss of riparian vegetation has reduced shading and created a lack of instream large wood. These land uses have resulted in warm, shallow and wide instream habitat conditions that have severely impacted coho salmon. Most of the basin is now comprised of forest stands of smaller diameter trees, with a greater percentage of hardwoods that provide different ecological functions than those found historically (GDRC 2006). Improved coho salmon access to lower river tributaries, such as Lindsay Creek, is occurring through culvert upgrades and removal, but some of the lower river tributaries still have habitat blocked by road-stream crossings. Water impoundment has resulted in greater than naturally occurring summer flows in the middle and lower sections of the river, potentially increasing

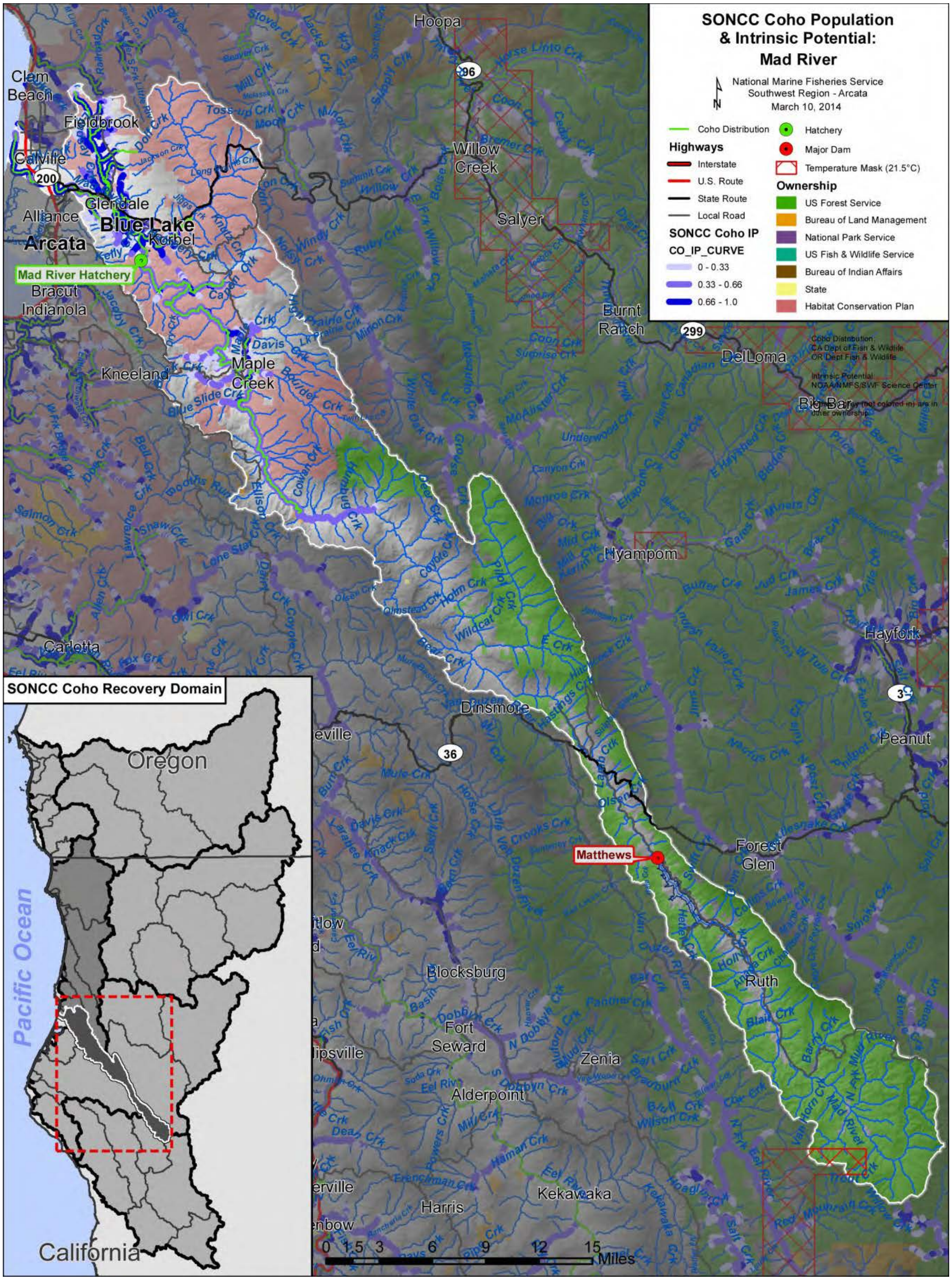

Figure 24-1. The geographic boundaries of the Mad River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

habitat availability during summer and early fall months. Screened water diversions at Essex in the lower river create fluctuations in the rate of flows in the summer and early fall. The impacts of this diversion are negligible in most instances, however peak flows in the fall are dampened and this may make adult migration more difficult.

24.2 Historic Fish Distribution and Abundance

There is limited data about the historic coho salmon population in the Mad River. Potential coho salmon habitat is primarily distributed in the downstream 40 percent of the basin. The area downstream of Matthews Dam is typically not accessible to coho salmon due to a series of boulder and bedrock falls (known as “the roughs”) that begin at Blue Slide Creek, RM 43, and extend to Deer Creek at RM 53 (D. Halligan, Stillwater Sciences, personal communication 2008). Since 1961, access to the upper basin has been blocked at Matthews Dam. The IP model shows the highest IP values (IP > 0.66) on private lands in the lower mainstem Mad River and its tributaries, such as Lindsay, Noisy, Hall and Mill creeks, and in the North Fork Mad River watershed. Table 24-1 shows the areas with high IP values.

Table 24-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Mad River (lower)	Squaw Creek	Warren Creek
Lindsay Creek	Leggit Creek	Powers Creek
Mill Creek	Hatchery Creek	Dry Creek
Hall Creek	Sullivan Gulch	Leggett Creek
Noisy Creek	Grassy Creek	North Fork Mad River
Quarry Creek	Mather Creek	Maple Creek
Palmer Creek	Essex Gulch	Cañon Creek
Boulder Creek		

From 1938 to 1964, the California Department of Fish and Wildlife (CDFW; previously CDFG) counted coho salmon migrating above Sweasey Dam at RM 22 in the middle portion of the basin (Sweasey Dam was built in 1938 and demolished in 1970). On average, 474 adult coho salmon passed the dam each year with a high of 3,580 adults in 1962 and a low of 3 adults in 1958 (CDFG 1968). In 1958, the California Department of Water Resources (DWR) determined the number of fish migrating above Sweasey Dam represented approximately 16 percent of the total Mad River population. DWR assumed that most coho salmon used the lower basin and its tributaries (e.g., Lindsay Creek). From the early 1970s to 1999 (the last year of artificial coho salmon propagation in the Mad River), the number of coho salmon adults returning to the Mad River hatchery declined. It should be noted, however, that in the early 1990s, the weir that directed fish into the hatchery ceased to operate, allowing adults to pass the facility. From 1995 to 2013, adult coho salmon counted in spawner survey index reaches in Cañon Creek averaged less than two and in the North Fork Mad River averaged less than one. The highest count of adult coho salmon occurred in Sullivan Gulch during this time period with an average of six (Bourque 2014).

24.3 Status of Mad River Coho Salmon

Spatial Structure and Diversity

Coho salmon have access to the most downstream 43 miles of the basin; approximately 60 percent of the basin may be naturally inaccessible to coho salmon because a collection of large boulders in the channel may prohibit upstream migration at RM 43 to 53 (Halligan 2008). Most of the population is limited to the lower Mad River and its tributaries, such as Lindsay Creek, and the most downstream 5 miles of the North Fork Mad River (CDFG 2000). Distribution has been reduced by road-stream crossing barriers in the lower portion of the basin, and access had been limited in much of the lower river tributary habitat until an intensive program of barrier removal began approximately 5 years ago, improving access to important low gradient tributary habitat.

Non-natal rearing of coho salmon in the estuary and lower Mad River results in increased survival and productivity of the Mad River population that primarily spawns and rears in tributaries (Halligan 2003, 2007). In general, non-natal rearing in the lower Mad River bolsters rearing success and increases the population's resiliency to disturbance and habitat degradation in the tributaries.

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) estimated that a minimum of 32 coho salmon per-IP-km of habitat are needed (4,900 spawners total) for the Mad River coho salmon population to approximate the historical abundance and distribution. The current distribution of spawning adults is mostly limited to the lower river tributaries.

Population Size and Productivity

There is little information on the current population size of coho salmon in the Mad River. Data from 1981 to 2013 indicate low abundance within index reaches, averaging less than one adult coho salmon in the mainstem or North Fork Mad River, less than two in Cañon Creek, and less than seven in Sullivan Gulch (GDRC 2006, Bourque 2014) (Figure 24-2). Information from the Mad River Hatchery shows that between 1991 and 1999, adult coho salmon returns declined to an average of 38. However, only a fraction of all fish ascending the Mad River entered the fish ladder at the hatchery. All available information indicates low numbers of returning adult coho salmon in the Mad River basin and suggests that the overall number of coho salmon in the basin is extremely low compared to historic conditions.

The population growth rate in the Mad River has not been quantified, although information from CDFG (2000) and GDRC (2006) suggests negative trends in population growth rate, as does the apparent long-term declines of coho salmon observed in the Mad River. Therefore, the Mad River coho salmon population is at high risk of extinction given its very low population size.

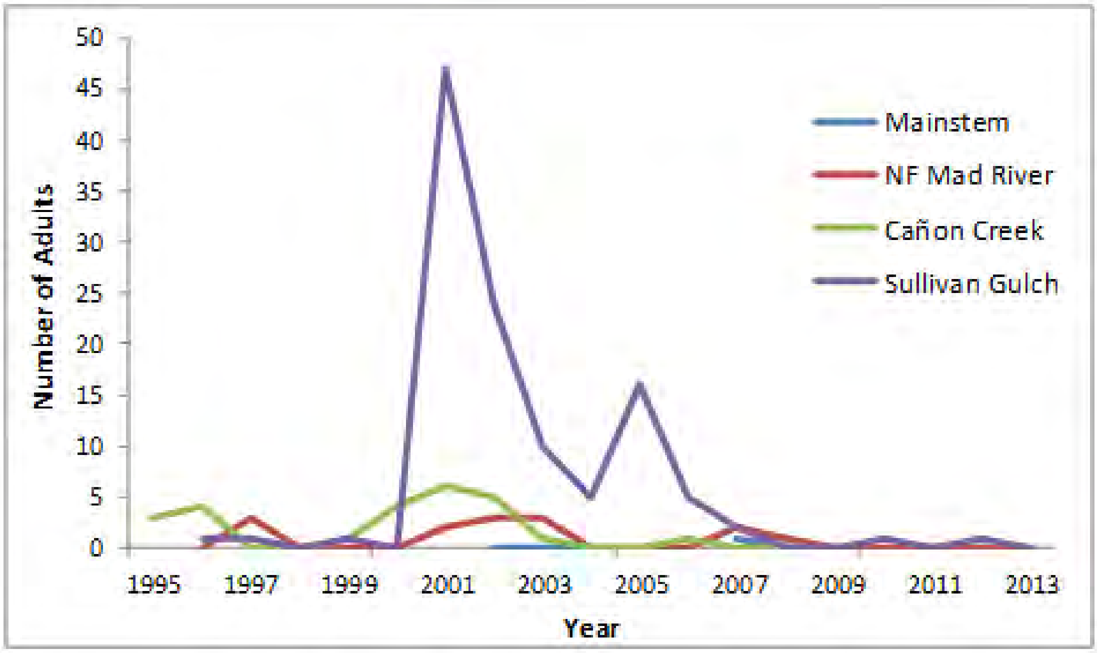

Figure 24-2. Coho salmon spawning surveys in index reaches for the Mad River. Source: Bourque 2014 and Mikus, I., pers. comm. 2014).

If a spawning population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 153 coho salmon must spawn in the Mad River basin each year to avoid such effects of extremely low population sizes.

Extinction Risk

The Mad River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role of Population in SONCC Coho Salmon ESU Viability

The Mad River population is a non-core, Functionally Independent population within the Central Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Mad River non-core population should have at least 540 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU.

24.4 Plans and Assessments

State of California

Mad River Total Maximum Daily Load
http://www.swrcb.ca.gov/northcoast/

The North Coast Regional Water Quality Control Board (RWQCB) identified the Mad River as water quality limited due to excessive sediment loads, high levels of turbidity, and high water temperatures. The Total Maximum Daily Load (TMDL) was developed for sediment and turbidity in accordance with Section 303(d) of the Clean Water Act (CWA) in 2007.

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. Priority actions in the Recovery Strategy for the Mad River hydrologic unit include minimizing sediment delivery to the river, protecting riparian vegetation, restoring floodplain and channel structure as well as estuarine sloughs and wetlands, and assessing impacts of Mad River Hatchery steelhead production on coho salmon (CDFG 2004b).

Humboldt Bay Municipal Water District (HBMWD)

HBMWD Habitat Conservation Plan (HCP)
http://www.hbmwd.com/site_documents/hcp.pdf

The HBMWD HCP (HBMWD 2004) describes plans for diversion operations for 50 years, covering listed salmonids including the coho salmon. The geographic range of the HCP includes the mouth of the Mad River upstream to the Matthews Dam. Some of the activities covered under the HCP include releasing flows at Matthews Dam, diverting water in the Essex Reach, bypassing flows below Essex, dredging, and maintaining adequate water surface elevation during low flow months. The HCP includes regular monitoring activities related to the operations of HBMWD and mitigation measures. Mitigation measures include providing minimum flows year-round downstream of Matthews Dam, retrofit of fish screens to minimize take of salmonids, and minimization of turbidity during construction.

Green Diamond Resource Company (GDRC)

Green Diamond Aquatic Habitat Conservation Plan (AHCP)

The GDRC AHCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in select watersheds of the Mad River basin. The majority of the roughly 65 percent of private land in the Mad River basin is owned by the GDRC, and therefore managed according to the provisions of the AHCP. The plan has a number of provisions designed to protect coho salmon and salmon habitat on GDRC land in the Mad River basin. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC’s activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of covered listed aquatic species. Elements of the AHCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. More information about the GDRC AHCP can be found in Section 3.2.5.

Redwood Community Action Agency (RCAA)

> *Mad River Watershed Assessment and Management Plan*
> http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/mad_river/pdf/120329/FINAL_PDF_MRWA.PDF

The RCAA, funded by a grant from the SWRCB, in conjunction with landowners and agency representatives, developed an assessment for the Mad River basin *(Stillwater Sciences 2010)*. The assessment focuses on identification of sediment sources within the basin and will be used to help develop an implementation plan that will assist public and private landowners in addressing water quality impairments and identifying basin-wide sediment source reduction opportunities for beneficial uses such as recovery of anadromous salmonids. The assessment was completed in July 2010 and work began on the implementation plan during summer 2010.

> *Lindsay Creek Community and Watershed-Based Land Use Assessment*
> http://www.naturalresourcesservices.org/lindsay-creek-community-and-watershed-based-land-use-assessment.html

RCAA led an innovative strategy to base land use decision-making on a new method of watershed assessment, including a strong component of community participation and Geographic Information System (GIS) Analysis. The assessment process culminated in the Strategy for the Lindsay Creek Watershed and Community, which includes GIS analyses that integrate information on riparian vegetation characteristics, salmonid habitat quality, sediment sources, landslide hazard, and land ownership. The strategy will help guide decision making and inform the Lindsay Creek Watershed Group of opportunities for sediment source reduction, riparian habitat improvement, and other salmonid habitat improvement efforts.

Mad River Stakeholders Group

http://www.naturalresourcesservices.org

The RCAA has begun to bring together stakeholders in the Mad River watershed with the intent of helping private and public landowners meet total maximum daily load (TMDL) implementation targets through sediment reduction activities. RCAA is developing an implementation plan for sediment reduction in the Mad River. The stakeholder group includes landowners and local, state and federal agencies that may be able to assist landowners with sediment reduction and high stream temperature alleviation projects.

Lindsay Creek Watershed Group

http://www.nrsrcaa.org/nrs/lindsaycreek/strategy/appendix/appC/FinalAppendixC3_05.pdf

Lindsay Creek Watershed Group is a watershed stakeholder group focused on community-based watershed improvement for the Lindsay Creek sub-watershed of the Mad River. The group seeks to integrate community land-use planning and watershed restoration opportunities through grant-funded projects.

U.S. Forest Service-Six Rivers National Forest

Although most of the USFS land is located upstream of the major coho salmon production areas, the management of these lands to minimize sediment and maintain and promote healthy riparian vegetation is important to downstream reaches occupied by coho salmon. The USFS has adopted a Watershed Condition Framework (WCF) assessment and planning approach (USFS and BLM 2011). The WCF is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, the Mad River was identified as a high priority 6th field sub-watershed in the Six Rivers National Forest (USFS and BLM 2011).

24.5 Stresses

Table 24-2. Severity of stresses affecting each life stage of coho salmon in the Mad River population. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	High	Very High	Very High[1]	High	Very High	Very High
2	Altered Sediment Supply[1]	High	Very High	Very High[1]	Very High	Medium	Very High
3	Impaired Water Quality	Low	Very High	Very High	Very High	Medium	Very High
4	Impaired Estuary/Mainstem Function	-	High	Very High	Very High	Medium	Very High
5	Degraded Riparian Forest Conditions	-	High	High	High	High	High
6	Altered Hydrologic Function	Medium	Medium	Medium	Medium	Low	Medium
7	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
8	Increased Disease/Predation/Competition	Medium	Medium	Medium	Low	Low	Medium
9	Barriers	-	Low	Low	Medium	Medium	Medium
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low

[1]Key limiting stresses and limited life stage.

Key Limiting Stresses and Life Stages

Lack of floodplain and channel structure and altered sediment supply are the stresses that limit juvenile rearing success for the Mad River coho salmon population. While many of the barriers to migration have been removed from the tributaries to the lower Mad River, many of these high IP tributaries have high sediment input, lack of channel structure, and lack of large woody debris, which adversely affects both summer and winter tributary rearing conditions. In the middle and lower portions of the mainstem Mad River, high summer water temperatures, increased sediment supply, and insufficient channel structure also adversely affect summer and winter rearing habitat. Off-channel rearing habitat, especially in the lower river and estuary, also likely limits the success of winter rearing.

The Recovery Strategy for California Coho Salmon (CDFG 2004b) identified tributaries that provide refugia value based on current habitat conditions (Table 24-3).

Table 24-3. Potential refugia areas in the geographic boundary of the Mad River population area.

Watershed	Stream Name	Watershed	Stream Name
Blue Lake	Warren Creek Lindsay Creek Grassy Creek Squaw Creek Mather Creek	Blue Lake	Hall Creek Noisy Creek Leggit Creek Hatchery Creek (Camp Bauer Creek) Powers Creek
North Fork	North Fork Mad River Sullivan Gulch	Butler Valley	Dry Creek Canon Creek Maple Creek Boulder Creek

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure poses a very high stress to fry, juvenile and adult life stages, and a high stress to smolt and eggs. In general, the lower to middle mainstem Mad River and the lower North Fork Mad River contain the poorest habitat conditions, and the tributaries that enter the lower Mad River, such as Lindsay Creek, provide relatively better habitat conditions. The mainstem channel is severely aggraded, and pool frequency and depth are likely poor throughout the mainstem. Halligan (2007) found few pools and riffles in the lower mainstem Mad River and the lower North Fork channel. Data on instream large wood structures is limited; however, given the poor riparian canopy conditions that likely exist in the lower to middle portions of the basin, a lack of instream wood is likely limiting the development of complex habitat. Some short sections of the lower North Fork and the lower Mad River are confined by flood control levees. These levees disconnect the channel from its floodplain and limit the formation of off-channel habitat, which is critical for juvenile winter rearing.

Altered Sediment Supply

Altered sediment supply is a very high stress for fry, juvenile and smolt life stages, a high stress eggs, and a medium stress for adult coho salmon in the Mad River. Increased sediment delivery has aggraded and widened channels, filled pools, and simplified stream habitat throughout the basin, especially within the mainstem Mad River and its lower tributaries, particularly the North Fork Mad River. Data from the Six Rivers National Forest suggest that sediment supply may be less of an issue in the upper basin. For example, some pools between RM 43 and RM 53 have low fine sediment accumulation; however, coho salmon are rarely able to access this portion of the basin due to boulder and bedrock falls. Data collected on the sediment budget during TMDL development (USEPA 2007a) indicate that both stored sediment within the channels and continued sediment delivery are critical stresses affecting the population. The USEPA (2007a) found that the middle Mad River area produces the greatest sediment relative to other areas of the basin, due to active landslides and active land management (e.g., timber harvest). The lower Mad/North Fork areas produce the greatest proportion of land management-related sediment. Sediment accumulation at the mouths of tributaries, such as the North Fork Mad River, may inhibit access.

Very high turbidity levels in the Mad River occur more frequently, with greater magnitude, and persist longer than turbidity levels in nearby basins that were used for comparisons (USEPA 2007a). The USEPA measured turbidity values at numerous locations during development of the TMDL, and found elevated turbidity from many sediment sources, such as legacy roads, naturally occurring and human-influenced landslides, past timber harvest, and first and second year adjustments of recently implemented road and barrier removal projects. Elevated turbidity levels result in a reduced ability of coho salmon to find food, gill abrasion, smothering of eggs, fine sediment accumulation in pools, and food assemblage changes which can result in decreased growth rate.

Impaired Water Quality

Impaired water quality is a very high stress to fry, juvenile and smolt life stages, a medium stress for adult coho salmon, and a low stress for eggs. These levels of stress coincide with high water temperature in the summer and early fall when the most affected life stages are present. Temperature data indicates that most of the lower to middle mainstem river, and the lower portions of the North Fork Mad River, have very high temperatures (greater than 17 °C) compared to tributaries. These data are consistent with the listing of the Mad River for temperature under Clean Water Act Section 303(d). High stream temperatures may limit coho salmon distribution and production in the basin. Water temperatures are cooler in lower reaches of the Mad River (Jensen 2000); however, temperature values still fall within the stressful to potentially lethal range for juvenile coho salmon. Halligan (2007) found hundreds of coho salmon rearing in the lower mainstem Mad River during summer months, but presence of juveniles was strongly correlated with undercut banks, overhanging vegetation, large wood recruitment, and thermal refugia provided by cool seeps and springs, intragravel water flow, groundwater or confluence with small tributaries.

Impaired Estuary/Mainstem Function

The loss and degradation of estuarine habitat in the Mad River is a high to very high stress for fry, juvenile and smolt coho salmon due to the loss of rearing habitat and refugia. Levees have been constructed in most of the historic estuary for agriculture or floodplain development. Limited estuary rearing habitat remains. Historically, the potential for estuarine rearing and the amount of refugia habitat were likely significant given the size of the floodplain in the estuary. The estuary was also once connected to sloughs and other off-channel rearing habitat, such as overflow channels and cut-off meanders. The mouth of the Mad River was previously located further south than its current location, and entered the ocean closer to Arcata. The Mad River now turns north and enters the ocean near McKinleyville (Figure 24-1). The relocation of the mouth has increased the size of the estuary, but available estuarine rearing habitat is simplified, with little instream structure or diversity, very little off-channel habitat, and a highly altered estuarine function.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions exist across the basin, and are a high stress to all coho salmon life stages. Streamside canopy data are lacking; however, based on the extensive timber harvest that has occurred in the lower to middle portion of the basin, including the North Fork, poor cover and shade conditions likely exist through much of the lower to middle basin. In addition, open and hardwood-dominated riparian forest conditions have likely replaced riparian forests that once contained large confers for large wood recruitment. Hardwood- and small conifer-dominated riparian forests provide limited wood recruitment into the Mad River.

Altered Hydrologic Function

Altered hydrologic function is a medium stress for the egg, fry, juvenile and smolt life stages of coho salmon and low stress for adults. Low summer stream flows are especially problematic where increased stored sediment has reduced the amount of available rearing habitat through aggraded channels, contributing to subsurface flows. Operations of the water district, which are managed under an HCP, include an upstream impoundment at RM 84 and groundwater pumping and surface water diversions at the Essex facility on RM 9 to 10. The water district operations affect the quantity and timing of water availability in the Mad River. The construction of Matthews Dam increased summer and early fall stream flows throughout the middle and lower mainstem Mad River downstream to the Essex facility, likely increasing availability of summer rearing habitat. However, groundwater pumping and surface water diversions at Essex result in minor daily flow fluctuations during the summer and fall. Smaller agricultural diversions exist in various locations throughout the basin reducing summer base flows.

Adverse Hatchery-Related Effects

The Mad River Hatchery produced coho salmon from 1971 to 1999. The original broodstock was from the Noyo River, and at other times coho salmon from other watersheds within and outside the ESU were released into the Mad River. Coho salmon production ceased after the 1999 brood year, but it is unclear if this has reduced genetic effects of hatchery-reared fish on wild fish within the Mad River basin, and if the reproductive ability of naturally spawned Mad River coho salmon is reduced due to past intermingling of hatchery-raised and wild fish. The Mad River Hatchery still produces steelhead, which are stocked into the Mad River. Adverse hatchery-related effects pose a medium risk to all life stages of coho salmon in the Mad River, because the Mad River is stocked with steelhead from the Mad River Hatchery (Appendix B).

Increased Disease/Predation/Competition

Disease, predation, and competition are a medium threat to eggs, fry, and juveniles, and a low threat to smolts and adult coho salmon. The primary source of this stress is the Mad River Hatchery, located in the lower Mad River near the town of Blue Lake at RM 12, which currently produces 150,000-1+ steelhead smolts annually. These smolts are released into the lower mainstem Mad River during the spring, when coho salmon juveniles are hatching and rearing in the same section of the river. While the Mad River Hatchery attempts to reduce predation effects by releasing steelhead during high turbidity, and by releasing fewer steelhead than historically, coho salmon fry and juveniles are likely eaten by and compete with the hatchery-reared steelhead. Juvenile coho salmon abundance and overall population size is negatively affected as a result.

Barriers

Barriers are a medium stress for the fry and juvenile coho salmon, and a low stress for smolts and adult coho salmon. Humboldt County and Caltrans have documented road related barriers or partial barriers within the basin, mostly within the lower river tributaries. Many of these road-stream crossing barriers have been removed (e.g., Lindsay, Mill, Anker, Grassy, Mather and Hall creeks and Sullivan Gulch) or are planned for removal. Barriers on Powers Creek, Essex Creek, and Quarry Creek in the lower Mad River also require improvements to allow for unimpeded juvenile and adult coho salmon passage. Green Diamond has been documenting and addressing fish passage barriers at road-stream crossings throughout their property. Green Diamond Resource Company has a policy to install bridges on fish-bearing watercourses wherever feasible or other fish friendly structures where bridges are not feasible. GDRC has also been working collaboratively with restoration groups to address known road related fish passage barriers. A recent example within the Mad River watershed is a road decommissioning project that included a culvert removal on Vincent Creek and opened up coho habitat formally blocked by the crossing barrier.

Adverse Fishery- and Collection Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

24.6 Threats

Table 24-4. Severity of threats affecting each life stage of coho salmon in the Mad River population. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	High	Very High	Very High[1]	Very High	High	Very High
2	Mining/Gravel Extraction[1]	Low	High	High[1]	High	Medium	High
3	Channelization/Diking	Low	High	High	High	Low	High
4	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
5	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
6	Dams/Diversion	Medium	Medium	Medium	Medium	Low	Medium
7	Agricultural Practices	Low	Medium	Medium	Medium	Low	Medium
8	High Severity Fire	Low	Medium	Medium	Medium	Low	Medium
9	Climate Change	Low	Low	Medium	Medium	Medium	Medium
10	Urban/Residential/Industrial Dev.	Low	Medium	Medium	Medium	Low	Medium
11	Fishing and Collecting	-	-	Low	Low	Medium	Low
12	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low

[1] Key limiting threats and limited life stage
[2] Invasive Non-Native/Alien Species is not considered a threat to this population

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and mining/gravel extraction.

Roads

Roads are a very high threat to the fry, juveniles and smolts, and a high threat to eggs and adults. Road density is very high throughout the basin, ranging from 4.4 to 6.3 miles of road per square mile in the lower Mad River and North Fork areas (USEPA 2007a). Roads are a significant source of both chronic and catastrophic sediment input to streams in the basin, affecting the quality and quantity of available coho salmon habitat in the Mad River and its tributaries. In 2007, the USEPA developed the TMDL for sediment and turbidity for the Mad River (USEPA 2007a). An estimated 64 percent of the total sediment delivered to streams was attributed to human and land management-related activities, and road-related sediment contributes approximately 62 to 73 percent of the anthropogenic sediment in the basin (USEPA 2007a).

Mining/Gravel Extraction

Mining/gravel extraction presents a high threat to the fry, juvenile and smolt life stages, a medium threat to the adults, and a low threat to the egg life stage, as coho salmon do not typically spawn in the gravel extraction area. Historic gravel extraction was very damaging to the habitat in the lower Mad River until 1994. Current instream mining practices are much improved over past practices. The current mining is permitted by the Army Corps of Engineers and the permit contains numerous minimization measures to reduce the effects of gravel extraction on fish habitat, such as a head-of-bar buffer to provide for channel steering around skimmed gravel bars, provisions to provide low to moderate flow channel confinement, mining volumes that are scaled to annual water yield, and annual estimates of sediment recruitment to the lower Mad River. However, even with minimization measures, gravel extraction reduces overall habitat complexity and reduces the quality and quantity of available pool habitat. Given the sensitivity of the channel to disturbance (i.e., current lack of floodplain and channel structure; low levels of instream wood), and the use of the gravel extraction reach by coho salmon juveniles for summer rearing, gravel extraction is a high threat to rearing juveniles and a moderate threat to adults who require resting habitat in pools during upstream migration.

Channelization/Diking

Channelization and diking presents a high threat to the Mad River population. Levees confine some of the lower mainstem river and the lower North Fork and disconnect the lower river channel from its floodplain and wetlands, reducing the availability of off-channel winter rearing habitat in the lower basin.

Timber Harvest

Timber harvest is a medium threat to the coho salmon population in the Mad River. Many of the changes that have occurred to instream and riparian conditions in the basin reflect legacy effects of more intensive harvest from previous decades. Such legacy effects are addressed under the appropriate stresses earlier in this profile. Although current timber harvest practices are more protective of coho salmon habitat than before, timber harvest likely threatens the persistence of the coho salmon population by increasing sediment yield and reducing streamside shading and potential large wood recruitment. The majority of the private timberland in the Mad River basin is owned by Green Diamond and will continue to be harvested for timber. Within Green Diamond property, harvest occurs at a moderate level and under the direction of the company's AHCP (GDRC 2006). This plan lays out goals and objectives to minimize and mitigate effects from timber harvest through measures related to road and riparian management, slope stability, and harvesting activities. Although the private timberland is managed under an AHCP that reduces the effects of timber harvest, increased sediment yield, decreased sources of instream wood, and decreased stream shading are still expected to occur.

Hatcheries

Hatcheries pose a medium threat to all life stages of coho salmon in the Mad River. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Dams/Diversions

Dams and diversions are a medium threat to the Mad River population. Diversions and groundwater pumping at the HBMWD Essex facility (RM 9 to 10) cause daily flow fluctuations during summer and fall months; however observations by NMFS staff and analysis of gage data (NMFS 2005c) show negligible impacts to juvenile salmonids, with water level never dropping more than 0.3 feet. Due to riffle grade control, it is unlikely that the amount of available habitat is decreased for rearing coho salmon and stranding has never been documented (HBMWD and Trinity Associates 2004). Changes in flows, however, may affect migration of adults during the fall. The impoundment of the Mad River at Matthews Dam has also increased summer and fall flows throughout most of the mainstem Mad River and increased habitat availability from RM 84 to RM 10.

Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Other water diversions for agriculture, some of which may be unauthorized, occur throughout the basin.

Agricultural Practices

Agricultural practices pose an overall medium threat to coho salmon. Grazing occurs throughout the basin and may contribute to increased sediment generation and delivery and to decreased riparian vegetation. Other agriculture, such as the cultivation of hay, also occurs in the lower basin. Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality in coho salmon streams. Specific information on the magnitude of these activities is limited.

High Severity Fire

Altered vegetation characteristics throughout the basin pose a medium threat to coho salmon from high severity fires. Most of the basin contains forests of small diameter trees that are close together. These types of previously logged forests burn with greater intensity than late seral forest stands, and high severity forest fires create an erosion hazard. The increased sediment yield from high severity fires would likely deliver sediment to coho salmon habitat in the basin, filling pools and reducing habitat complexity. Riparian vegetation would also be reduced or eliminated, and issues associated with inadequate riparian cover, including increased water temperatures and decreased macroinvertebrate abundance would be aggravated.

Climate Change

Climate change poses a medium threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles and adult coho salmon. Although the current climate is generally cool, modeled regional average temperature shows a relatively large increase over the next 50 years (see Appendix B for modeling methods). Average air temperature could increase by up to 2 °C in the summer and by 1 °C in winter. Annual precipitation in this area is predicted to change little over the next century. The vulnerability of the estuary and coast to sea level rise is moderate in this population. Juvenile and smolt rearing are most at risk due to increasing temperatures and changes in the amount and timing of precipitation, which will affect water quality and hydrologic function in the summer. The range and degree of temperature and precipitation is likely to increase in all populations in the ESU, and adult coho salmon will be negatively affected by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Urban/Residential/Industrial Development

Population growth and development, especially in the Arcata and McKinleyville area, will continue to present a moderate threat to coho salmon in the Mad River because it results in removal of vegetation, increased sediment delivery, introduction of exotic species, and increased landscape coverage with impervious surfaces that alters water transport on land and subsequently affects instream flows. Most of the growth within Humboldt County is in the Arcata and McKinleyville area (projected at 0.6 percent annually), resulting in more water diverted from the lower Mad River.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Road-Stream Crossing Barriers

Road-stream crossing barriers are a low threat to the population. Many of the road-stream crossing barriers in the lower Mad River and its tributaries have been removed or treated during the past 5 years.

24.7 Recovery Strategy

Abundance of coho salmon in the Mad River basin is severely depressed, and consequently, their spatial distribution is restricted. Recovery activities in the basin should promote increased spatial distribution, particularly in the tributaries of the lower Mad River, as well as increased productivity and abundance. Efforts to increase distribution may also yield increases in diversity, abundance and productivity. Preservation of observed life history traits (i.e., mainstem juvenile rearing) is necessary to ensure long-term viability. Activities to improve habitat conditions should focus on the low gradient tributaries that enter the lower Mad River, all with high IP values, and the mainstem Mad River from the mouth upstream to the boulder and bedrock falls that begin at RM 43.

Lack of floodplain and channel structure, impaired estuary function, impaired water quality, and altered sediment supply are the key limiting factors for coho salmon production in the Mad River basin. Top recovery priorities in the basin should include improving channel structure and off-channel rearing habitat, reducing sediment delivery, and reducing summer stream temperatures in the mainstem Mad River. Additional high priority activities include increasing amounts of LWD in the tributaries and mainstem, improving estuarine function, providing adequate instream flow, removing barriers, and addressing predation by and competition with hatchery steelhead. Conservation partnerships with the Blue Lake Rancheria Indian Tribe, gravel mining and timber industries, HBMWD, and other local and state agencies will be essential to improving instream habitat for recovery of coho salmon. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 24-5 on the following page lists the recovery actions for the Mad River population.

Table 24-5. Recovery action implementation schedule for the Mad River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MadR.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2a
SONCC-MadR.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MadR.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-MadR.2.1.50	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-MadR.2.1.50.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MadR.2.1.50.2	*Place instream structures, guided by assessment results*					
SONCC-MadR.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Lower Mad River and high IP tributaries, all streams where coho salmon would benefit immediately	2a
SONCC-MadR.2.2.2.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MadR.2.2.2.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MadR.2.2.51	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-MadR.2.2.51.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MadR.2.2.51.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MadR.8.1.16	Sediment	Yes	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	2a
SONCC-MadR.8.1.16.1	*Develop grading ordinance for maintenance and building of private and County roads that minimizes the effects to coho*					
SONCC-MadR.8.1.13	Sediment	Yes	Reduce delivery of sediment to streams	Reduce erosion	Lower Mad River and all streams where coho salmon would benefit immediately	2a
SONCC-MadR.8.1.13.1	*Inventory sediment sources, and prioritize for treatment based on probability of sediment delivery and treatment feasibility*					
SONCC-MadR.8.1.13.2	*Treat sources of erosion, based on prioritization*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MadR.8.1.57	Sediment	Yes	Reduce delivery of sediment to streams	Reduce erosion	Population wide	2b
SONCC-MadR.8.1.57.1	*Inventory sediment sources, and prioritize for treatment based on probability of sediment delivery and treatment feasibility*					
SONCC-MadR.8.1.57.2	*Treat sources of erosion, based on prioritization*					
SONCC-MadR.8.1.15	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	2a
SONCC-MadR.8.1.15.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MadR.8.1.15.2	*Decommission roads, guided by assessment*					
SONCC-MadR.8.1.15.3	*Upgrade roads, guided by assessment*					
SONCC-MadR.8.1.15.4	*Maintain roads, guided by assessment*					
SONCC-MadR.8.1.58	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2b
SONCC-MadR.8.1.58.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MadR.8.1.58.2	*Decommission roads, guided by assessment*					
SONCC-MadR.8.1.58.3	*Upgrade roads, guided by assessment*					
SONCC-MadR.8.1.58.4	*Maintain roads, guided by assessment*					
SONCC-MadR.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Restore natural channel form and function	Lower Mad River	2b
SONCC-MadR.2.2.3.1	*Re-evaluate existing gravel mining permit minimization measures*					
SONCC-MadR.2.2.3.2	*Update minimization measures in existing and new gravel mining permits if necessary and possible*					
SONCC-MadR.8.1.14	Sediment	Yes	Reduce delivery of sediment to streams	Reduce risk of catastrophic fire	Population wide	2b
SONCC-MadR.8.1.14.1	*Identify forested stands for fire hazard reduction*					
SONCC-MadR.8.1.14.2	*Based on assessment, apply appropriate management techniques (e.g. thinning) to reduce risks of high severity fire*					
SONCC-MadR.5.1.37	Passage	No	Improve access	Reduce invasive species	Lindsay Creek and all streams where coho salmon would benefit immediately	2b
SONCC-MadR.5.1.37.1	*Eradicate invasive riparian species, such as reed canary grass*					
SONCC-MadR.5.1.37.2	*Plant native riparian vegetation to shade out emergent reed canary grass*					
SONCC-MadR.5.1.37.3	*Monitor success and re-treat if necessary*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MadR.5.1.54	Passage	No	Improve access	Reduce invasive species	Population wide	2d
SONCC-MadR.5.1.54.1	*Eradicate invasive riparian species, such as reed canary grass*					
SONCC-MadR.5.1.54.2	*Plant native riparian vegetation to shade out emergent reed canary grass*					
SONCC-MadR.5.1.54.3	*Monitor success and re-treat if necessary*					
SONCC-MadR.5.1.10	Passage	No	Improve access	Remove barriers	Tributaries to lower Mad river, all streams where coho salmon would benefit immediately	2b
SONCC-MadR.5.1.10.1	*Evaluate and prioritize barriers for removal*					
SONCC-MadR.5.1.10.2	*Remove barriers, based on evaluation*					
SONCC-MadR.5.1.53	Passage	No	Improve access	Remove barriers	Population wide	2d
SONCC-MadR.5.1.53.1	*Evaluate and prioritize barriers for removal*					
SONCC-MadR.5.1.53.2	*Remove barriers, based on evaluation*					
SONCC-MadR.1.1.4	Estuary	No	Improve connectivity of tidally-influenced habitat	Reconnect estuarine habitat	Lower Mad River/Estuary	2b
SONCC-MadR.1.1.4.1	*Identify opportunities in the estuary and lower river for reconnecting sloughs, tributaries and tidal and non-tidal wetlands*					
SONCC-MadR.1.1.4.2	*Re-connect sloughs and tidal wetlands to estuary*					
SONCC-MadR.7.1.6	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve regulatory mechanisms	Lower and middle Mad; North Fork Mad	2b
SONCC-MadR.7.1.6.1	*Develop regulatory mechanisms and enforce measures to protect existing LWD recruitment potential*					
SONCC-MadR.7.1.8	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2b
SONCC-MadR.7.1.8.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan)*					
SONCC-MadR.7.1.8.2	*Apply best management practices for timber harvest*					
SONCC-MadR.26.1.48	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-MadR.26.1.48.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MadR.5.1.9	Passage	No	Improve access	Reduce sediment/flow barrier	Lower and middle Mad, North Fork, Canon Creek, Dry Creek, Lindsay Creek, Powers Creek, and other disconnected tributaries where coho salmon would benefit immediately	3b
SONCC-MadR.5.1.9.1		*Develop a plan to restore and maintain tributary and mainstem habitat connectivity where low flow or sediment aggradation is restricting coho salmon passage*				
SONCC-MadR.5.1.9.2		*Excavate, or otherwise treat, tributary mouths to restore connectivity, guided by the plan*				
SONCC-MadR.5.1.55	Passage	No	Improve access	Reduce sediment/flow barrier	Population wide	3d
SONCC-MadR.5.1.55.1		*Develop a plan to restore and maintain tributary and mainstem habitat connectivity where low flow or sediment aggradation is restricting coho salmon passage*				
SONCC-MadR.5.1.55.2		*Excavate, or otherwise treat, tributary mouths to restore connectivity, guided by the plan*				
SONCC-MadR.1.2.36	Estuary	No	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	3b
SONCC-MadR.1.2.36.1		*Identify parameters to assess condition of estuary and tidal wetland habitat*				
SONCC-MadR.1.2.36.2		*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*				
SONCC-MadR.1.2.36.3		*Restore estuary and tidal wetland habitat guided by the plan*				
SONCC-MadR.3.1.41	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	3b
SONCC-MadR.3.1.41.1		*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*				
SONCC-MadR.3.1.41.2		*If needed, develop plan to reduce effects of marijuana cultivation*				
SONCC-MadR.3.1.41.3		*Implement plan*				
SONCC-MadR.3.1.18	Hydrology	No	Improve flow timing or volume	Manage flow	Population wide	3b
SONCC-MadR.3.1.18.1		*Collaborate with HBMWD to explore changes in releases, pumping and Essex diversion that will benefit coho salmon*				
SONCC-MadR.3.1.18.2		*Implement recommended changes*				
SONCC-MadR.3.1.19	Hydrology	No	Improve flow timing or volume	Reduce diversions	All areas where coho salmon would benefit immediately	3b
SONCC-MadR.3.1.19.1		*Identify diversions*				
SONCC-MadR.3.1.19.2		*Review diversions for opportunities to increase instream flow during summer low flow period*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MadR.3.1.52	Hydrology	No	Improve flow timing or volume	Reduce diversions	Population wide	3d
SONCC-MadR.3.1.52.1	*Identify diversions*					
SONCC-MadR.3.1.52.2	*Review diversions for opportunities to increase instream flow during summer low flow period*					
SONCC-MadR.7.1.7	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	All areas where coho salmon would benefit immediately	3b
SONCC-MadR.7.1.7.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-MadR.7.1.7.2	*Develop and implement grazing management plans to improve water quality and coho salmon habitat*					
SONCC-MadR.7.1.7.3	*Plant vegetation to stabilize stream bank*					
SONCC-MadR.7.1.7.4	*Fence livestock out of riparian zones*					
SONCC-MadR.7.1.7.5	*Remove instream livestock watering sources*					
SONCC-MadR.7.1.56	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-MadR.7.1.56.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-MadR.7.1.56.2	*Develop and implement grazing management plans to improve water quality and coho salmon habitat*					
SONCC-MadR.7.1.56.3	*Plant vegetation to stabilize stream bank*					
SONCC-MadR.7.1.56.4	*Fence livestock out of riparian zones*					
SONCC-MadR.7.1.56.5	*Remove instream livestock watering sources*					
SONCC-MadR.7.1.5	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase riparian vegetation	Population wide	3b
SONCC-MadR.7.1.5.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MadR.7.1.5.2	*Thin, or release conifers, guided by the plan*					
SONCC-MadR.7.1.5.3	*Plant conifers, guided by the plan*					
SONCC-MadR.7.1.5.4	*Suppress invasives, guided by the plan*					
SONCC-MadR.7.1.5.5	*On USFS lands, continue implementation of Aquatic Conservation Strategy and follow restoration plans developed under the CWA TMDL*					
SONCC-MadR.16.1.21	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3b
SONCC-MadR.16.1.21.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MadR.16.1.21.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MadR.16.1.22	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3b
SONCC-MadR.16.1.22.1	*Determine actual fishing impacts*					
SONCC-MadR.16.1.22.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-MadR.16.2.23	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3b
SONCC-MadR.16.2.23.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-MadR.16.2.23.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-MadR.16.2.24	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3b
SONCC-MadR.16.2.24.1	*Determine actual impacts of scientific collection*					
SONCC-MadR.16.2.24.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-MadR.17.2.12	Hatcheries	No	Reduce adverse hatchery impacts	Identify and reduce impacts of hatchery on SONCC coho salmon	Lower Mad River	3b
SONCC-MadR.17.2.12.1	*Identify means to reduce ecological interactions from hatchery-raised steelhead*					
SONCC-MadR.17.2.12.2	*Develop and implement Hatchery and Genetic Management Plan*					
SONCC-MadR.10.2.20	Water Quality	No	Reduce pollutants	Develop and implement TMDLs	Population wide	3b
SONCC-MadR.10.2.20.1	*Implement sediment TMDLs for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-MadR.10.2.20.2	*Develop temperature TMDL for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-MadR.10.7.47	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-MadR.10.7.47.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MadR.10.7.47.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MadR.10.7.49	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MadR.10.7.49.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MadR.10.7.49.2	*Supply marine-derived nutrients to streams guided by the plan*					

25. Humboldt Bay Tributaries Population

Southern Coastal Diversity Stratum

Core, Functionally Independent Population

Moderate Extinction Risk

Population likely above depensation threshold

5,700 Spawners Required for ESU Viability

157 mi² (9% Federally owned)

191 IP-km (118 IP-mi) (62% High)

Dominant Land Uses are Timber Harvest and Agriculture

Key Limiting Stresses are 'Impaired Estuary/Mainstem Function' and 'Lack of Floodplain and Channel Structure'

Key Limiting Threats are 'Channelization/Diking' and 'Roads'

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, or other instream structure • Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows • Remove or replace tidegates	• Remove, set back, or reconfigure levees and dikes • Improve grazing practices • Restore tidally influenced zones

25.1 History of Habitat and Land Use

Vegetation in the upper watershed of the Humboldt Bay Tributaries population area was historically (pre-Euro-American settlement) coniferous forest, dominated by coast redwood. Historic riparian canopy cover was likely high and large wood abundant in streams. Sediment delivery, storage, and transport processes within the streams were a function of the geology, climate, and channel morphology (Doughty 2003). Prior to the 1800s, the historic coho salmon habitat in the population area was largely unaffected by anthropogenic land use activities. Euro-American settlement and resource extraction influenced landscape processes, which resulted in decreased quality, quantity, and accessibility of habitat for coho salmon spawning and rearing (Beechie et al. 2003).

Harvest of old growth trees began in the 1860s with associated building of railroads linking the forests to the mills on the Humboldt Bay waterfront. Timber harvest practices that degraded aquatic habitat included: (1) large clear cuts that altered the hydrology and increased sediment delivery to the watercourse; (2) loss of riparian floodplain to harvest and road construction; (3) use of tributary stream channels as haul roads; (4) steam donkey dragging of logs within stream channels; and (5) use of larger stream channels for log transport and splash-dams. Several periods of timber harvest have occurred in the Humboldt Bay watershed; initially harvesting the easily accessible timber from 1860 to 1910, and then subsequent harvesting higher in the watershed. In the 1800s, a common road building practice for road-stream crossings was a "Humboldt" log crossing, where organic debris were pushed into the stream and buried with soil. The use of Humboldt crossings, instead of culverts, continued into the 1970s and created a persistent source of sediment delivery to watercourses [Humboldt Bay Watershed Advisory Committee (HBWAC 2005)].

Currently, the dominant land use in the population area is timber production and harvest in the upper portions of tributary watersheds. Agriculture and urban, residential, and industrial development are the dominant land uses in the middle and lower portions of the tributary watersheds (Figure 25-2). The majority of land in the upper watershed of the population area is privately owned by two commercial timber companies, Humboldt Redwood Company (HRC) and Green Diamond Resource Company (GDRC). Approximately 78 percent of the Freshwater Creek (30.7 mi^2) and Ryan Slough (14.7 mi^2) watersheds are managed by these two companies for commercial timber harvest (Pacific Watershed Associates 2006). Urban, residential, and industrial land use is concentrated in the cities of Arcata (population 16,651) and Eureka (population 26,128), and five smaller communities near Humboldt Bay, with a total population of approximately 70,000 (HBWAC 2005). There is currently more residential development in the Arcata, Jacoby Creek, and Freshwater Creek watersheds than in the Elk River or Salmon Creek watersheds.

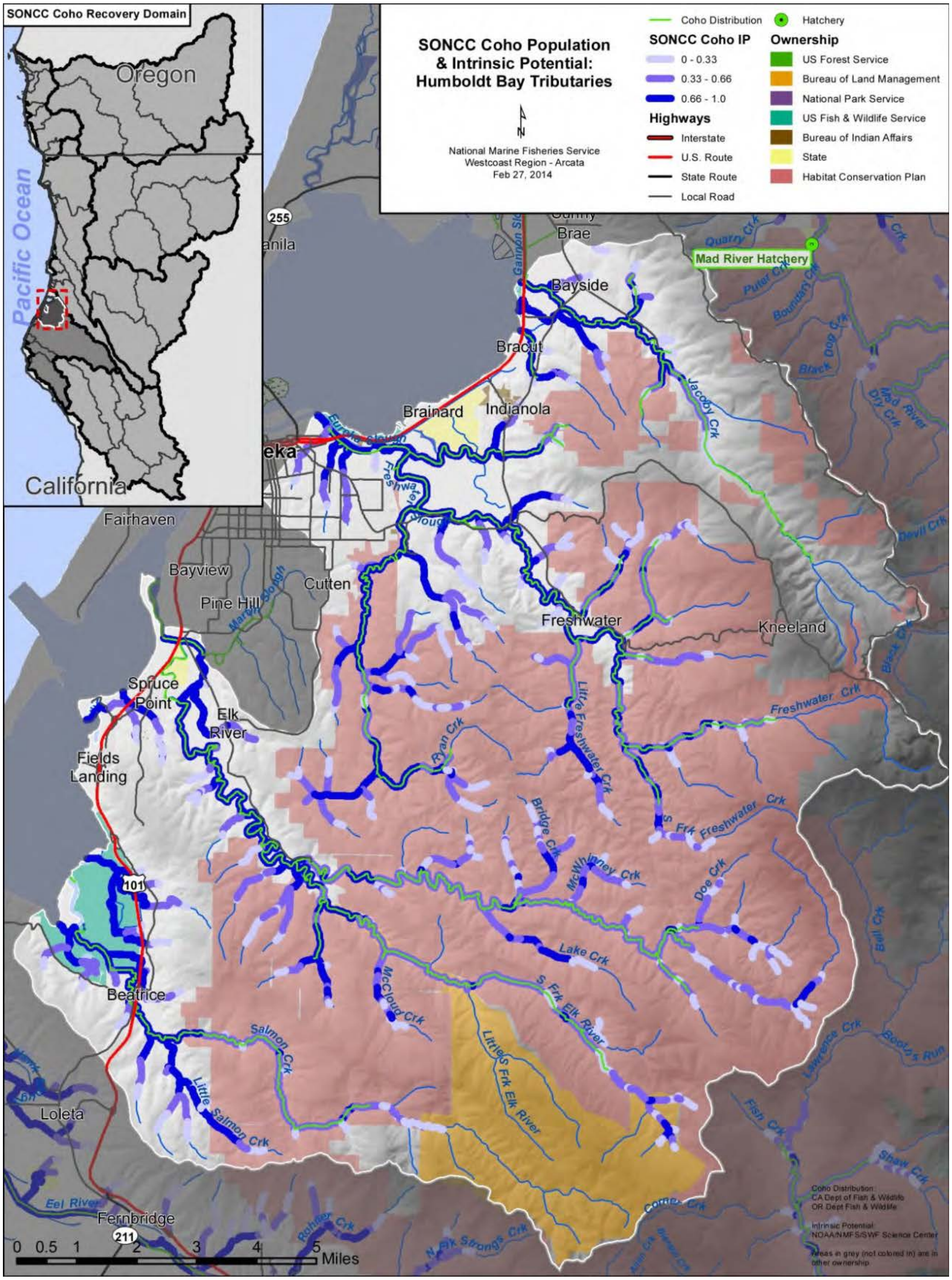

Figure 25-1. The geographic boundaries of the Humboldt Bay Tributaries coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Southern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

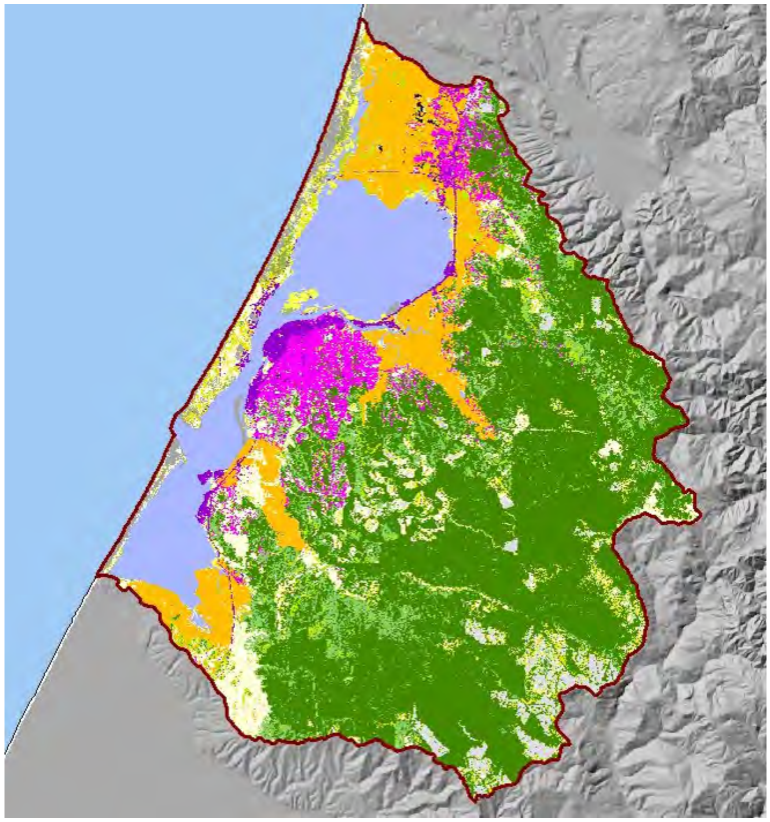

Figure 25-2. Major land use in the Eureka Plain HU. Key: (green = commercial timber; orange = agricultural, and pink = urban/residential/industrial; KRIS 2006).

The aquatic habitat in the upland watersheds of the population area have been degraded through altered hydrology, accelerated sediment delivery, and loss of floodplain and channel structure due to land use practices. In the upper watersheds, timber harvest practices have historically increased sediment delivery to watercourses through mass wasting and landslides, and surface erosion from roads. In the lower watersheds, runoff from urban development, livestock grazing, and agricultural land use increased fine sediment supply to channels.

Loss of riparian vegetation from timber harvest in the mid-1800s to mid-1900s, and more recent increased rates of road building and timber harvest in the 1980s and 1990s, have degraded habitat by increasing delivery of sediment to the watercourses as a result of deep and shallow landslides, and gully and bank erosion. In addition, abundant road-stream crossings have altered the hydrology and sediment transport processes (Figure 25-3).

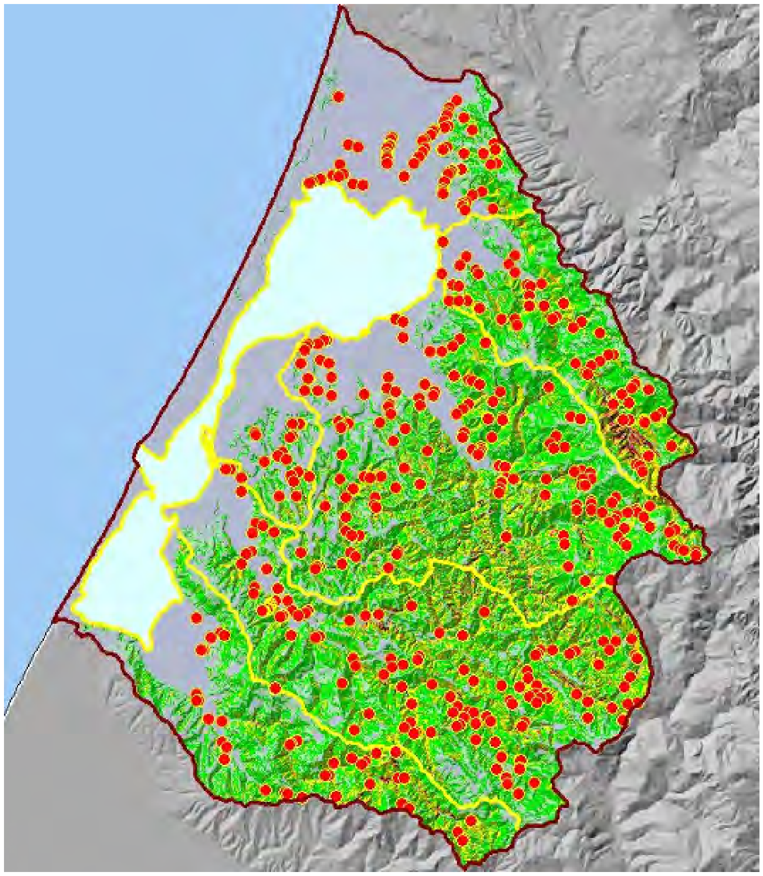

Figure 25-3. Road-stream crossings in the Eureka Plain HU.(KRIS 2006)

Accelerated erosion has increased the percentage of fine sediment and embeddedness, filled in pools, reduced pool depth and pool frequency, increased duration of suspension of sediments and subsequent turbidity, and reduced the quantity and quality of spawning and rearing of the habitat.

Humboldt Bay is California's second largest coastal estuary (Barnhart et al. 1992), encompassing over 17,000 acres (Pinnix et al. 2005), and is the fifth largest estuary along the continental U.S. Pacific Coast (Trianni 1996). However, most of the bays of the Pacific coast are essentially marine bays, not estuaries (Ricketts et al. 1985), and true estuarine conditions in Humboldt Bay occur only where bay waters are measurably diluted by fresh water from major winter storms (Barnhart et al. 1992). As stated in Barnhart et al. (1992), Humboldt Bay has been characterized as a "multibasin, tide driven coastal lagoon with limited fresh water input." Humboldt Bay, managed primarily as a deepwater port, links the freshwater habitat to the Pacific Ocean through the tidally influenced drowned river mouths of its tributaries (HBHRCD 2007).

Since the 1800s, the physical habitat and habitat forming processes within Humboldt Bay, as well as in the tidally influenced portions of the watersheds, have been altered by human activities associated with both upland and adjacent land use (agriculture, urban, residential, industrial) and construction and maintenance of transportation corridors (land and marine). Recent and ongoing activities within Humboldt Bay include: (1) annual dredging of the Federal Navigation Channels and deepwater port, (2) construction and maintenance of numerous port-related overwater and hardened shoreline structures; (3) maintenance of agricultural and urban levees and tidegates; and (4) planting and cultivation of approximately 300 acres of oyster aquaculture.

In the tidally-influenced lower watersheds, the physical alteration and disconnection of backwater, side channel and floodplain habitats and subsequent inaccessibility to juvenile and adult coho salmon, due to passage barriers (culverts, tide gates), have reduced the quantity and quality of the tidal freshwater and estuarine rearing habitat. An estimated 85 percent of the original salt marsh and tidal slough habitat around Humboldt Bay is no longer available to coho salmon (Shapiro and Associates 1980, Barnhart et al. 1992). The quantity and quality of existing rearing habitat was reduced from historic values due to construction of dikes and levees; draining, and filling of tidal sloughs for agricultural use; and fragmentation of tidal slough habitat by construction of the railroad and Highway 101. However, recent restoration efforts in areas such as McDaniel Slough (City of Arcata), Rocky Gulch, Wood Creek, and Salmon Creek have expanded the amount of slough habitat available to coho salmon. Annual maintenance dredging of the interior Federal Navigation Channels in Humboldt Bay, as well as the bar and entrance channels, increases turbidity and turbulence, and thereby reduces the rearing and migratory corridor functions at various locations from March through May.

25.2 Historic Fish Distribution and Abundance

The Humboldt Bay Tributaries population of SONCC coho salmon consists of all individuals that spawn and rear within the Eureka Plain Hydrologic Unit (HU) (Figure 25-1). Streams tributary to Humboldt Bay historically have been important to the local sport fishery, but Hull et al. (1989) report estimates of coho abundance in these streams are lacking. The watershed areas of the main spawning tributaries in the population area from north to south are as follows: Jacoby Creek (17 mi^2); Freshwater Creek, including Ryan Creek and Fay Slough (58 mi^2); Elk River, including Martin Slough (58.2 mi^2) and Salmon Creek (17 mi^2). In the 1800s, these four main tributaries supported large numbers of coho salmon (CDFG 1994, Weitkamp et al. 1995), however, numbers of fish began to noticeably decline by the 1940s (HBWAC 2005). Prior to construction of the railroad, diking of agricultural lands and installation of tide gates, the Arcata watershed (Janes, Campbell and Beith creeks, as well as other smaller tributaries) likely supported low numbers of spawning coho salmon adults as well as provided non-natal estuarine juvenile coho salmon rearing habitat

Recent evidence of juvenile coho salmon rearing in non-natal tributaries to the Arcata and Freshwater Creek watersheds demonstrates the importance of these tributaries to the population (Wallace 2008a, 2008c). The model used for describing IP habitat was related to spawning potential and did not include the Arcata watershed within the population area. In addition, the estuarine and tidal freshwater low-gradient habitats in the Arcata watershed, similar to the historic habitat (Figure 25-1) in the major spawning tributaries, were often hydrologically connected to each other as well as to the Jacoby Creek watershed during periods of concurrent high freshwater inflow and high tide. Non-natal rearing of coho salmon juveniles also occurs in the lower one-half mile of Elk River and in Martin Slough.

Hallock et al. (1952) seined 8,642 juvenile coho salmon from Freshwater Creek, 17,671 from Elk River and 14,243 from Jacoby Creek, indicating substantial populations in those streams. Spawning surveys conducted in North Fork Elk River on two index reaches totaling 7.4 km (4.6

miles) during the 1986-1987 season documented 343 live coho adults, 53 carcasses and 206 redds. Total coho escapement in 1986-1987 was estimated at of 773 fish.

Juvenile coho salmon have been documented in Wood Creek (Wallace 2008d), Rocky Gulch, Gannon Slough, and Martin Slough (Wallace 2008b, Wallace 2010a, Wallace 2010b) during the winter, presumably where they were escaping higher velocity flows in the main channels of Freshwater Creek, Jacoby Creek, and Elk River. In the Freshwater Creek watershed, age 0+ coho salmon rearing in the freshwater/estuarine ecotone grow larger than their upstream cohorts (Wallace 2008a). Wallace (2008d) reported that age 1+ coho salmon smolts originating from Freshwater Creek used lower Elk River during rearing and outmigration through Humboldt Bay en route to the Pacific Ocean.

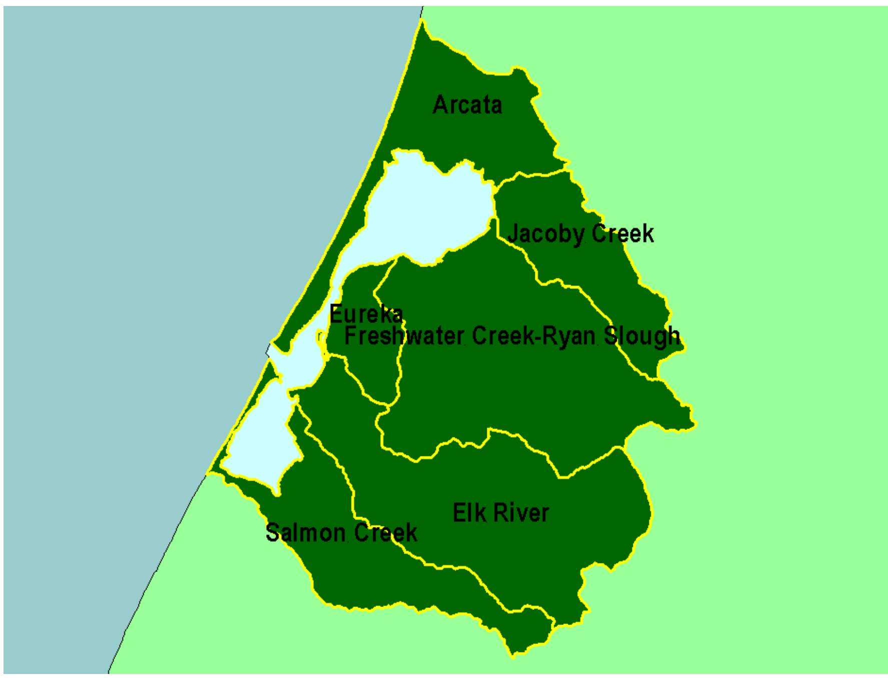

Figure 25-4. Watersheds within the Eureka Plain. Map from KRIS Humboldt Bay June 2006

Although high IP habitat appears to be most extensive in Freshwater Creek and Elk River and least extensive in Jacoby Creek (Table 25-1), the low gradient non-natal rearing function of the historic tidal wetlands in the Arcata and Jacoby Creek watersheds demonstrates the importance of these areas for rearing.

Table 25-1. Tributaries with high IP reaches (IP > 0.66).

Stream Name	Stream Name	Stream Name
Janes Creek/McDaniel Slough[1]	Beith Creek/Gannon Slough[1]	Freshwater Creek
Jolly Giant Creek/Butcher Slough[1]	Grotzman Creek/Gannon Slough[1]	Elk River
Campbell Creek/Gannon Slough[1]	Jacoby Creek and tributaries	Salmon Creek

[1]IP in the streams in the Arcata subarea are not mapped in Figure 25-1. However NMFS included these streams in this table because (1) IP is derived from a model predicting juvenile rearing habitat, and (2) the streams are important to the population as non natal rearing sites.

25.3 Status of Humboldt Bay Tributaries Coho Salmon

Spatial Structure and Diversity

The diversity and complexity of the environmental conditions within the Humboldt Bay Tributaries population area have contributed to the evolutionary legacy of coho salmon. The Humboldt Bay Tributaries population is considered functionally independent within the ESU (Williams et al. 2008). As a functionally independent population, the Humboldt Bay Tributaries population is sufficiently large to be historically viable-in-isolation and its demographics and extinction risk are minimally influenced by immigrants from adjacent populations (Williams et al. 2006). The population is unique in the SONCC coho salmon ESU in that it is comprised of several tributaries that share a large bay.

Redd surveys in recent years have documented coho salmon spawning in all major Humboldt Bay sub-watersheds (Elk River, Jacoby, Salmon, and Freshwater creeks), indicating a relatively well-distributed spawner population. However, recent distribution of redds likely reflects current habitat suitability rather than historic distribution due to degradation of spawning habitat. In addition, individual fish have been found to spawn both in tributaries and in the mainstem of Freshwater Creek, or in more than one tributary, which may represent a life history strategy to increase egg survival in the relatively small, dynamic stream (Goin 2009).

Based on data from Freshwater Creek, juvenile coho salmon residing in upstream, higher gradient reaches migrate downstream in the fall to the stream-estuary ecotone, which contains low gradient and low velocity over-wintering habitat (Wallace 2008a), illustrating the importance of the connectivity among freshwater and tidally influenced habitats for growth and survival. The lower mainstem of Freshwater Creek had greater numbers of emigrating age 1+ coho salmon per km than the upper mainstem and tributary watersheds. In addition, these fish were larger and emigrating earlier than cohorts from upstream areas (Wallace et al. 2006, Ricker 2008, Wallace 2008a). Juvenile coho salmon utilize non-natal sloughs and marshes while rearing or migrating through Humboldt Bay. For example, individuals marked in Freshwater Creek have been recaptured in Elk River Slough.

Population Size and Productivity

Williams et al. (2008) determined at least 191 coho salmon must spawn in the Humboldt Bay tributaries each year to avoid effects of extremely low population sizes. The population size of the Humboldt Bay tributaries population is unknown, but the most recent redd abundance estimates for the population were 194 redds in 2009-10 and 2,002 redds in 2010-11 (Ricker, S., pers. comm. 2011a). The trend in Freshwater Creek adult abundance estimates (Figure 25-5) indicates adult escapement has declined since 2002-03, ranging from a high of 1,807 in 2002-03 to a low of 89 in 2009-10 (Moore and Ricker 2012). However, all three cohorts have experienced slight increases in abundance over the past three years. Published values of marine survival for wild populations of coho salmon range from 29% to 0.6% and average near 10%. Estimates of coho salmon marine survival from Freshwater Creek for 2007 (2.66%) and 2008 (0.85%) smolt cohorts are below this average and likely contribute largely to the short term negative trend in adult escapement (Ricker and Anderson 2011). Although the number of juvenile coho salmon emigrating from Freshwater Creek tributaries has remained relatively constant over 8 years, and is estimated at 3,000 individuals (Ricker 2008), there appears to be a large variation in the annual number of juvenile coho salmon rearing in the stream-estuary ecotone. In Freshwater Slough, the catch per unit effort of young-of-the-year coho salmon caught by CDFG declined between 2005 and 2008.

Although annual spawner escapement in Jacoby Creek is unknown, monitoring in Morrison Gulch following the removal of a fish passage barrier indicates the number of live adult coho salmon (10 individuals) observed in 2008 to 2009 were the lowest since 2001; and the overall eight-year trend in returning adult coho salmon and constructed redds in Morrison Gulch was downward (Taylor and Associates 2009). CDFG spawner and redd surveys of index reaches in Elk River (South Fork, Upper North Fork, and Lower North Fork) varied in number both among years and among locations so no direct comparison among years is possible (Collins 2008). Overall, the trend is a decline in number of live fish observed in Elk River at these locations.

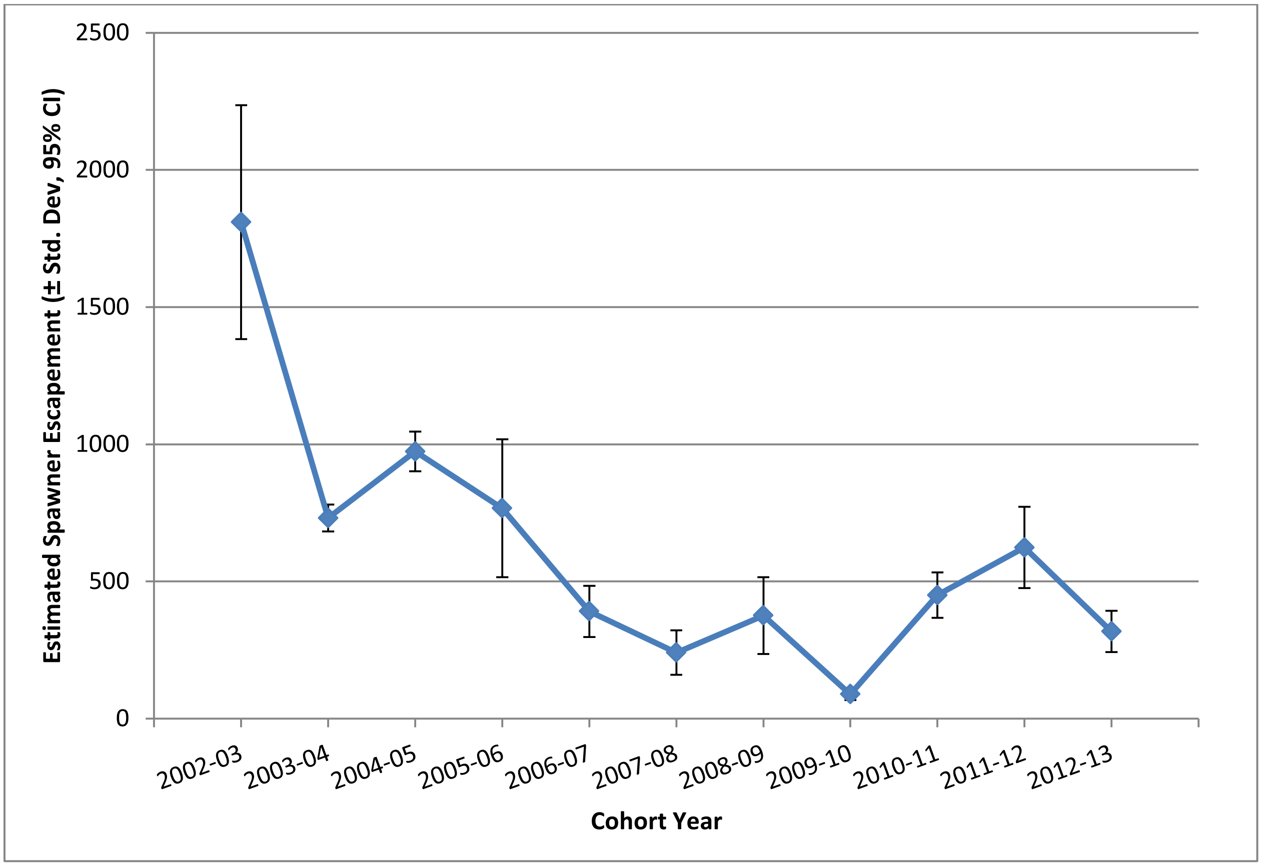

Figure 25-5. Escapement estimates for adult coho salmon in Freshwater Creek (data from Moore and Ricker 2012, Moore, T., pers. comm. 2013).

Extinction Risk

The Humboldt Bay Tributaries population is at moderate risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one, but the ratio is less than the minimum required spawner density (both criteria described in Williams et al. 2008).= NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Humboldt Bay Tributaries population is a core, Functionally Independent population within the Southern Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Humboldt Bay Tributaries core population needs to have at least 5,700 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Humboldt Bay Tributaries population fulfills other needs within the Southern Coastal stratum. The Humboldt Bay Tributaries population may serve as a source of spawner strays, including for the extremely depressed Mattole River population to the south and the Mad River to the north.

25.4 Plans and Assessments

Humboldt Redwood Company

Humboldt Redwood Company Habitat Conservation Plan

Humboldt Redwood Company (HRC) (formerly Pacific Lumber Company (PALCO)) owns land in the upper Freshwater Creek and Elk River watersheds in the population area. The PALCO Habitat Conservation Plan (HCP), finalized in 1999 and valid through 2049, provides for (1) assessment of existing road network and associated sediment sources on HCP-covered lands (2) storm proofing of all medium and high priority sites within five years of completion of the assessment, and within 20 years of the effective date of the HCP; and (3) updating the road inventories within five years of the actual storm proofing. Elk River and Freshwater Creek were the first two watershed analyses to be completed. In 2004, the period for completion of road assessment and associated sediment sources was revised from 2005 to 2010. The HCP is intended to provide for storm proofing of 1,500 miles of road by 2019, at a minimum rate of 75 miles per year. The Freshwater Watershed Analysis and the Hillslope Management and Riparian Management Prescriptions were completed in 2003. The Elk River and Salmon Creek Watershed Analyses and the Hillslope Management and Riparian Management Prescriptions, were completed in 2005 (PALCO 2005). More information about HCPs in the Humboldt Bay Tributaries can be found in Section 3.2.5.

U.S. Bureau of Land Management (Arcata Field Office)

Headwaters Forest Reserve Resource Management Plan

The 7,472- acre Headwaters Forest, located in the upper Elk River and Salmon Creek watersheds, was acquired by the Secretary of the Interior and the State of California on March 1, 1999, to preserve old-growth redwood forest. The acquisition was part of a comprehensive agreement between the Department of the Interior and PALCO that created the Headwaters Forest, and required PALCO and the U.S. Fish and Wildlife Service (USFWS) to complete an HCP for PALCO's remaining lands in Humboldt County. The Headwaters Forest Reserve Resource Management Plan (Jones and Stokes 2003, BLM and CDFG 2004) calls for the removal of 50 miles of abandoned timber management roads within the Reserve. Approximately 45 percent of the watershed restoration work identified in the plan has been completed (Fuller 2010).

Green Diamond Resource Company

Habitat Conservation Plan

Green Diamond Resource Company owns 38,870 acres in the Eureka Plain HU, primarily within the Freshwater/Ryan Creek, Jacoby Creek, and Salmon Creek watersheds. Their Aquatic Habitat Conservation Plan was finalized in 2007 and is valid through 2057. The plan has a number of provisions designed to protect coho salmon and aquatic habitat on their land within the Humboldt Bay watershed.

City of Eureka

General Land Use Plan

This plan designates diked former tidelands, rivers, creek, sloughs, gulches, and associated riparian habitat as environmentally sensitive areas within the Coastal Zone, and requires that any land use activity occurring within 250 feet of any such area must avoid or minimize habitat disturbance and delivery of sediment to waterways. Where a federal nexus exists at a project scale, additional protections to coho salmon and their critical habitat may be identified during the ESA section 7 consultation.

City of Arcata

General Plan

The City of Arcata's Creeks Management Plan provides policy direction for new and modified development along creeks in order to control watershed erosion, enhance riparian habitat, protect instream habitat and flows, and promote restoration. The management plan is generally protective of coho salmon habitat in Janes Creek (including North Fork South Fork and McDaniel Slough), Sunset Creek, Jolly Giant Creek (including Butchers Slough), Campbell Creek, Fickle Hill Creek, Grotzman Creek, Beith Creek, Jacoby Creek, and Washington Gulch. Also included are Liscom Slough, the Mad River and Gannon Slough. The city of Arcata also owns and manages, under a Non-industrial Timber Management Plan, the 793 acre Arcata

Community Forest, in the upper watershed of Janes Creek, as well as the 1,312 acre Jacoby Creek Forest.

United States Fish and Wildlife Service (Humboldt Bay National Wildlife Refuge)

Humboldt Bay National Wildlife Refuge Comprehensive Conservation Plan (USFWS 2009b)

The Humboldt Bay National Wildlife Refuge Comprehensive Conservation Plan (CCP) outlines the management direction and strategies for U.S. Fish and Wildlife Humboldt Bay and Castle Rock National Wildlife Refuges (NWR) for the next 15 years. Management activities will focus on the conservation of the Refuges' resources, particularly migratory birds and wildlife species that are federally listed as threatened or endangered, and their habitats; and providing opportunities at Humboldt Bay NWR for compatible wildlife-dependent recreation including wildlife observation photography, environmental education, interpretation, and hunting. The Salmon Creek Delta Restoration plan was developed to improve fish passage, fish habitat, and water quality, create additional estuarine habitat, improve sediment transport, and reduce flooding upstream of the Humboldt Bay NWR.

Sea Grant: Eureka Office Humboldt Bay Ecosystem Based Management

Humboldt Bay Watershed Salmon and Steelhead Conservation Plan (HBWAC 2005)

This multi-stakeholder plan, which focused on the four main watersheds in the Humboldt Bay watershed (Jacoby Creek, Freshwater Creek, Elk River and Salmon Creek), compiled and evaluated watershed information and developed a list of high priority goals and objectives aimed at protecting or restoring watershed processes in order to preserve and enhance salmon and steelhead habitat. This document provides a template for recovery actions in freshwater and estuarine habitats.

Humboldt Bay Initiative
http://www.westcoastebm.org/Humboldt_Bay_Initiative.html

The Humboldt Bay Initiative (HBI), led by NOAA's SeaGrant Extension Office in Eureka, California seeks, using an ecosystem-based management approach, to create a coordinated resource management framework that links the needs of people, habitats and species by increasing scientific understanding of the ecosystem. In order to address priority threats to the local ecosystem and communities including climate change, invasive species and human activities, HBI includes a set of strategies aimed at creating the conditions necessary to achieve their shared vision of a healthy ecosystem. These strategies include development of several models of natural science processes (e.g., conceptual ecosystem linkages, sea level rise and sediment/circulation) to be used as a decision-making tool for activities that may potentially affect eelgrass and salmonid rearing habitat.

Humboldt Bay Harbor, Recreation and Conservation District (HBHRCD)

Humboldt Bay Management Plan

In 1970, the HBHRCD was established to manage Humboldt Bay for the promotion of commerce, navigation, fisheries, recreation, and the protection of natural resources, and to acquire, construct, maintain, operate, develop, and regulate harbor works. The Humboldt Bay Management Plan (HBHRCD 2007) was developed around ecosystem-based approach with stakeholder participation through an Advisory board. This approach will strive to balance priorities and policies for the District's legislatively directed obligation to manage harbor, recreation, and conservation-related goals for Humboldt Bay.

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The strategy includes actions to improve coho salmon habitat in the Humboldt Bay Tributaries population area.

Water Quality Control Plan for the North Coast Region
http://www.swrcb.ca.gov/northcoast/water_issues/programs/basin_plan/

This plan, mandated by both the Federal Clean Water Act (CWA) and the State Porter-Cologne Water Quality Act (Porter-Cologne), identifies actions to preserve and enhance water quality and to protect beneficial uses of water in the North Coast Region, and is used as a regulatory tool by the Regional Water Board.

Enclosed Bays and Estuaries of California Water Quality Control Plan
http://water.epa.gov/scitech/swguidance/standards/wqslibrary/upload/2009_12_15_standards_wqslibrary_ca_ca_9_74_43.pdf

This plan provides guidance and regulatory standards for sediment in Humboldt Bay.

Natural Stocks Assessment Program (2003-ongoing)

The Natural Stocks Assessment Program (NSA) was developed to collect information on the distribution, growth, and estuarine residency times of juvenile salmonids in the tidal portion of selected Humboldt Bay tributaries and in McNulty Slough in the Eel River Estuary. The information collected by the NSA is shared with the restoration community to help improve marsh restoration projects around Humboldt Bay. Data was collected in Elk River Slough which was discontinued in June 2009. Data was collected in Gannon Slough/Jacoby Creek estuary, Rocky Gulch, and Martin Slough and was discontinued in June 2010. Data is currently being collected for Wood Creek, Freshwater Slough, Salmon Creek, Hookton Slough, and Ryan Slough and being used to assess ongoing or planned estuarine habitat restoration projects. Sites are monitored on a monthly basis; with the exceptions of Elk River Slough and Freshwater

Slough, which are monitored weekly; and Salmon Creek and Hookton Slough, which are monitored every two weeks.

North Coast Integrated Regional Water Management Plan
http://www.northcoastirwmp.net/docManager/1000006299/NCIRWMP_Phase_I_maps_2007.pdf

The North Coast Integrated Regional Water Management Plan (NCIRWMP) is a stakeholder-driven collaboration among seven counties, local government, watershed groups, tribes and interested partners in the North Coast region of California. The NCIRWMP integrates long term planning and project implementation in an adaptive management framework. It focuses on salmonid recovery, enhancement of the beneficial uses of water, and the synchronization of state and federal priorities with local priorities, knowledge and leadership.

Pacific Coast Joint Venture

Pacific Coast Joint Venture Coastal Northern California Component Strategic Plan
http://pcjv.org/california/pdfs/Strategic%20Plan%20CAL%20PCJV%202004.pdf

The Pacific Coast Joint Venture (PCJV) is a public-private partnership which was created to implement the North American Waterfowl Management Plan and has since been expanded to include all native flora and fauna and the full range of habitats associated with the region's wetland ecosystems. PCJV focuses on identification, protection, and restoration of the most important wetlands and associated upland and riparian habitats. Numerous restoration and acquisition priorities have been identified in the Eureka Plain HU.

University of California Subtidal & Intertidal Habitat Goals Project

Subtidal Habitat Goals Project for Humboldt Bay and the Eel River Estuary

The objectives of the project are to evaluate and define benthic habitat in order to provide management recommendations and identify restoration opportunities and research needs.

The Nature Conservancy

North Coast Anadromous Salmonid Conservation Assessment (Tussing and Wingo-Tussing 2005)

This assessment was developed as a guide and reference to actively pursue opportunities related to aquatic biodiversity. The Humboldt Bay Tributaries population was identified as a priority basin, due to the historically large population sizes and current numbers of returning adults that would aid both short and long-term viability of the ESU.

25.5 Stresses

Table 25-2. Severity of stresses affecting each life stage of coho salmon in the Humboldt Bay Tributaries. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	Medium	Very High	Very High[1]	High	Medium	Very High
2	Impaired Estuary/Mainstem Function[1]	-	High	Very High[1]	High	Medium	High
3	Altered Sediment Supply	Very High	High	High	High	Medium	Very High
4	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
5	Impaired Water Quality	Medium	High	High	High	Low	High
6	Barriers	-	Medium	High	High	Low	High
7	Altered Hydrologic Function	Medium	Medium	Medium	Medium	Low	Medium
8	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low
10	Increased Disease/Predation/Competition	Low	Low	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for the Humboldt Bay Tributaries population are lack of floodplain and channel structure and impaired estuary/mainstem function, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. The juvenile life stage is most limited, primarily due to reductions in quality and quantity of summer and winter rearing habitat. The lack of instream structure significantly reduces sorting of gravels and pool formation, and high flow refugia habitat is severely lacking for winter rearing juveniles due to disconnected floodplains. Furthermore, the population historically depended on the rich tidally influenced habitat for rearing, and the current impaired state of the estuary has limited the population's life history diversity and growth opportunities.

Lack of Floodplain and Channel Structure

Altered floodplain and channel structure (e.g., pool frequency and depth, large woody structures) is a very high stress to the fry and juvenile life stages. Levees and dikes are limiting connectivity between mainstem slough channels and potential floodplain habitat in valley floor and stream-estuary ecotone sections of most Humboldt Bay tributaries. Lack of backwater pools along the channel margins reduces overwintering refugia from high flows. Reduced habitat connectivity and complexity of estuarine functions is detrimental to the juveniles and smolts found there.

Given the extensive timber harvesting that has occurred in the population area and the changes in riparian vegetation characteristics, lack of large wood likely limits the sorting of gravels, formation of pool habitat, and instream cover throughout much of the watershed.

Impaired Estuary/Mainstem Function

Since this population is inherently dependent on the estuary for rearing, the life stages most affected are fry and juveniles that rear in the estuary and smolts that use estuarine habitat for rearing, transitional habitat, and refugia. Coho fry and juveniles rearing in the estuary are almost always found in tidally influenced freshwater habitat while smolts utilize fresh and brackish water habitat in the estuary (Wallace, M., pers. comm. 2011). There is potential for estuarine rearing, although the quality and quantity are reduced compared to historic conditions. The structure and function of the tidally influenced habitat in the drowned river mouths around Humboldt Bay, as well as in the contiguous nearshore and deeper channel habitats in Humboldt Bay, have been significantly altered from natural conditions. The quality of rearing habitat for fry, juvenile and smolts has been reduced as a result. The physical and biological habitat-forming processes, the light regime, and the spatial extent of the intertidal and subtidal habitats in Humboldt Bay have been directly altered as a result of: (1) upland land use activities that increase sediment transport, reduce floodplain/tidal marsh storage of sediment, and limits large wood recruitment and delivery to the tidally influenced habitats; (2) agricultural practices that diked, drained and eliminated estuarine rearing habitat; (3) construction of roads and railroads that effectively act as dikes, altering hydrology and habit accessibility; (4) port and harbor development and interrelated commercial and recreational activities; and (5) urbanization and development of Arcata and Eureka.

Maintenance dredging of the Federal Navigation Channels and jetty construction to stabilize the mouth of Humboldt Bay; changed the volume of flood and ebb-tidal shoals, modified the tidal prism, and forced a new equilibrium state (Larson et al. 2002). Since 1950, from March through May, juvenile coho salmon present in Humboldt Bay may be exposed to the annual dredging. Overflow of the hopper dredge during annual maintenance dredging of the Federal Navigation Channels, results in water quality that has: (1) been degraded due to increased turbidity; (2) reduced the localized availability of the water column habitat for rearing and migration of juvenile coho salmon during each daylight dredge cycle; and (3) disoriented fish entrained in the prop wake and turbidity plume, and in turn increased the likelihood of predation by birds during the day.

Over-water structures (piers, piles, docks, and moored boats) in Humboldt Bay, along with associated shading and localized hydraulic effects, cause detrimental effects to coho salmon habitat. These structures: (1) reduce the amount of nearshore intertidal and subtidal eelgrass habitat, (2) reduce the connectivity of nearshore habitat, (3) alter the type of cover and prey available for juvenile salmonids, and (4) trigger salmonid behavioral habitat avoidance. Because coho salmon avoid swimming under over-water structures, individuals will occupy the middle to the surface of the water column in deeper water adjacent to structures, as opposed to occupying more shallow water as they would in the absence of the structures (Toft et al. 2004). As a result of fragmentation of nearshore habitat, including eelgrass habitat, juvenile salmonids likely increase the amount of time traveling between eelgrass patches, which (1) results in decreased foraging; and (2) increases their exposure to predators where eelgrass cover is reduced or over-water structures are present.

Alteration and loss of salt marsh, intertidal and subtidal habitat in Humboldt Bay adjacent to the Eureka watershed resulted from the construction of the three State Highway 255 Humboldt Bay bridges (Bridges) in 1971 and Woodley Island Marina (Marina) in 1981. Hardening of the shoreline has reduced the extent of the intertidal habitat, restricted sediment transport, and likely increased nearshore turbulence. Artificial illumination in the nearshore during otherwise normal periods of darkness can provide enough light for visual feeders to see and capture prey (Yurk and Trites 2000, DeVries et al. 2003, Longcore and Rich 2004). Harbor seals prey on juvenile salmonids in water at least 2 m deep, and feed actively in the light-shadow boundary produced by halogen bridge lights and residual city lighting (Yurk and Trites 2000).

Tidal freshwater habitat has been demonstrated to be important for the growth and survival of juvenile coho salmon (Koski 2009). The size of fish observed in off-channel ponds, both established and newly created, indicate that growth rates are significantly higher than those fish rearing in the mainstem channels, likely increasing their survival once they enter the ocean. For example, Wood Creek, and likely Ryan Slough, provide winter habitat refugia from high flows for age 0+ and 1+ juvenile coho salmon in the Freshwater Creek watershed (Wallace, M., pers. comm. 2011).

Altered Sediment Supply

Altered (increased) sediment supply is a very high stress to the egg life stage, and a high stress to the fry and juvenile life stages. The excessive amount of instream sediment is exacerbated by the lack of instream structure to sort gravels and provide scour mechanisms for pool formation. The severity of sediment as a stress is reflected in the listing under Clean Water Act Section 303(d) for Jacoby Creek, Freshwater Creek, and Elk River as sediment-impaired waterbodies. Increased sediment delivery and deposition has increased channel embeddedness, filled pools, widened channels, increased the amount of fine sediments that can be suspended in the water column, and simplified stream habitat throughout the watershed, including the estuary.

Embedded channel gravels reduce permeability of redds, which reduces the amount of oxygen available to coho salmon eggs, thereby potentially reducing growth and survival of eggs. Further, the success of coho salmon fry emergence from spawning gravels decreases as channel embeddedness increases. Increased suspension of sediments, and resultant increased turbidity, can cause avoidance responses, and physical damage to gills of fry, juveniles, smolts and adults, as well as reduced feeding and growth rates of fry, juveniles and smolts. High levels of fine sediment and embeddedness can also reduce the feeding success, and ultimately growth of 0+ and 1+ fish, because extended periods of high turbidity reduce visibility of prey as well as the type of invertebrate prey available. Epibenthic grazer and predator taxa of benthic macroinvertebrates, an important food source for salmonids, are limited or non-existent in channels with high levels of sedimentation. Sediments delivered to the streams and creeks are, over time, transported to tidally influenced habitats in the lower portions of the tributaries and ultimately into Humboldt Bay, as discussed in the previous section on impaired function of tidally influenced habitat.

The Humboldt Bay watersheds are comprised of moderately unstable geologic composition. As a result of a poorly constructed road network and a recent intensification in timber harvest operations, the large storms between 1993 and 1997 routed stored sediment from lower order tributary watersheds to the low gradient storage reaches and caused significant amounts of landsliding to occur, resulting in a considerable volume of sediment to route downstream.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions exist across the watershed and present high stresses for the fry, juvenile, and smolt life stages. Clearing of riparian forests is one factor that alters recruitment of large woody debris to streams (another being harvest of unstable or potentially unstable slopes), subsequently altering sediment transport and storage, deposition and storage of sediment, bed roughness, interaction between the channel and floodplain, and channel habitat characteristics including pool habitat (spacing, area, and depth) both in freshwater and tidally influenced habitats. Riparian vegetation also provides (1) shade, which influences water temperature; (2) nutrients and organic material (leaves, insects); and (3) bank stabilization. The composition of the prey community is a factor in habitat use, for example, a study conducted in the Freshwater Creek watershed in 2004 (Cummins et al. 2005) found that greater numbers of juvenile coho salmon were present where the system was heterotrophic, relying on riparian inputs of energy. Reductions in large wood also modify the hydrology and hydraulics, as discussed, below, in the *Altered Hydrologic Function* subsection.

Impaired Water Quality

Impaired water quality is a high stress to the fry, juvenile, and smolt life stages. As described above, increased levels, or duration, of turbidity may reduce juvenile coho salmon growth. Low dissolved oxygen in combination with high summer water temperatures are stresses in lower Salmon Creek, lower Freshwater Creek, and in the lower South Fork of Elk River (Wallace and Allan 2007). Nutrient loading from septic tank overflow, runoff from grazing lands, and reduced riparian vegetation, contribute to these conditions. Water quality is also likely impaired by pollutants contained in urban runoff.

Barriers

Barriers to passage in the tidally influenced portions of the population area are a high stress to the juvenile and smolt fish life stages. Numerous water control structures around Humboldt Bay drain agricultural, residential, urban, and industrial land. Tide gates block fish passage into formerly accessible estuarine rearing habitat and spawning tributaries in the Eureka Plain hydrologic unit watersheds (USFWS 2007) and constitute the most problematic barriers to the population overall.

Altered Hydrologic Function

Altered hydrologic function is an overall medium stress to coho salmon in the population area. Clearing of vegetation and replacing with impervious surfaces has increased surface runoff. Relative to hydrologic function, reductions in large woody debris decreases in-channel sediment storage, reduces channel roughness, and reduces the ability of the stream to attenuate peak flows. Inboard ditches collect and channelize surface runoff and subsurface flows, then efficiently route water, sediment and other pollutants to streams resulting in higher, earlier, and more frequent peak flows. Increased peak flow may increase the frequency of channel bed mobilization, thereby increasing the probability of redd scour, disturbance of alevins in redds, and displacing over-wintering coho salmon juveniles.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Adverse Hatchery-Related Effects

A small egg collecting station operated on Freshwater Creek from 1978 to 1995. However, there are no operating hatcheries in the Humboldt Bay Tributaries population area at this time. Numerous steelhead smolts produced by the Mad River hatchery were found in lower Elk River Slough shortly after their release in March 2006 (Wallace 2006), indicating some straying from that hatchery has occurred. Hatchery-origin coho salmon may stray into Humboldt Bay; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

Increased Disease/Predation/Competition

Non-native species pose a medium threat to juveniles and smolts both in freshwater and in tidally influenced habitat in the watersheds, as well as in Humboldt Bay. Capture of six Sacramento pikeminnow, a salmonid predator currently present in the Eel River, in Martin Slough in 2008 prompting CDFG to survey other tributaries within the Elk River watershed, and to begin a targeted eradication program. One additional pikeminnow was captured in Martin Slough in May 2011 roughly 2.5 years after the eradication effort began (Wallace, M., pers. comm. 2011).

25.6 Threats

Table 25-3. Severity of threats affecting each life stage of coho salmon in the Humboldt Bay Tributaries. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	Very High	Very High	Very High[1]	Very High	Medium	Very High
2	Channelization/Diking[1]	Medium	High	Very High[1]	Very High	Medium	Very High
3	Agricultural Practices	Medium	Medium	High	High	Medium	High
4	Urban/Residential/Industrial Dev.	Medium	High	High	High	Medium	High
5	Timber Harvest	High	High	High	High	Medium	High
6	Climate Change (sea level rise)	Low	Low	High	High	Medium	High
8	Invasive Non-Native/Alien Species	Low	Low	Medium	Medium	Low	Medium
7	Dams/Diversions	Low	Low	Medium	Medium	Medium	Medium
9	Fishing and Collecting	-	-	Low	Low	Low	Low
10	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low
12	High Severity Fire	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage
[2]Mining/Gravel Extraction is not considered a threat to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and channelization/diking.

Roads

Roads pose a very high threat to all life stages of coho salmon, except adults. Forest roads are a primary causative factor for both altered sediment supply and altered hydrologic function. The density of roads in the Eureka Plain hydrologic unit is generally high throughout the watershed (>3 miles of roads per square mile). Pacific Watershed Associates (PWA 2006) reported that between 1989 and 2003 there were 76 miles of road constructed in Freshwater Creek (30.7 mi^2), which resulted in an overall road density of 7.6 mi/mi^2. Ryan Slough and Fay Slough, both tributaries to Freshwater Creek, have road densities of 8.7 mi/mi^2, and 8.8 mi/mi^2, respectively (PWA 2006). Roads and road ditches extend the stream channel network, concentrate hillslope runoff and capture subsurface flows, often resulting in changes to the natural hydrograph.

Specifically, historic peak flows are exceeded due to the increase in road-stream connectivity and peak flows occur more frequently. Further, inboard ditches effectively convey road-related sediment to streams. In some watersheds, road erosion may annually contribute more sediment to the stream system than mass wasting (PWA 2006). The future effect of roads under lands managed under an HCP is described in Chapter 3.

Channelization/Diking

Existing stream channelization and diking poses a very high threat to the juvenile and smolt life stages. Diking of tidelands and installation of tidegates to create land for agriculture has eliminated the majority of the intertidal rearing habitat around Humboldt Bay. The continued existence of diked tidelands will continue to limit the population's ability to recover by restricting life history strategies and diminishing growth opportunities in the productive estuarine nursery habitat.

Agricultural Practices

Agricultural practices pose a high threat to the juvenile and smolt life stages. Grazing and haying occurs throughout the lower watersheds and likely contributes to increased sediment generation and delivery. Cattle grazing and instream watering contribute to degraded riparian and aquatic habitat, primarily in the lower watershed, and reduce its function for rearing. Production of prey is also likely limited by increased turbidity and nutrient loading from feces.

Urban/Residential/Industrial Development

Development in the population area poses a high threat to coho salmon fry, juveniles, and smolts. The Humboldt Bay Management Plan (HBHRCD 2007) identified the primary use in Humboldt Bay, in the area below the Samoa bridge to South Bay (which serves as a coho salmon migratory corridor and rearing habitat), for port related activities. Continued port development in the Samoa Channel (e.g., Redwood Marine Terminal Dock) would degrade habitat in an area where juvenile coho salmon concentrate (Pinnix, W., pers. comm. 2008). Future development may degrade existing tidally influenced habitat and limit the value of existing or planned restoration projects. Of particular concern is the potential subdivision of timberlands for residential use, which would result in an expanded network of roads and impervious surfaces. Discharge of treated wastewater to Humboldt Bay is permitted from treatment plants for the city of Arcata, greater Eureka, and College of the Redwoods (NCRWQCB 2005a), and the volume of discharge would increase with fully realized potential of the land zoned for residential development. The Non-Point Discharge Permit for the city of Eureka's Elk River wastewater treatment facility requires a study, completed by 2014, to verify that the wastewater discharged from the facility during an outgoing tide is transported into the ocean (NCRWCB 2005a).

Timber Harvest

Timber harvest poses a high threat to all life stages of coho salmon, except adults. Many of the changes that have occurred to instream and riparian conditions in the Humboldt Bay tributaries reflect legacy effects of more intensive harvest from previous decades. However, given the percentage of the watershed that is privately owned by timber companies and actively managed as such, future timber harvest activities have the potential to affect coho salmon habitat by contributing to sediment deposition and reducing sources of large wood. HCP holders in the population area (e.g., HRC and GDRC) are expected to help reduce the threat of timber harvest through those conservation measures and mitigations developed for each plan.

Climate Change

Climate change poses an overall medium threat to this population due to its potential impact on juveniles, smolts, and adults. Although current water temperatures in the population area are currently a low risk, modeled regional average temperature shows a moderate increase over the next 50 years (see Appendix B for modeling methods). Average water temperature could increase by up to 0.5 °C in the summer and by approximately 1.0 °C in the winter. Annual precipitation in the Humboldt Bay watershed is predicted to change little over the next century.

The vulnerability of the estuary to sea level rise is high in the population area. Tidally influenced rearing and migratory habitat for juveniles and smolts are most susceptible to climate change. Increasing temperatures and rising sea level will reduce water quality and hydrologic function in the summer. Rising sea level will likely reduce the quality and quantity of tidal-wetland rearing habitat in Humboldt Bay, e.g., increase salt marsh and reduce intertidal flats (Galbraith et al. 2002). Wetlands could migrate inland with rising sea level, but there are currently few areas without levees where this could occur.

The tidally influenced habitat of the Humboldt Bay watershed is highly vulnerable to sea-level rise due the location of urban and residential developments, existing land use and public infrastructure (CNRA 2009, Heberger et al. 2009, NMFS 2009). Stresses previously described for estuarine function will likely be exacerbated, depending on decisions and subsequent implementation of actions to protect existing public sector infrastructure [transportation (e.g., highway, airport, port facilities); energy (e.g., power plant, natural gas pipeline, transmission lines); water (e.g., Humboldt Bay Municipal Water District water main, city of Arcata and Eureka wastewater treatment facilities) and public and private land use (e.g., city of Arcata and Eureka; Humboldt Bay National Wildlife Refuge, Humboldt Bay Reclamation District; Humboldt Bay Harbor, Recreation, and Conservation District). Because of the land and infrastructure ownership, these decisions will be made at multiple Federal, state, and local jurisdictional levels.

Also, as with all populations in the ESU, adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Invasive/Non-Native Species

Non-native species pose a medium threat to fry, juveniles and smolts both in freshwater and in tidally influenced habitat in the watersheds, as well as in Humboldt Bay. CDFG's Natural Stock Assessment Program captured six Sacramento pikeminnow, a salmonid predator currently present in the Eel River, during routine and subsequent sampling, and during a multi-agency eradication effort in Martin Slough in 2008. CDFG continues to monitor Martin Slough and is working with NMFS and other agencies to develop a response plan for addressing future pikeminnow that are captured.

Bullfrogs have been captured in Freshwater Creek in lower watershed downstream migrant traps every year since 2006. In 2009, CDFG found a pit-tagged coho smolt in the stomach of an adult bullfrog at the weir site in Freshwater Creek (Garwood et al. 2010).

Non-native species are commonly introduced to estuaries that are ports because they are carried in ballast water, or on the vessel hulls. In Humboldt Bay, culture of the non-native oyster, *Crassostrea japonica*, introduced a number of non-native invertebrate species. Monitoring of non-native invertebrates and intertidal and salt marsh vegetation, as well as eradication programs, are ongoing.

Several species of invertebrates, as well intertidal and saltmarsh vegetation are non-native and have the potential to replace native species. Many of the fouling organisms present within the Eureka boat basin and the Woodley Island Marina (WIM) are non-indigenous species, introduced either in ballast water of vessels or attached to vessel hulls (Ruiz et al. 2000, Boyd et al. 2002). The concrete piers and pilings of the WIM have been colonized by non-native species of amphipods *Corophium acherusicum* and *C. insidiosum*. The non-native dwarf eel grass *Zostera japonica* is also present in the bay, and the non-native denseflower cordgrass *Spartina densiflora*, occurs in salt and brackish marshes surrounding the bay.

Invasive reed canary grass has been documented in many locations within the population area (e.g., Janes Creek). In-channel reed canary grass can cause excessive sediment deposition leading to loss of channel connectivity and capacity, and can also deplete dissolved oxygen levels for juvenile coho during the summer and fall.

Dams/Diversions

There are no large dams in the Eureka Plain HU. The Union Water Company constructed a small dam on Jolly Giant Creek in 1930. The 50-foot high structure, located above the zone of anadromy, within the Arcata Community Forest, is no longer used as a water impoundment. The City of Arcata and State Water Board recently upgraded the structure with a new standpipe and spillway that reduces the amount of sediment from mobilizing downstream.

From the 1920s through 2001, a flashboard dam had been installed on Freshwater Creek at Freshwater Park from June through September to create a swimming area. Prior to 2002, this summer dam was a barrier to potential upstream and downstream movement of juvenile salmonids. In order to enable fish passage, the County of Humboldt, owner and operator of Freshwater Park, worked with fisheries biologists and engineers (private, academic, State, and Federal) in 2001 to design, and build: (1) a temporary dam bypass structure (operated 2002-2007); and (2) a permanent concrete fish ladder, embedded in the streambank (2009). Neither the dam, nor the temporary bypass, were installed in 2008. Juvenile salmonids currently utilize the permanent fish ladder, and have been observed moving upstream and downstream of the flashboard dam (Humboldt County Department of Public Works 2010, 2011).

Diversions pose a medium threat to the juvenile life stage. According to the Department of Water Resources (DWR) data base, there are 53 appropriative water rights and diversion points in the Eureka Plain, but they are not all active. However, not all water diversions are registered with DWR. Riparian residential and agricultural uses can comprise significant amounts of water especially during low flow periods. Due to channel aggradation and subsequent limited instream water storage, water withdrawals in the summer months can reduce both the fluvial and tidal freshwater habitat available for rearing coho salmon. Consequently, the combination of reduced natural flow and anthropogenic withdrawals further reduces water quality (e.g., lowered dissolved oxygen) in the remaining habitat.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Road-Stream Crossing Barriers

Based on the culverts associated with the Humboldt County road system, this threat is ranked as low. Taylor (2000) identified five culverts in the Humboldt County road system, within the Humboldt Bay population area that remain as potential fish barriers but were ranked as low priority (Table 25-4).

Table 25-4. List of Humboldt County barrier road culverts in the Eureka Plain HU (Taylor 2000).

Stream Name	Road Name	Watersheds
Martin Slough #1	Herrick Road	Elk River
Martin Slough #2	Campton Road	Elk River
Golf Course Creek	Jacoby Creek Road	Jacoby Creek
Wood Creek	Myrtle Avenue	Freshwater Creek
McCready Gulch	Kneeland Road	Freshwater Creek

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Humboldt Bay Tributaries population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

High Severity Fire

The threat of High severity fire in the population area is minimal because climatic conditions do not favor frequent or high-intensity fires in this area. The present fire risks in this area are the result of past timber harvest activities and fire suppression.

25.7 Recovery Strategy

Recovery actions to reduce the stresses in the habitat of the Humboldt Bay Tributaries population should focus on restoring the natural watershed processes (i.e., the fluvial transport of wood, water, sediment, nutrients, and energy). Improved quality and quantity of habitat, as well as increased accessibility of seasonally important rearing habitats (backwater freshwater habitats, and tidally- influenced wetland habitats) will increase the growth and survival of individuals. Increasing abundance of individual coho salmon, as well as the potential for expression of diverse life history strategies through increased diversity of spatially and temporally available spawning and rearing habitats should enhance the resilience and increase the viability of this population. Because many designated land uses in the population area have not yet been realized (e.g., land not yet developed, timber not yet harvested), the opportunity for protection of habitat through innovative incentive programs, alternative land-use scenarios, and partnerships provides a means to reduce the stresses and begin restoring the natural landscape processes. The effects of fishing on this population’s ability to meet its viability criteria should be evaluated.

Table 25-5 on the following page lists the recovery actions for the Humboldt Bay Tributaries population.

Table 25-5. Recovery action implementation schedule for the Humboldt Bay Tributaries population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HBT.1.1.5	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Remove, set back, or reconfigure levees and dikes	Tidally influenced habitat in the lower portions of tributaries where coho salmon would benefit immediately	2c
SONCC-HBT.1.1.5.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees or dikes have been removed or set back*					
SONCC-HBT.1.1.5.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-HBT.1.2.40	Estuary	Yes	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	2c
SONCC-HBT.1.2.40.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-HBT.1.2.40.2	*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*					
SONCC-HBT.1.2.40.3	*Restore estuary and tidal wetland habitat guided by the plan*					
SONCC-HBT.1.2.45	Estuary	Yes	Improve estuarine habitat	Restore tidally influenced habitats	Former tidelands where coho salmon would benefit immediately	2c
SONCC-HBT.1.2.45.1	*Pursue land conservation tools (e.g., easements) within historic extent of Humboldt Bay in order to increase extent of functioning tidal habitat*					
SONCC-HBT.1.2.62	Estuary	Yes	Improve estuarine habitat	Restore tidally influenced habitats	Population wide	2d
SONCC-HBT.1.2.62.1	*Pursue land conservation tools (e.g., easements) within historic extent of Humboldt Bay in order to increase extent of functioning tidal habitat*					
SONCC-HBT.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2c
SONCC-HBT.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-HBT.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-HBT.1.3.4	Estuary	Yes	Increase tidal exchange of water	Remove or replace tidegates	Tidally influenced habitat in the lower portions of tributaries where coho salmon would benefit immediately	2c
SONCC-HBT.1.3.4.2	*Remove or replace tidegates, guided by the USFWS's Humboldt Bay National Wildlife Refuge Comprehensive Conservation Plan (2009)*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HBT.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2c
SONCC-HBT.2.2.2.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-HBT.2.2.2.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-HBT.3.1.21	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2c
SONCC-HBT.3.1.21.1	*Identify and characterize diversions and develop a plan to reduce amount of water diverted, which may include such measures as securing dedicated unused water diversion rights and negotiating acquisition or easement of water rights from willing sellers/owners*					
SONCC-HBT.3.1.21.2	*Reduce diversions as described in the plan*					
SONCC-HBT.3.1.66	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-HBT.3.1.66.1	*Identify and characterize diversions and develop a plan to reduce amount of water diverted, which may include such measures as securing dedicated unused water diversion rights and negotiating acquisition or easement of water rights from willing sellers/owners*					
SONCC-HBT.3.1.66.2	*Reduce diversions as described in the plan*					
SONCC-HBT.7.1.46	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Restore riparian vegetation in tidal zones	Tidally influenced lands, particularly Elk River estuary, Fay Slough, Freshwater Slough, and Eureka Slough	2c
SONCC-HBT.7.1.46.1	*Assess tidal marshlands, shrublands, and forestlands and develop a plan for restoration*					
SONCC-HBT.7.1.46.2	*Restore tidal marshlands, shrublands, and forestlands, guided by the plan*					
SONCC-HBT.26.1.56	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2c
SONCC-HBT.26.1.56.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-HBT.8.1.11	Sediment	No	Reduce delivery of sediment to streams	Improve grazing practices	Low gradient stream reaches in pasture lands where coho salmon would benefit immediately	2c
SONCC-HBT.8.1.11.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-HBT.8.1.11.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition, based on assessment*					
SONCC-HBT.8.1.11.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HBT.8.1.68	Sediment	No	Reduce delivery of sediment to streams	Improve grazing practices	Population wide	2d
SONCC-HBT.8.1.68.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-HBT.8.1.68.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition, based on assessment*					
SONCC-HBT.8.1.68.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-HBT.8.1.12	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	All streams where coho salmon would benefit immediately	2c
SONCC-HBT.8.1.12.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-HBT.8.1.12.2	*Implement plan to stabilize slopes and revegetate areas based on assessment*					
SONCC-HBT.1.1.57	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Remove, set back, or reconfigure levees and dikes	Population wide	2d
SONCC-HBT.1.1.57.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees or dikes have been removed or set back*					
SONCC-HBT.1.1.57.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-HBT.2.1.59	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-HBT.2.1.59.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-HBT.2.1.59.2	*Place instream structures, guided by assessment results*					
SONCC-HBT.1.3.58	Estuary	Yes	Increase tidal exchange of water	Remove or replace tidegates	Population wide	2d
SONCC-HBT.1.3.58.2	*Remove or replace tidegates, guided by the USFWS's Humboldt Bay National Wildlife Refuge Comprehensive Conservation Plan (2009)*					
SONCC-HBT.2.2.60	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-HBT.2.2.60.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-HBT.2.2.60.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HBT.8.1.61	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	2d
SONCC-HBT.8.1.61.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-HBT.8.1.61.2	*Implement plan to stabilize slopes and revegetate areas based on assessment*					
SONCC-HBT.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve channel function by redirecting urban streams into above-ground channels ('daylighting')	Lower watersheds in the developed areas of Eureka and Arcata where coho salmon would benefit immediately	3c
SONCC-HBT.2.2.3.1	*Assess feasibility of daylighting urban streams. Prioritize sites, develop daylight plans*					
SONCC-HBT.2.2.3.2	*Daylight streams, guided by assessment results*					
SONCC-HBT.2.2.65	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve channel function by redirecting urban streams into above-ground channels ('daylighting')	Population wide	3d
SONCC-HBT.2.2.65.1	*Assess feasibility of daylighting urban streams. Prioritize sites, develop daylight plans*					
SONCC-HBT.2.2.65.2	*Daylight streams, guided by assessment results*					
SONCC-HBT.5.1.43	Passage	No	Improve access	Reduce invasive species	All streams where coho salmon would benefit immediately	3c
SONCC-HBT.5.1.43.1	*Eradicate reed canary grass*					
SONCC-HBT.5.1.67	Passage	No	Improve access	Reduce invasive species	Population wide	3d
SONCC-HBT.5.1.67.1	*Eradicate reed canary grass*					
SONCC-HBT.5.1.10	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	3c
SONCC-HBT.5.1.10.1	*Inventory and prioritize barriers*					
SONCC-HBT.5.1.10.2	*Remove barriers, based on evaluation*					
SONCC-HBT.8.1.55	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	All streams where coho salmon would benefit immediately	3c
SONCC-HBT.8.1.55.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-HBT.8.1.55.2	*Implement plan to stabilize slopes and revegetate areas based on assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HBT.8.1.70	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-HBT.8.1.70.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-HBT.8.1.70.2	*Implement plan to stabilize slopes and revegetate areas based on assessment*					
SONCC-HBT.8.1.13	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	3c
SONCC-HBT.8.1.13.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-HBT.8.1.13.2	*Decommission roads, guided by assessment*					
SONCC-HBT.8.1.13.3	*Upgrade roads, guided by assessment*					
SONCC-HBT.8.1.13.4	*Maintain roads, guided by assessment*					
SONCC-HBT.8.1.69	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-HBT.8.1.69.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-HBT.8.1.69.2	*Decommission roads, guided by assessment*					
SONCC-HBT.8.1.69.3	*Upgrade roads, guided by assessment*					
SONCC-HBT.8.1.69.4	*Maintain roads, guided by assessment*					
SONCC-HBT.10.2.16	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	All areas where coho salmon would benefit immediately	3c
SONCC-HBT.10.2.16.1	*Identify pollution sources, and develop a strategy to minimize runoff to streams*					
SONCC-HBT.10.2.16.2	*Implement strategy to minimize pollution runoff to streams*					
SONCC-HBT.10.2.63	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	3d
SONCC-HBT.10.2.63.1	*Identify pollution sources, and develop a strategy to minimize runoff to streams*					
SONCC-HBT.10.2.63.2	*Implement strategy to minimize pollution runoff to streams*					
SONCC-HBT.10.7.54	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-HBT.10.7.54.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-HBT.10.7.54.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HBT.10.7.64	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-HBT.10.7.64.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-HBT.10.7.64.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-HBT.3.1.47	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	3d
SONCC-HBT.3.1.47.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-HBT.3.1.47.2	*If needed, develop plan to reduce effects of marijuana cultivation based on assessment*					
SONCC-HBT.3.1.47.3	*Implement plan*					
SONCC-HBT.7.1.7	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	3d
SONCC-HBT.7.1.7.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-HBT.7.1.7.2	*Develop watershed-specific guidance for managing riparian vegetation*					
SONCC-HBT.7.1.9	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
SONCC-HBT.7.1.9.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan)*					
SONCC-HBT.7.1.8	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3d
SONCC-HBT.7.1.8.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-HBT.7.1.8.2	*Thin, or release conifers, guided by the plan*					
SONCC-HBT.7.1.8.3	*Plant conifers, guided by the plan*					
SONCC-HBT.3.2.22	Hydrology	No	Increase water storage	Improve long-range planning	Population wide	3d
SONCC-HBT.3.2.22.1	*Develop ordinance, permit requirements, and guidance to maintain open space*					
SONCC-HBT.3.2.22.2	*Provide tax and permit incentives for protection of coho salmon and their habitat*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HBT.16.1.24	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-HBT.16.1.24.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-HBT.16.1.24.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-HBT.16.1.25	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-HBT.16.1.25.1	*Determine actual fishing impacts*					
SONCC-HBT.16.1.25.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-HBT.16.2.26	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-HBT.16.2.26.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-HBT.16.2.26.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-HBT.16.2.27	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-HBT.16.2.27.1	*Determine actual impacts of scientific collection*					
SONCC-HBT.16.2.27.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-HBT.8.1.14	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3d
SONCC-HBT.8.1.14.1	*Develop grading ordinance for maintenance and building of private roads that minimizes effects to coho*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-HBT.10.2.18	Water Quality	No	Reduce pollutants	Set standard	Elk River, Freshwater Creek, Jacoby Creek	3d
SONCC-HBT.10.2.18.1	*Complete TMDLs for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-HBT.3.1.19	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-HBT.3.1.19.1	*Encourage users to reduce stream diversions during the summer by providing educational materials describing how to increase water use efficiency*					
SONCC-HBT.7.1.6	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Educate stakeholders	Population wide	BR
SONCC-HBT.7.1.6.1	*Develop an educational program that teaches landowners about alternative land use and opportunities such as carbon credits and conservation easements*					
SONCC-HBT.3.2.23	Hydrology	No	Increase water storage	Educate stakeholders	Population wide	BR
SONCC-HBT.3.2.23.2	*Develop an outreach and education program about preservation of open spaces*					

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26. Lower Eel and Van Duzen River Population

Southern Coastal Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

7,900 Spawners Required for ESU Viability

726 mi^2 (11% Federal ownership)

394 IP-km (244 IP-mi) (50% High)

Dominant Land Uses are Timber Harvest and Agriculture

Key Limiting Stresses are ‘Impaired Estuary/Mainstem Function’ and ‘Lack of Floodplain and Channel Structure’

Key Limiting Threats are ‘Dams/Diversions’ and ‘Channelization and Diking’

Highest Priority Recovery Actions

• Reduce abundance of Sacramento pikeminnow • Setback or remove dikes and levees • Increase large woody debris (LWD), boulders, or other instream structure	• Restore salt marsh and tidal sloughs • Reconnect tidal channels and wetlands • Increase instream flows

26.1 History of Habitat and Land Use

Historically, the Lower Eel/Van Duzen River sub-basin consisted primarily of late-seral redwood/Douglas-fir (coniferous) forests with limited open oak woodland/prairies farther inland at higher elevations. Beginning near the turn-of-the twentieth century, timber harvest along stream corridors and easily accessible areas led to development of hardwood-dominated forests and reduced large wood recruitment potential to streams. In addition, floodplain and estuarine wetland areas were cleared, diked, and drained to provide land for agriculture and urban development. Technological developments after World War II enabled timber harvest and road building in steeper, more landslide prone areas. This caused excessive sediment delivery to streams, especially following large floods in 1955 and 1964, which resulted in shallow pools and wide streams. Levees were constructed along portions of the lower Van Duzen and Eel rivers to protect agricultural land and urban areas from flooding.

Since 1922, Eel River flows have been regulated and water has been diverted to the Russian River for hydroelectric power, municipal water supply, and agriculture via the Potter Valley Project. There are two major dams on the Upper Eel River associated with the Potter Valley Project: the Cape Horn Dam which impounds the 700 acre-foot Van Arsdale Reservoir and the Scott Dam which impounds the 75,000 acre-foot storage reservoir, Lake Pillsbury. Sacramento pikeminnow were introduced to Lake Pillsbury in 1979 (California Department of Fish and Game (CDFG) 1997b), and have since colonized all accessible reaches of the Eel River watershed. This predator thrives in the warmer waters in the Eel River.

Pools that were refuges and reaches that had large wood are lacking because of sedimentation, dams, historic wood removal from stream channels, and degraded riparian forests. These pools and large woody debris would have provided juvenile coho salmon some protection from native predators and the pikeminnow.

Establishment of rural residences, smaller ranches, and agriculture increased the need for water. Currently, much of this demand is accommodated through in-stream diversions or shallow wells, which have lowered stream flows during summer low-flow periods. The Potter Valley Project also diverted 160,000 acre feet of water from the Eel River to the Russian River prior to 2002 (FERC 2000).

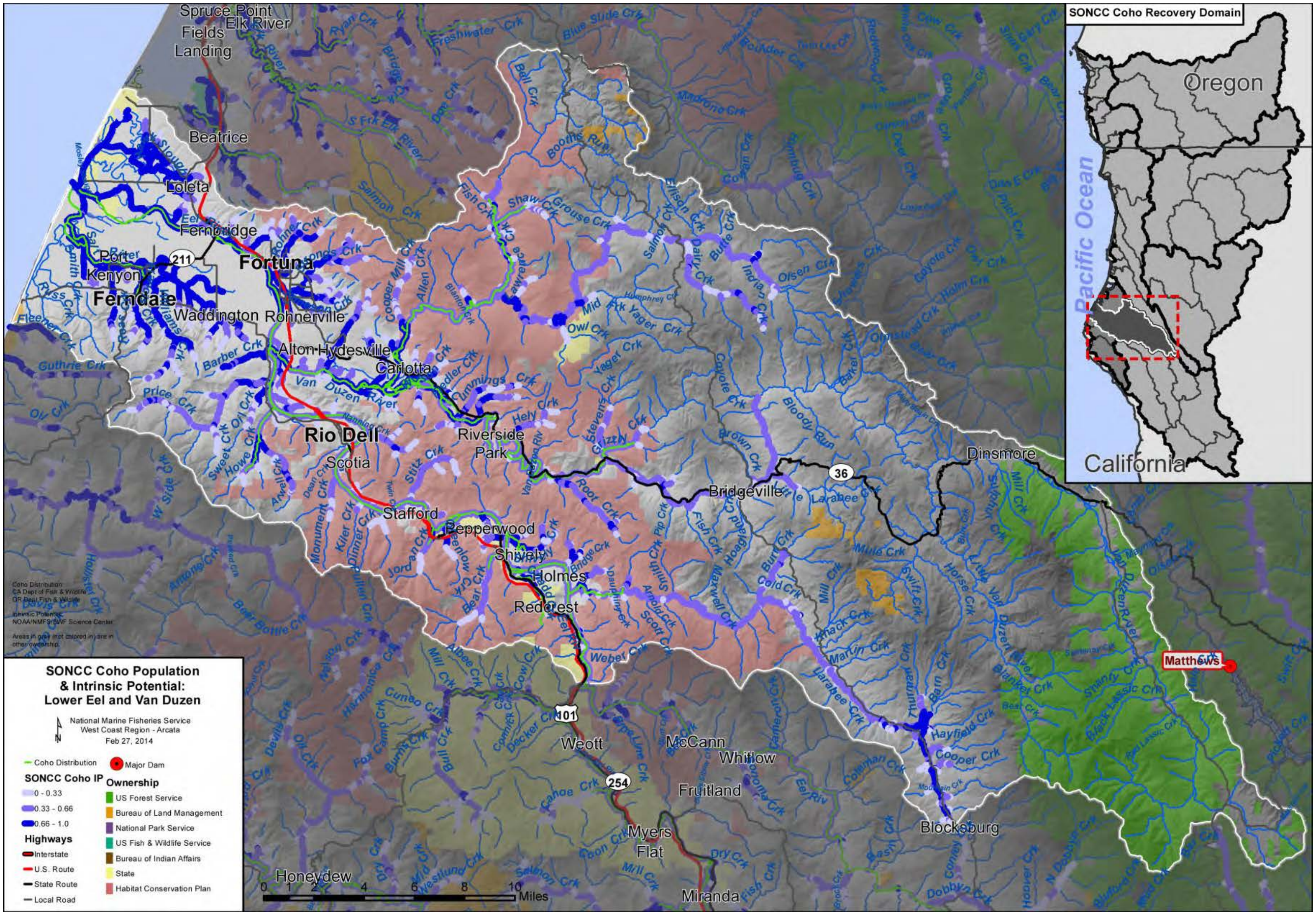

Figure 26-1. The geographic boundaries of the Lower Eel and Van Duzen rivers coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Southern Coastal diversity stratum (Williams et al. 2006. Grey areas indicate private ownership.

In the estuary, salt marsh was drained and riparian vegetation cleared to convert tidelands to pasture (Figure 26-2). The estuary appears to be mixing during the dry months and is stratified, or creates a "salt wedge" during wetter months (Gossard 1986). Tideland reclamation and the construction of dikes and levees have changed the function of the estuary considerably. Slough and creek channels that once meandered throughout the delta are now confined by levees, sufficiently slowing flow to a point that many have become filled with sediment. Remnant slough channels are visible throughout the delta. The estuary and tidal prism have been reduced by over half of their original size (CDFG 2010b).

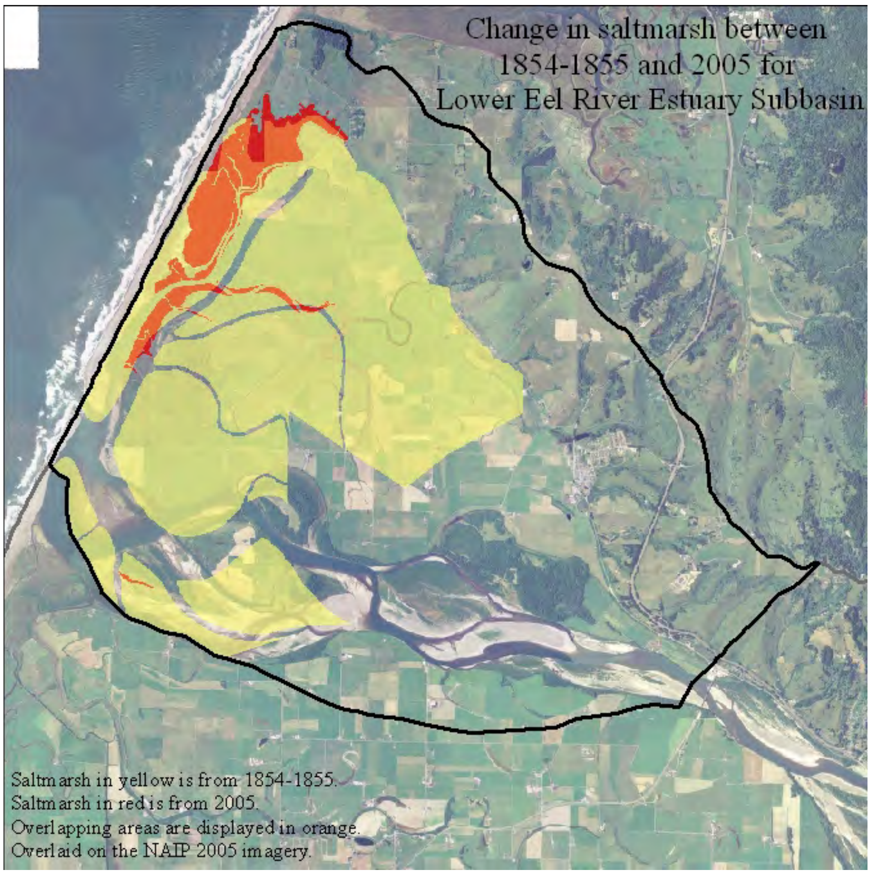

Figure 26-2. Change in salt marsh in the Eel River estuary between 1854 and 2005.

26.2 Historic Fish Distribution and Abundance

Historically, coho salmon occupied much of the Lower Eel and Van Duzen River sub-basin (CDFG 2010b). However, information on historic coho salmon distribution and abundance is limited. Coho salmon have been observed intermittently over the past few decades, but coho salmon are absent in many historically occupied tributaries. In 1965, CDFG estimated the escapement to be 500 each for the mainstem Eel River and the Van Duzen River (CDFG 1965). Two decades later, the escapement estimate for 1984 to 1985 declined to 200 for each (Wahle and Pearson 1987).

Survey records indicate coho salmon spawned in Carson, Bear, Chadd, and Shaw creeks (CDFG 1994, Brown et al. 2007). In a recent 2011 spawning survey conducted by CDFW in Fish Creek, a tributary to Lawrence Creek (and Van Duzen River), a total of eight adult coho salmon were observed spawning in a 1-km reach of IP habitat. If multiple surveys had been conducted in a more systematic fashion, it is likely that several more adult coho salmon spawners may have been detected in Fish Creek. This recent observation provides some optimism that the status of coho salmon in the population may be more stable than previously believed. The small number of fish observed in this population may be more a result of limited survey efforts rather than the actual number of fish in the population.

In addition, juveniles have been observed in the Van Duzen River, Grizzly, Cummings, Cuddeback, Fiedler, Howe, Wolverine Gulch, Oil, Atwell, Newman, Poison Oak, Strongs, Reas, Francis, Palmer, Rohner, and Jordan creeks (CDFG 1972, Brown and Moyle 1991, PALCO 2006a, Crowser 2005, Downie and Gleason 2007) as well as the Eel River estuary (Puckett 1977), the slough portion of Salt River (CDFG 1977), Centerville Slough (CDFG 1984) and North Slough channels (Puckett 1977). Estuary use by juveniles has been observed in multiple seasons from winter to summer (Puckett 1977, CDFG 2010b).

High IP reaches are found in the Salt River watershed, the lower Van Duzen River, lower Eel River and estuary sloughs, and upper Larabee Creek (see Table 26-1 for all tributaries with instances of high IP habitat).

Table 26-1. Tributaries with high IP reaches (IP > 0.66). (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Reas Creek	Rohner Creek	Burr Creek
Francis Creek	Strongs Creek	Boulder Flat Creek
Williams Creek	North Fork Strongs Creek	Cooper Creek
Salt River	Jameson Creek	Van Duzen River
Sweet Creek	Rogers Creek	Yager Creek
Howe Creek	Stevens Creek	Cummings Creek
Atwell Creek	Root Creek	Hely Creek
Manning Creek	N. Fk. Yager Creek	Fox Creek
Price Creek	Dairy Creek	Wilson Creek
Nanning Creek	Lawrence Creek	Cuddeback Creek
Hawks Slough	Blanton Creek	Fiedler Creek
Van Duzen River	Yager Creek	Chadd Creek
Penny Slough	Cooper Mill Creek	Bridge Creek
Coffee Creek	Larabee Creek	Greenlow Creek
Oil Creek	Carson Creek	Jordan Creek
Barber Creek	Thurman Creek	Stitz Creek
Eel River	Chris Creek	Burr Creek

26.3 Status of Lower Eel and Van Duzen River Coho Salmon

Spatial Structure and Diversity

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 20 coho salmon per-IP-km of habitat are needed (7,900 spawners total) to approximate the historical distribution of Lower Eel/Van Duzen River coho salmon. The current distribution of spawners is unknown, but it is expected to be extremely limited because the habitat has been severely degraded in most of the high to moderate IP reaches.

Population Size and Productivity

The Lower Eel/Van Duzen River coho salmon population size is unknown, but it is likely extremely reduced compared to historic levels. Breeding groups have been lost or severely depressed in some Lower Eel/Van Duzen River streams (CDFG 2002). Population growth rate is unknown, but it is expected to be negative in most years given the likely extremely low abundance of spawners. Therefore, the Lower Eel/Van Duzen River coho salmon population is at an elevated risk of extinction given the extremely low population size and negative population growth rate.

If a spawning population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 394 coho salmon must spawn in the Lower Eel/Van Duzen River each year to avoid such effects of extremely low population sizes.

Extinction Risk

The Lower Eel/Van Duzen River coho population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Lower Eel/Van Duzen River population is a core, Functionally Independent population within the Southern Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Lower Eel/Van Duzen River core population should have at least 7,900 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Lower Eel/Van Duzen population may serve as a source of spawner strays for nearby coastal populations, as well as other populations in the Eel River basin. At present, the capacity of the Lower Eel/Van Duzen River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from nearby rivers may enhance recovery of the Lower Eel/Van Duzen River population. The tributaries and estuary located within this population may serve as essential non-natal rearing habitats for all populations in the Eel River watershed. Large-scale movements into non-natal streams have been documented in the Klamath River, tributaries to Humboldt Bay, and a variety of other locations where the 'nomad' life history pattern has been documented (Koski 2009). It is likely that Lower Eel and Van Duzen tributaries and estuarine habitats are key non-natal habitat for the populations within the entire Eel River watershed.

26.4 Plans and Assessments

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The strategy contains recovery actions to improve coho salmon habitat in the Lower Eel and Van Duzen Rivers.

California Department of Fish and Game Eel River Salmon and Steelhead Restoration Action Plan

In 1997, the California Department of Fish and Game completed their assessment of the Eel River watershed and provided recommendations for restoration of salmonid stocks. The issues and recommended action plans for the Eel River watershed are incorporated into this plan. Primary recommendations include removing barriers, reducing sediment inputs, improving riparian forest conditions, reducing water withdrawals, habitat enhancement, and suppressing Sacramento pikeminnow.

The North Coast Watershed Assessment Program (NCWAP)
http://www.coastalwatersheds.ca.gov

Lower Eel River Basin Assessment Report and Van Duzen River Basin Assessment Report

The NCWAP Lower Eel River Basin (CDFG 2010b) and Van Duzen River (CDFG 2012b) Assessment Reports identify limiting factors for anadromous salmonids including estuarine conditions, lack of habitat complexity, increased sediment levels, and high water temperatures.

Environmental Protection Agency (USEPA)

In 1999 and 2007, the USEPA published the final Total Maximum Daily Loads (TMDL) for the Van Duzen and the Lower Eel River watersheds, respectively. The North Coast Regional Water

Quality Control Board is required to develop measures which will result in implementation of these TMDLs in accordance with the requirements of 40 CFR 130.6.

Humboldt Redwood Company (HRC)

Habitat Conservation Plan

Pacific Lumber Company (PALCO) finalized a Habitat Conservation Plan (HCP) covering SONCC coho salmon and their habitats in 1999. Since then, in 2008 the Humboldt Redwood Company (HRC) acquired the bankrupt PALCO and formally adopted the PALCO HCP. The HCP requires that forest roads are treated to minimize erosion at the rate of 75 miles of road treatments per year, resulting in 1,500 miles of road treatments in the first two decades of the HCP permit term. The HCP also identifies measures which will help trend aquatic habitat conditions towards ‘properly functioning conditions’.

Green Diamond Resources Company (GDRC)

Green Diamond Habitat Conservation Plan (HCP)

The GDRC HCP (GDRC 2006) contains measures that will aid in conservation of aquatic species in the Lower Eel and Van Duzen watersheds. The plan has a number of provisions designed to protect coho salmon and salmon habitat on GDRC land in the Mad River basin. The plan was developed in accordance with section 10(a)(1)(B) of the ESA and contains a conservation strategy to minimize and mitigate the potential adverse effects of any authorized take of aquatic species that may occur incidental to GDRC’s activities. The authorized take and its probable impacts will not appreciably reduce the likelihood of survival and recovery in the wild of aquatic species. Elements of the HCP are expected to contribute to efforts to reduce the need to list currently unlisted species in the future under the ESA by providing early conservation benefits to those species. GDRC covered lands in the Lower Eel/Van Duzen River population are located in Rohner Creek, Cummings Creek, Stevens Creek, Slater Creek, and Wilson Creek. More information about the GDRC HCP can be found in Section 3.2.5.

26.5 Stresses

Table 26-2. Severity of stresses affecting each life stage of coho salmon in the Lower Eel and Van Duzen rivers. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Sediment Supply	Very High	Very High	Very High	Medium	Very High	Very High
2	Impaired Estuary/Mainstem Function[1]	-	Medium	Very High[1]	High	Medium	High
3	Lack of Floodplain and Channel Structure [1]	Medium	High	High[1]	High	High	High
4	Degraded Riparian Forest Conditions	-	High	High	High	High	High
5	Impaired Water Quality	Medium	High	High	High	High	High
6	Increased Disease/Predation/Competition	Low	High	High	Very High	Low	High
7	Altered Hydrologic Function	Low	Medium	High	Medium	Low	Medium
8	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
8	Barriers	-	Low	Low	Low	Low	Low
10	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses include an impaired estuary/mainstem function and a lack of floodplain and channel structure. Dikes and levees have disconnected the mainstem channel from its floodplain and also significantly reduced the size and extent of the estuary. Sedimentation and poor land management practices resulted in a loss of channel complexity throughout most of the population area. Based on the type and extent of stresses and threats affecting the population as well as the key limiting stresses influencing productivity, it is likely that the juvenile life stage is the most limited. Juvenile coho salmon summer and winter rearing success is most limited by a lack of off channel and estuarine rearing habitat, elevated water temperatures, decreased flows from diversions, and an increased sediment supply that deteriorates the habitat quality in the tributaries. All of these factors contribute to preferable conditions for pikeminnow. Complexity of freshwater channels and a diverse estuary with suitable cover and deep channels and sloughs is important to juvenile coho salmon, increasing their size and fitness prior to ocean entry, and overall marine survival.

Complex stream channels with deep pools and woody structure as well as tidally influenced wetlands with off channel ponds are important refuge areas for juvenile coho salmon. Properly functional rearing habitat buffers other stresses affecting the population. Juvenile coho salmon would be more protected against predation, competition, and warm mainstem water temperatures if there were additional refugia areas. Currently, refugia areas for coho salmon are limited in the Lower Eel/Van Duzen River population area.

Altered Sediment Supply

Excessive sediment poses a medium stress to smolts and a very high stress to all other life stages of coho salmon in this population. Except for two sampling sites with moderate percentages of fines (<1mm), all sampling sites throughout the lower Eel and Van Duzen rivers have excessive levels of fines and sand (>6.4 mm). High sediment loads result in excessive embeddedness and reduce pool depths. High sediment levels impair feeding, simplify habitat, reduce reproductive success, and result in adverse physiological stress responses. The USEPA listed the Lower Eel and the Van Duzen rivers as impaired by sediment. The Eel River is one of the most erodible watersheds in the United States (Brown and Ritter 1971) because of the highly active tectonic setting, highly erodible soils in the area, and high precipitation. The Eel River carries fifteen times as much sediment as the Mississippi River and more than four times as the Colorado River (Brown and Ritter 1971). Anthropogenic activities in the Lower Eel/Van Duzen River population have exacerbated these naturally high sediment loads. A study of the continental shelf deposits offshore from the mouth of the Eel River indicates that there has been a sudden, three-fold increase in the rate of sedimentation since 1954 (USEPA 2007b). Most of the deep pools that existed in the estuary were filled by sediment brought by the flood waters of 1964. Excessive amounts of sediments generated by land use are still delivered to the estuary from upstream sources (USEPA 2007b).

Aggradation has interrupted the connectivity of surface flow in several areas. The Van Duzen River is often isolated from the Eel River by subsurface flows in late summer and early fall. An abundance of gravels and sediment are deposited at the confluence of the Van Duzen and Eel River which results in sub-surface flows and dry channels (Downie and Gleason 2007). Sedimentation has also restricted access to the Salt River downstream of Williams Creek and has severely restricted fish access to Salt River tributaries. Salmon Forever has been monitoring Francis Creek since January 2007, and preliminary results show maximum turbidity levels have reached 2200 Nephelometric Turbidity Unit (NTU) during a single storm. Combined with flow data, 2200 NTU is equivalent to 8.5 tons of sediment moving downstream every 10 minutes (Downie and Gleason 2007).

Impaired Estuary/Mainstem Function

This stress refers to the estuary and mainstem conditions in the Eel River, since this population is a part of a larger basin containing multiple populations (see chapter 3 for further description of this stress). Conditions in the Eel River mainstem and estuary are important to this population since all coho salmon that originate from the Eel River migrate to and from the ocean through the mainstem Eel River and Eel River estuary.

The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon populations. The degraded function of the Eel River estuary and mainstem migratory corridor today constitutes a very high stress for juveniles, a high stress for smolts, medium stress for adults, and a medium stress for fry. The Eel River estuary is severely impaired because of past diking, and filling of tidal wetlands for agriculture and flood protection. Approximately 60 percent of the estuary has been lost through the construction of levees and dikes and CDFG (2010b) estimates that only 10% of salt marsh habitats remain today. The estuary once supported a high degree of estuarine habitat and rearing potential, but very little of that historic function still exists. The function of the estuary (e.g., rearing, refugia, ocean transition) for coho salmon that originate in the Lower Eel/Van Duzen River is very important given the degraded habitat conditions and predation and competition from non-native Sacramento pikeminnow occurring upstream of the estuary in the mainstem river. Juveniles, smolts, and adults transitioning through mainstem and estuarine habitat are stressed by the degraded conditions in these migratory habitats. Juveniles and smolts suffer from the lost opportunity for increased growth, which would improve their survival at ocean entry. The loss and degradation of the formally-extensive and complex estuarine and mainstem habitat is a high stress for the population, with the most affected life stages being juveniles, smolts, and adults due to the degradation of rearing and migratory habitat.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions exist across the population area, and present a high stress to fry, juvenile, smolt, and adult coho salmon. Where data exist, streamside canopy cover shows a range of conditions, with some good cover in the headwater areas of some tributaries, primarily in the Lawrence Creek watershed, and poor cover and shade conditions in the mainstem channel of all of the major tributaries in the Lower Eel/Van Duzen River watershed, and in the mainstem of the Lower Eel downstream of about Alton, California. Riparian habitat has somewhat rebounded from past large flood events (e.g., 1964). However, even where streamside canopy cover is good, it consists of open and hardwood dominated riparian forest conditions. Mature coniferous riparian forests provide the size and amount of large wood necessary for coho salmon rearing habitat, shade streams, reduce sediment delivery, and provide terrestrial subsidies. Hardwood and small conifer-dominated riparian forests provide limited large wood recruitment into the Lower Eel/Van Duzen River.

Riparian corridors in the Salt River watershed are, in places, lacking riparian vegetation; particularly the tributaries in the wildcat geological formation. The trans-delta reaches of the Salt River tributaries, such as in Reas Creek, tend to have little to no riparian vegetation.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in the population area and upstream of the population area. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate. SOD was recently (2011) detected in tributaries to the Van Duzen River.

Impaired Water Quality

Impaired water quality, specifically high water temperature, poses a high stress to all rearing life stages and a medium stress to eggs. The Lower Eel River and the Larabee Creek watershed are listed as impaired for elevated temperature under section 303(d) of the Clean Water Act. Water temperature in the Lower Eel/Van Duzen River and its tributaries approach lethal levels in a number of stream reaches and is stressful in most others, and severely limits the amount of habitat available to rearing coho salmon. An airborne thermal infrared remote sensing study of the main channel, as well as in-water monitoring, indicate water temperature is near lethal levels for rearing coho salmon in most of the mainstem of the Lower Eel River (USEPA 2007b).

However, modeling efforts show these water temperatures are only marginally higher than they would be with full riparian cover; because the mainstem of the Lower Eel is naturally very wide, much of it was likely not shaded even before the 1800s (USEPA 2007b). Tributaries in the coastal zone such as Salt River are important because of their cold water contribution to the mainstem. Temperature problems in the tributaries were attributed to inadequate shading due to removal of riparian vegetation, and to excess sediment which widens streams, fills pools, and makes the river shallower. The loss of deep pools removes cooler-water refugia, which coho salmon could use to persist in areas with otherwise uninhabitable water temperatures. Many tributaries in the population have suitable water temperature as evidenced by the monitoring being conducted by both HRC and GDRC related to their HCP's.

Additionally, water quality problems from agricultural runoff have been identified in the Salt River watershed and conductivity, turbidity, and dissolved oxygen may be limiting factors in the middle sub-basin. Therefore, water quality is likely a limiting factor, specifically nutrient enrichment, excess sediment, elevated water temperatures, and low dissolved oxygen.

Increased Disease/Competition/Predation

Competition and predation from non-native California roach and Sacramento pikeminnow poses a high stress to fry and juveniles and a very high stress to smolts. These invasive species have the greatest impact in watersheds such as the Lower Eel/Van Duzen, with the most impaired habitat conditions, because the altered conditions favor production of these non-native species over indigenous salmonids.

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure is a high stress for juveniles, smolts, adults, and fry; and a medium stress for eggs. The floodplains and channels have been degraded due to excessive sediment loads, coupled with the paucity of large wood and riparian vegetation. Except for one reach with fair levels of embeddedness, all surveyed reaches of Yager Creek and smaller tributaries to the Eel River have excessive embeddedness. These same surveyed reaches have mostly fair (2.01 to 3 ft.) or poor (<2 ft.) pool depths and mostly poor pool frequencies (<35 percent by length). Levees in the Lower Eel River from Fortuna to the Pacific Ocean significantly alter floodplain and channel structure (through altered connectivity) and significantly reduce the size of the estuary. Habitat complexity, via pools, large wood cover, and floodplains, is essential for juvenile rearing to optimize forage, avoid predation, and access thermal and velocity refuges.

Altered Hydrologic Function

Altered hydrologic function (the timing and availability of water) poses an overall medium stress to coho salmon. Base flows in tributaries to the Lower Eel/Van Duzen River are affected by rural and urban water withdrawals. Due to all the land changes that have occurred since the

1800s, the way that water runs off the land is altered compared to historic conditions; overall, peak flows are higher and base flows are lower. The Potter Valley Project diverted as much as 160,000 acre feet of water from the Eel River and into the Russian River prior to 2002 (FERC 2000). After 2002, the diversion has decreased depending on the water year type.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Barriers

Barriers to fish passage do not present a major impediment to restoration and recovery of the Lower Eel/Van Duzen River coho salmon population, as reflected by their low stress ranking. Tidegates that separate the estuary from the river can be problematic because they can block juvenile access and therefore make it more difficult for them to utilize the estuary. In addition, tide gates reduce the tidal prism of the estuary which is important for maintaining water quality, channel maintenance, and overall estuarine function. Many tributaries to the mainstem Eel River become disconnected and inaccessible in the summer months due to sediment deposition and the resulting sub-surface flows. If the tributaries were accessible, they may provide refuge which is very limited in the Eel River mainstem reaches.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Lower Eel/Van Duzen River population area. Hatchery-origin coho salmon may stray into the Lower Eel/Van Duzen River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

26.6 Threats

Table 26-3. Severity of threats affecting each life stage of coho salmon in the Lower Eel and Van Duzen rivers. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads	Very High	Very High	Very High	Very High	Very High	Very High
2	Channelization/Diking [1]	Medium	High	High[1]	High	Medium	High
3	Dams/Diversion [1]	Low	High	High[1]	Medium	High	High
4	Timber Harvest	High	High	High	High	Medium	High
5	High Severity Fire	Medium	Medium	Medium	Medium	Medium	High
6	Invasive Non-Native/Alien Species	Low	Very High	High	High	Low	High
7	Agricultural Practices	Medium	High	High	High	Medium	High
8	Urban/Residential/Industrial Dev.	Medium	High	High	High	High	High
9	Mining/Gravel Extraction	Medium	Medium	Medium	Medium	Medium	Medium
10	Climate Change	Low	Low	High	Medium	Medium	Medium
11	Fishing and Collecting	-	-	Low	Low	Medium	Low
12	Hatcheries	Low	Low	Low	Low	Low	Low
13	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
[1]Key limiting threats and limited life stages							

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are channelization/diking and dams/diversions.

Roads

Roads constitute a very high threat across all life stages. Road density is very high (>3 miles per square mile) in the Lower Eel/Van Duzen River sub-basin. Unpaved roads deliver large volumes of sediment to stream channels. Roads also alter the hydrology of stream systems resulting in higher peak flows and lower summer base flows. Unregulated road construction associated with marijuana cultivation contributes to the very high threat rankings of roads in this population.

Channelization/Diking

Channelization and diking is identified as high threat in the population area. The existence of extensive channelization and diking in the Lower Eel River, tributaries to the Eel River, especially in the Salt River watershed, and the estuary severely limits the function of the floodplain and estuary for production of coho salmon. For example, Reas Creek is contained in levees the entire length across the delta, and realigned with two 90 degree turns. The channelization and lengthening of the trans-delta reach of Reas Creek is suspected of causing problems related to sediment deposition and discharge within Reas Creek as well as in the Salt River. Williams Creek was leveed in 1999 from the mouth to 2,500 feet upstream. In addition, Williams Creek was diverted from the Salt River and now drains to the Eel River through the Old River, resulting in altered hydrology and sediment transport in the Salt River. Rohner Creek has been realigned and channelized through the City of Fortuna.

In 2006, the CDFG received permits to expand, raise, and widen the levee network in the vicinity of the Eel River Wildlife Area to address breaches of the levees which occurred in 1994 and 1998. The levees were enhanced to ensure that tidal action would not compromise the integrity of the levees and also to assist in keeping freshwater impoundments from being exposed to saltwater. Levees in the Eel River estuary are known to reduce the extent and intensity of tidal flushing which causes sedimentation and the resulting widening and reductions in depth. The Eel River estuary appears to be shrinking due to continued sedimentation and the number of species it harbors has apparently diminished from historic numbers (Puckett 1977). The exchange of tide water scours sediment and transports it to the ocean which helps maintain the depths of estuarine channels. In the late 1890s a court agreed that the construction of levees and the ensuing reduction of the tidal prism were responsible for the filling of the channels near the Salt River area (CDFG 2010b).

The Humboldt County Resource Conservation District is the lead agency on the Salt River Ecosystem Restoration Project. In the late 1800s the Salt River was a functioning river and large enough to accommodate small ocean vessels and steamers. At Port Kenyon, the Salt River was approximately 200 feet wide and 15 feet deep. Now the Salt River is so small that a person could jump over it. Over time fine sediments have eroded from the surrounding Wildcat Hills into the tributaries and deposited in the Salt River channel. Vegetation has sprouted up in the channel which traps more sediment, impedes fish passage and increases flooding on the surrounding agricultural lands, roads, and residences.

Reducing the amount of sediment that reaches the tributaries and the Salt River is one step in creating an open and functioning channel. This ecosystem-scale project includes a large tidal wetland restoration component that will create a succession of biologically rich and diverse tidal wetland habitats, including transitional wetlands and adjacent uplands as part of a sustainable estuary system. To offer some insight on the level of sedimentation involved, consider the following: in hydrologic year 2010 the annual suspended sediment yield from the Francis Creek watershed was 38 million pounds. This equates to an annual suspended sediment yield of 6,091 tons/sq. mile. By comparison, the sediment impaired Freshwater Creek and Elk River watersheds in Humboldt County have yields of 300-600 tons/sq. mile/year, and the Eel River carries 4,330 tons of sediment/sq. mile/year (Buffleben 2009).

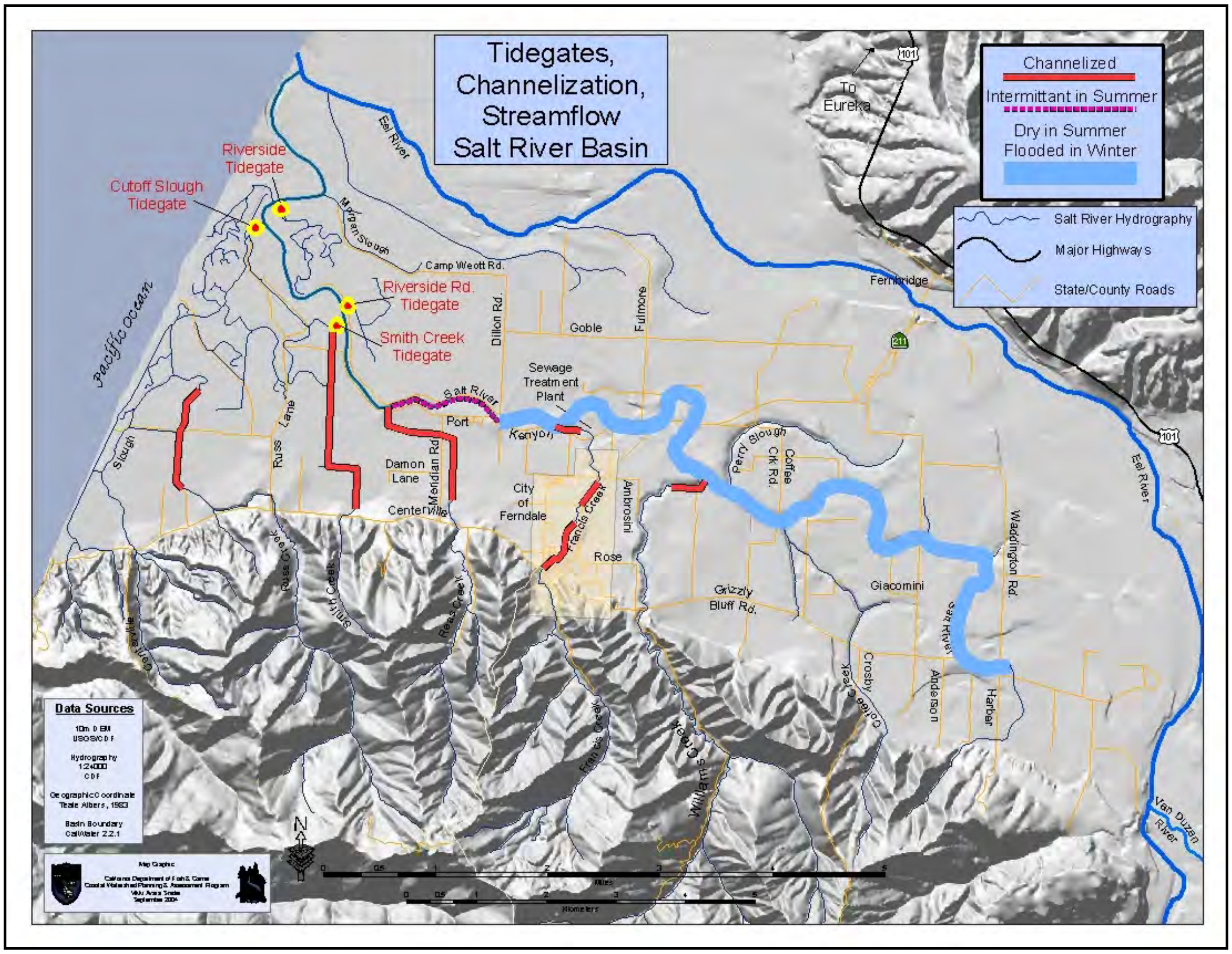

Figure 26-3. A map of tide gates and channelization in the Salt River watershed.

Figure 26-4. Photo of a tidegate on Cutoff Slough in the Lower Eel River estuary.

Dams/Diversions

Dams and diversions pose a medium threat to smolts and a high threat to all other life stages of coho salmon. Scott Dam and the Potter Valley Project altered the mainstem hydrologic regime under which the Lower Eel/Van Duzen River coho salmon evolved. In addition, localized water diversions for rural residential and agricultural operations reduce streamflow during juvenile rearing periods. Tide gates restrict juvenile coho salmon use of the estuary and levees reduce the tidal prism necessary for flushing the high sediment load to the ocean (Figure 26-3 and Figure 26-4).

Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the extent of marijuana production is unknown, the water diversion required to support these plants appears to be placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Timber Harvest

Timber harvest is a high threat to most life stages. Many of the changes that have occurred to instream and riparian conditions in the Lower Eel/Van Duzen River reflect legacy effects of more intensive harvest from previous decades. However, given the percentage of the watershed that is privately owned by timber companies and actively managed as such, future timber harvest activities will continue to exacerbate the stresses caused by legacy timber harvest activities. Nearly half of the sub-basin has been logged on over 35 percent of its area, and continuing harvest on these areas has the potential to affect high IP-areas downstream by contributing to sediment deposition and reducing sources of large wood. HCP holders in the population area (HRC and GDRC) are expected to help reduce the threat of timber harvest through those conservation measures and mitigations developed for each plan.

Forest lands in the Van Duzen watershed are being cleared and graded to create new marijuana cultivation sites. In many cases the land disturbance and clearing of trees is not regulated, and likely contributes fine sediment to channels already burdened by sediment problems. Land clearing for marijuana operations also may result in a loss of shade and wood recruitment.

High Severity Fire

Fires pose a medium threat to all life stages. The dense understory vegetation throughout the population area increases the probability for high severity fires to alter sedimentation processes as well as riparian vegetation characteristics. Most of the population area is within the coastal influence and dominated by redwoods. Because only a fraction of the population area is subject to high severity fire, it was not considered a significant threat.

Invasive/Non-native Species

Sacramento pikeminnow thrive in the degraded habitat conditions in the Lower Eel/Van Duzen River, resulting in significant levels of competition and predation on coho salmon. The non-native Sacramento pikeminnow is a threat to fry, juveniles, and smolts because they compete with and prey on the young coho salmon. Sacramento pikeminnow were introduced to Lake Pillsbury in 1979 (Brown and Moyle 1997), and has spread throughout all accessible reaches of the Eel River watershed. The warm water temperatures in the Eel River and Lake Pillsbury allow this predator to thrive in this system. The widespread distribution and success of the Sacramento pikeminnow makes eradication extremely difficult.

Cordgrass (*Spartina densiflora*) is an introduced and invasive salt marsh plant that has spread across the estuarine wetlands. *S. densiflora* tends to displace native marsh species, can exacerbate sediment accumulations in wetlands, and may cause other undesirable changes to the estuarine ecosystem. Eradication projects have cleared areas of invasive cordgrass around Humboldt Bay. No efforts have been planned to control *S. densiflora* in the Eel River estuary. There are also a number of other invasives including non-native eel grass and reed-canary grass that may affect the success of restoration actions.

Agricultural Practices

Grazing occurs throughout the population area and increases sediment generation and delivery. In addition, much of the estuary is directly influenced by agriculture in historical tidelands. Agricultural land makes up 28 percent of the Lower Eel River sub-basin, and increases in area closer to the mouth (Downie and Gleason 2007). Livestock have unrestricted access to many of the Lower Eel River tributaries and estuary sloughs, resulting in stream bank erosion. Much of the Lower Eel River sub-basin has been cleared of riparian vegetation to create pastureland for cattle, and waste from the dairy industry has affected water quality. In the past, waste from dairies would flow into low lying areas, which are often former slough channels. During times of heavy precipitation, these often became active sloughs that would transport waste into the estuary.

Grazing cattle is common in many of the tributaries and grassy openings throughout the population area, including the valley bottoms and ridges of the mainstem Eel and Van Duzen rivers. Grazing beef or dairy cattle is the most common land use in the lower sub-basin and estuary (CDFG 2010b), where rich grasslands thrive in the delta of the Eel and Van Duzen rivers. Although this area has rich grasslands which can support a significant cattle industry, the effects of cattle grazing are very apparent. There are only a few areas with riparian exclusion fencing and livestock are commonly allowed unrestricted access to the creek.

Marijuana may be the primary crop cultivated in the area, and it has been implicated as a source of excessive nutrient inputs to streams. An excess of nutrients can degrade water quality by fueling toxic algal blooms that increase biological demand either through respiration or decomposition. Algae blooms are naturally occurring, however, excess nitrogen can increase the extent and severity of effects (i.e., decreased dissolved oxygen). The Van Duzen River has chronic issues with toxic blooms of blue-green algae. Blue green algal blooms are related to excess nitrogen and poor water quality conditions.

Urban/Residential/Industrial Development

Urban/residential/industrial development is a high threat because much of the watershed with high IP value is located in and around the cities of Ferndale and Fortuna. Future growth of this area is likely, with northerly migration from southern metropolitan areas due to declining water supplies. In addition, further rural residential development is likely as large agricultural holdings are subdivided into smaller ranches. All of this will combine to further increase road building, land clearing, and other development. Marijuana production is also common in many urban and residential areas.

When flows are sufficiently high, the Eel River floods the treatment ponds of the Fortuna Wastewater Treatment Plant (Downie and Gleason 2007). The Fortuna Wastewater Treatment Plant is working on raising the elevation of the surrounding levees to prevent flooding into the treatment ponds. In the winter months, the effluent from the Ferndale wastewater treatment plant is directed into Francis Creek, which historically had sufficient flow to meet dilution requirements year round. Sediment deposition has reduced the cross sectional area of the creek and now the wastewater treatment plant effluent exceeds one percent of receiving flows during winter months, which is a violation of Waste Discharge Requirements. The wastewater treatment facility has accumulated 241 water quality violations since 1996 (Spencer Engineering 2004). Improvements to the existing facility have been made in recent years and the number of water quality violations has declined. In addition, the City of Ferndale and the NCRWQCB have agreed on a design for tertiary treatment of effluent which will result in an improvement to water quality conditions in Francis Creek and the Salt River.

Treatment and percolation ponds are also constructed at the Town of Scotia to ensure that effluents from the mill and town site are allowed to settle and percolate into the sub-surface zones of the gravel bar to comport with NCRWQCB requirements, which does not allow treated or untreated effluents to be discharged into the Eel River. As high winter flow regimes approach in the fall, the percolation ponds are dismantled and allowed to be discharged into the Eel River when flows become high enough to capture the ponds.

Mining/Gravel Extraction

Past gravel mining in the Lower Eel sub-basin likely contributed to braiding and flattening of the Eel River between the confluence with the Van Duzen River to one mile downstream of Fernbridge (Humboldt County 1992). A shallow, wide channel provides less cover from predation, less food, and higher water temperatures for juvenile fish as the channel is often decoupled from riparian vegetation. Braiding reduces water depth and can become a migration barrier for adult fish, sometimes leading to stranding on shallows and mortality. A significant level of gravel extraction occurs in the Lower Eel/Van Duzen River, but is conducted with State and Federal oversight. The medium threat ranking reflects sensitivity of the channel to additional disturbances (i.e., lack of floodplain and channel structure). However, gravel extraction has been used successfully to address some of the problems associated with the high sediment load in the Lower Eel/Van Duzen River including an adult migration barrier that occasionally develops at the Van Duzen/Eel River confluence. Gravel mining methodologies have evolved over time to accommodate the narrowing and deepening of channels by using wet trenching techniques.

Climate Change

Climate change poses a medium threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. Although the current climate is generally cool, modeled regional average temperature shows a moderate increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 1.6 °C in the summer and by 1 °C in the winter. Annual precipitation in this area is predicted to trend downward over the next century. Snowpack in upper elevations of the Eel River basin, upstream of the Lower Eel and Van Duzen river sub-basin, will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009). Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Rising sea level may also impact the quality and extent of wetland rearing habitat in the estuary. Wetlands could migrate inland with rising sea level but there are few places that are not armored and would allow for this migration and sea level may rise too quickly for adaptation of wetlands. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, with all populations in the ESU adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Lower Eel/Van Duzen River population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Road-stream Crossing Barriers

Barriers pose a low threat. However, there are five known barriers to fish habitat, including one on Francis Creek at Port Kenyon road, two on Barber Creek, and two more on an unnamed tributary extending north from the mainstem west of Carlotta, CA.

A culvert on Mill Creek does not meet CDFW and NMFS fish passage guidelines. Other creeks with possible fish passage restrictions include Palmer, Dean, Price, and Adams.

26.7 Recovery Strategy

The degraded condition of the Lower Eel/Van Duzen River population area, combined with the depressed coho salmon population size and restricted distribution increases the risk of extinction of this important, coastal coho salmon population. Most of the population area is in private ownership, much of the high IP areas are in developed areas, and predation and competition from non-native Sacramento pikeminnow severely limits juvenile survival. Restoration activities that improve estuarine habitat, increase floodplain connectivity, reduce sediment input, increase riparian vegetation, increase summer instream flows, and reduce the influence of Sacramento pikeminnow should be immediately implemented. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 26-4 on the following page lists the recovery actions for the Lower Eel/Van Duzen River population.

Table 26-4. Recovery action implementation schedule for the Lower Eel/Van Duzen River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LEVR.1.1.13	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Remove or replace tidegates	Areas of estuary where coho salmon would benefit immediately	2a
SONCC-LEVR.1.1.13.1		*Inventory tidegates and develop a plan that prioritizes removal or replacement. Research possible incentive opportunities and work with landowners to replace tidegates with fish friendly versions*				
SONCC-LEVR.1.1.13.2		*Remove or replace tidegates as described in the plan*				
SONCC-LEVR.1.1.66	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Remove or replace tidegates	Population wide	2b
SONCC-LEVR.1.1.66.1		*Inventory tidegates and develop a plan that prioritizes removal or replacement. Research possible incentive opportunities and work with landowners to replace tidegates with fish friendly versions*				
SONCC-LEVR.1.1.66.2		*Remove or replace tidegates as described in the plan*				
SONCC-LEVR.1.1.12	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Set back or remove dikes or levees	Mid-channel islands such as Cock Robin Island, Salt River Slough, Mosley Slough, and McNulty Slough	2a
SONCC-LEVR.1.1.12.1		*Assess and prioritize levees for setback or removal*				
SONCC-LEVR.1.1.12.2		*Remove or setback levees, guided by assessment results*				
SONCC-LEVR.1.1.65	Estuary	Yes	Improve connectivity of tidally-influenced habitat	Set back or remove dikes or levees	Population wide	2b
SONCC-LEVR.1.1.65.1		*Assess and prioritize levees for setback or removal*				
SONCC-LEVR.1.1.65.2		*Remove or setback levees, guided by assessment results*				
SONCC-LEVR.1.2.38	Estuary	Yes	Improve estuarine habitat	Assess and improve estuary and tidal wetland habitat	Estuary	2a
SONCC-LEVR.1.2.38.1		*Identify parameters to assess condition of estuary and tidal wetland habitat*				
SONCC-LEVR.1.2.38.2		*Determine amount of estuary and tidal wetland habitat needed for population recovery and develop a plan for restoration*				
SONCC-LEVR.1.2.38.3		*Restore estuary and tidal wetland habitat guided by the plan*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.1.2.15	Estuary	Yes	Improve estuarine habitat	Re-connect tidal channels and wetlands	State lands including, Morgan Slough, Smith Creek, and Sevenmile Slough	2a
SONCC-LEVR.1.2.15.1	*Develop a plan to re-connect historic tidal channels and tidal wetlands as well as restore channelized tidal channels to a more natural channel form*					
SONCC-LEVR.1.2.15.2	*Re-connect tidal channels and wetlands, guided by the plan*					
SONCC-LEVR.1.2.15.3	*Restore channelized tidal channels to a more natural channel form, guided by the plan*					
SONCC-LEVR.1.2.16	Estuary	Yes	Improve estuarine habitat	Restore brackish wetlands	McNulty Slough and Salt River, and areas of estuary where coho salmon would benefit immediately	2a
SONCC-LEVR.1.2.16.1	*Develop a plan for the conversion of freshwater wetlands to functioning tidal habitat*					
SONCC-LEVR.1.2.16.2	*Convert formally brackish wetlands from freshwater wetlands back to functioning tidal habitat, guided by the plan*					
SONCC-LEVR.1.2.14	Estuary	Yes	Improve estuarine habitat	Restore salt marsh and tidal sloughs	State lands including, Hawk Slough, Hogpen Slough, Smith Creek Cutoff Slough, and Sevenmile Slough, and areas of estuary where coho salmon would benefit immediately	2a
SONCC-LEVR.1.2.14.1	*Develop a management plan in the Eel River estuary to restore salt marsh and tidal slough habitat*					
SONCC-LEVR.1.2.14.2	*Restore salt marsh and tidal slough habitat, guided by the plan*					
SONCC-LEVR.2.1.36	Floodplain and Channel Structure	Yes	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately, particularly Yager and Lawrence creeks	2a
SONCC-LEVR.2.1.36.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LEVR.2.1.36.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-LEVR.2.1.72	Floodplain and Channel Structure	Yes	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-LEVR.2.1.72.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LEVR.2.1.72.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.2.2.45	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, oxbows, and side channels and restore features if needed	Yager Creek (upstream of Lawrence Creek)	2a
SONCC-LEVR.2.2.45.1	*Develop a plan to reconnect channel to old oxbows on Yager Creek (upstream of Lawrence Creek)*					
SONCC-LEVR.2.2.45.2	*Reconnect channel to old oxbows on Yager Creek, guided by the plan*					
SONCC-LEVR.2.2.47	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Reconnect floodplains, wetlands, oxbows, and off channel habitat	Lawrence Creek	2a
SONCC-LEVR.2.2.47.1	*Develop a plan to reconnect old oxbows, side channels, and off channel habitats to Lawrence Creek*					
SONCC-LEVR.2.2.47.2	*Reconnect old oxbows, side channels, and off channel habitats to Lawrence Creek, guided by the plan*					
SONCC-LEVR.3.1.20	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	2a
SONCC-LEVR.3.1.20.1	*Provide education and training on conserving water while diverting*					
SONCC-LEVR.3.1.20.2	*Provide incentives to landowners to reduce water consumption*					
SONCC-LEVR.3.1.48	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-LEVR.3.1.48.1	*Identify and cease unauthorized water diversions*					
SONCC-LEVR.3.1.74	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-LEVR.3.1.74.1	*Identify and cease unauthorized water diversions*					
SONCC-LEVR.14.2.4	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2a
SONCC-LEVR.14.2.4.1	*Determine the effectiveness of various pikeminnow suppression techniques and develop experimental control methods. Develop a plan that identifies watersheds suitable for experimental pikeminnow suppression*					
SONCC-LEVR.14.2.4.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					
SONCC-LEVR.2.1.17	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2b
SONCC-LEVR.2.1.17.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LEVR.2.1.17.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.2.1.71	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2c
SONCC-LEVR.2.1.71.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LEVR.2.1.71.2	*Place instream structures, guided by assessment results*					
SONCC-LEVR.3.1.52	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2b
SONCC-LEVR.3.1.52.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-LEVR.3.1.52.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-LEVR.3.1.52.3	*Implement plan*					
SONCC-LEVR.26.1.64	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-LEVR.26.1.64.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-LEVR.8.1.77	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2d
SONCC-LEVR.8.1.77.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-LEVR.8.1.77.2	*Decommission roads, guided by assessment*					
SONCC-LEVR.8.1.77.3	*Upgrade roads, guided by assessment*					
SONCC-LEVR.8.1.77.4	*Maintain roads, guided by assessment*					
SONCC-LEVR.10.1.51	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	All areas where coho salmon would benefit immediately	2b
SONCC-LEVR.10.1.51.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-LEVR.10.1.51.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-LEVR.10.1.51.3	*Increase riparian vegetation and shading at sources of cool water*					
SONCC-LEVR.10.1.67	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Population wide	2d
SONCC-LEVR.10.1.67.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-LEVR.10.1.67.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-LEVR.10.1.67.3	*Increase riparian vegetation and shading at sources of cool water*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.8.1.49	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	All streams where coho salmon would benefit immediately	2c
SONCC-LEVR.8.1.49.1	*Identify and cease unauthorized road building or grading*					
SONCC-LEVR.8.1.76	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	Population wide	2d
SONCC-LEVR.8.1.76.1	*Identify and cease unauthorized road building or grading*					
SONCC-LEVR.8.1.5	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	2c
SONCC-LEVR.8.1.5.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-LEVR.8.1.5.2	*Decommission roads, guided by assessment*					
SONCC-LEVR.8.1.5.3	*Upgrade roads, guided by assessment*					
SONCC-LEVR.8.1.5.4	*Maintain roads, guided by assessment*					
SONCC-LEVR.5.1.46	Passage	No	Improve access	Remove barrier	Port Kenyon	3a
SONCC-LEVR.5.1.46.1	*Remove barrier on Port Kenyon Creek*					
SONCC-LEVR.5.1.37	Passage	No	Improve access	Reduce sediment barriers	Tributary confluences with mainstem Eel and Van Duzen rivers where coho salmon would benefit immediately	3b
SONCC-LEVR.5.1.37.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-LEVR.5.1.37.2	*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*					
SONCC-LEVR.5.1.75	Passage	No	Improve access	Reduce sediment barriers	Population wide	3d
SONCC-LEVR.5.1.75.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-LEVR.5.1.75.2	*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*					
SONCC-LEVR.7.1.3	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3b
SONCC-LEVR.7.1.3.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan)*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.7.1.2	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	High IP sub watersheds	3b
SONCC-LEVR.7.1.2.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-LEVR.7.1.2.2	*Thin, or release conifers, guided by the plan*					
SONCC-LEVR.7.1.2.3	*Plant conifers, guided by the plan*					
SONCC-LEVR.7.1.1	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	3c
SONCC-LEVR.7.1.1.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-LEVR.7.1.1.2	*Develop watershed-specific guidance for managing riparian vegetation*					
SONCC-LEVR.10.2.42	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	All streams where coho salmon would benefit immediately	3c
SONCC-LEVR.10.2.42.1	*Identify point and nonpoint pollution sources throughout the watershed*					
SONCC-LEVR.10.2.42.2	*Implement strategy to minimize pollution, guided by the assessment*					
SONCC-LEVR.10.2.68	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	3d
SONCC-LEVR.10.2.68.1	*Identify point and nonpoint pollution sources throughout the watershed*					
SONCC-LEVR.10.2.68.2	*Implement strategy to minimize pollution, guided by the assessment*					
SONCC-LEVR.10.7.63	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All areas where coho salmon would benefit immediately	3c
SONCC-LEVR.10.7.63.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LEVR.10.7.63.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-LEVR.10.7.70	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-LEVR.10.7.70.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LEVR.10.7.70.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-LEVR.7.1.43	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	Van Duzen River	3d
SONCC-LEVR.7.1.43.1	*Ensure channel modifications are permitted and reviewed*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LEVR.16.1.22	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LEVR.16.1.22.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-LEVR.16.1.22.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-LEVR.16.1.23	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LEVR.16.1.23.1	*Determine actual fishing impacts*					
SONCC-LEVR.16.1.23.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-LEVR.16.2.24	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LEVR.16.2.24.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-LEVR.16.2.24.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-LEVR.16.2.25	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LEVR.16.2.25.1	*Determine actual impacts of scientific collection*					
SONCC-LEVR.16.2.25.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-LEVR.8.1.9	Sediment	No	Reduce delivery of sediment to streams	Improve grazing practices	Ferndale and Bridgeville HSAs	3d
SONCC-LEVR.8.1.9.1	*Develop educational materials for landowners that encourage retention of riparian vegetation*					
SONCC-LEVR.8.1.9.2	*Develop riparian buffer ordinance for grazing and agriculture*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LEVR.8.1.44	Sediment	No	Reduce delivery of sediment to streams	Improve land management practices	Van Duzen River	3d
SONCC-LEVR.8.1.44.1		*Identify and cease all unauthorized land clearing and grading associated with marijuana cultivation*				
SONCC-LEVR.8.1.6	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3d
SONCC-LEVR.8.1.6.1		*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*				
SONCC-LEVR.8.1.7	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3d
SONCC-LEVR.8.1.7.1		*Develop regulatory mechanisms to limit off-road use of the floodplain and stream channel*				
SONCC-LEVR.8.1.11	Sediment	No	Reduce delivery of sediment to streams	Reduce risk of catastrophic fire	Population wide	3d
SONCC-LEVR.8.1.11.1		*Assess fire hazard and risk*				
SONCC-LEVR.8.1.11.2		*Promote appropriate treatment to reduce high severity fire hazard*				

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27. Guthrie Creek Population

Southern Coastal Stratum

Dependent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

20.74 mi² (3% Federal ownership)

14 IP-km (9 IP-mi) (57% High)

Dominant Land Uses are Timber Harvest and Agriculture

Key Limiting Stresses are 'Altered Sediment Supply' and 'Lack of Floodplain and Channel Structure'

Key Limiting Threats are 'Timber Harvest' and 'Agriculture'

Highest Prioritized Recovery Actions

• Improve grazing practices • Reduce stream bank erosion • Improve timber harvest practices by revising California Forest Practice Rules	• Reduce road-stream hydrologic connection • Minimize mass wasting • Increase riparian vegetation

27.1 History of Habitat and Land Use

The Guthrie Creek population occupies four streams along a three-mile stretch of coast south of the Eel River (Figure 27-1). These include, from north to south, Fleener Creek, Guthrie Creek, Bear Creek, and Oil Creek. These watersheds have been impacted by both natural and anthropogenic changes over the past century, leading to degraded habitat conditions for coho salmon. The soils in this area of coastal California are naturally highly erodible and tend to produce mass wasting, bank destabilization, and high volumes of silt and cementation of gravel. Landslides and bank failures are particularly common in the lower part of Guthrie, Fleener, and Oil Creek due to both natural soil instability in this area and decades of grazing. Land use throughout these watersheds has been limited by the rugged terrain and most areas have been used solely for grazing and timber production over the past century. There is little to no development in these watersheds.

Historically, the lower reach of all three primary coho streams (Guthrie, Fleener, and Oil Creeks) have been highly grazed and consequently suffer from bank instability, degraded riparian forest conditions, and sediment loading. Early timber harvest in these areas originally removed any riparian cover and since then there has been little recovery due to the effects of grazing which continue to suppress regeneration. However, through a series of recent acquisitions by the California State Coastal Conservancy, the lower portions of Guthrie and Fleener Creek are now managed by the BLM as part of the Lost Coast Headlands.

Management practices by the BLM include light and low impact passive recreational uses and managed livestock grazing. There is no public land grazing in Guthrie Creek and the established grazing allotment includes new fencing along Fleener Creek (and elsewhere) and a rotation strategy using five pastures per year with water troughs located away from riparian areas (Fuller 2010). As part of their goal to provide coastal access and recreation opportunities, the BLM has constructed two coastal trails, the Fleener Creek and Guthrie Creek trails, to provide visitor access to the coast.

Timber harvest continues to impact the middle and upper reaches of streams in the Guthrie Creek population area which are privately-owned and managed for timber production. Impacts primarily manifest through the loss of riparian conifers, lack of large woody debris in streams, and elevated rates of sediment loading and accretion. Currently, many areas are actively harvested or remain in an early seral condition

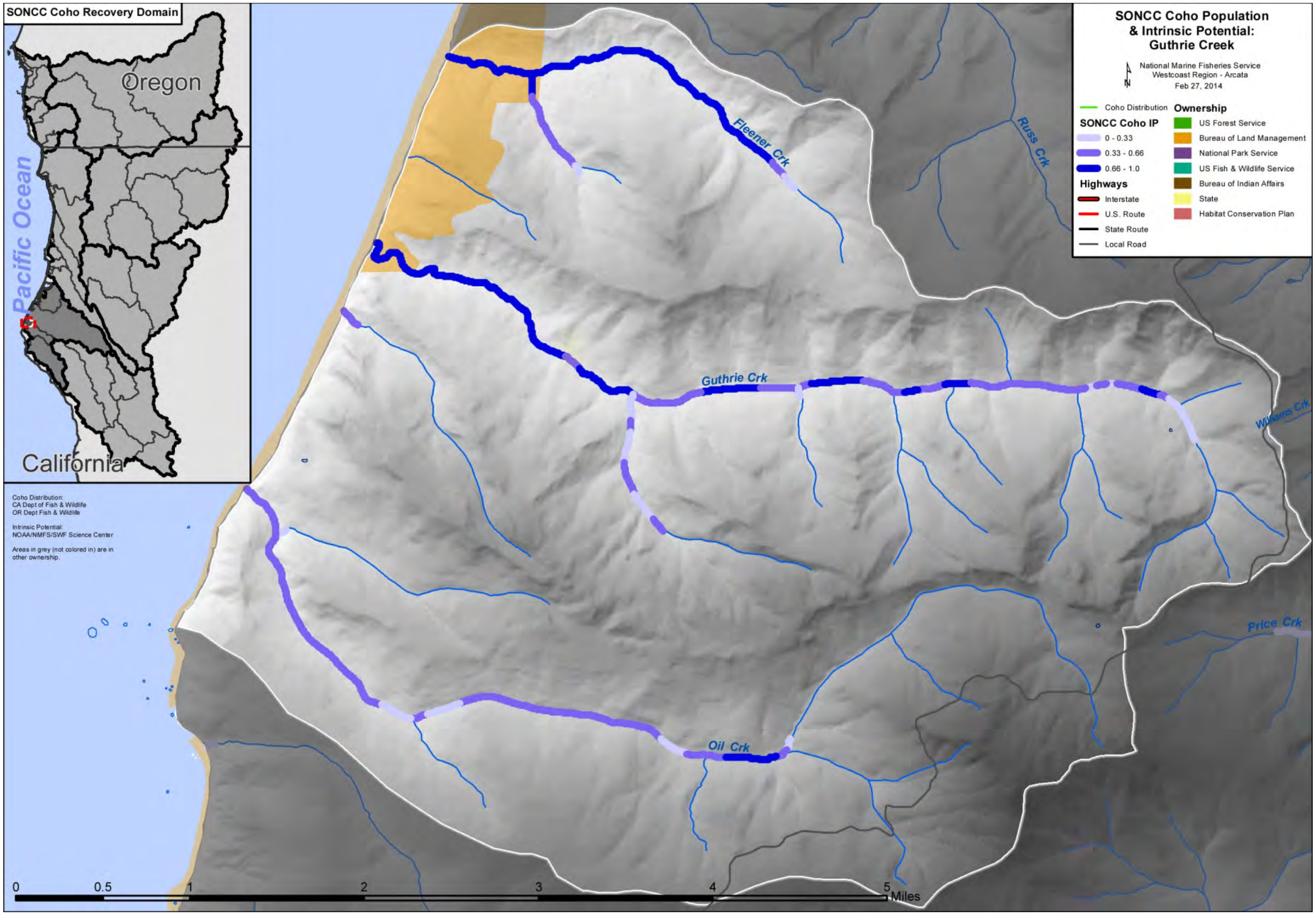

Figure 27-1. The geographic boundaries of the Guthrie Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Southern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

27.2 Historic Fish Distribution and Abundance

Based on the IP values for the streams included in the Guthrie Creek population area, Fleener, Guthrie, and Oil creek have potential for coho salmon spawning and rearing (Table 27-1). Guthrie Creek is the largest of these streams and comprises about 60 kilometers of stream channel. Habitat suitable for coho salmon quickly diminishes upstream of the lowest tributary; however, isolated pockets of high IP habitat (>0.66) occur along the mainstem up to 4 miles upstream of the mouth (Figure 27-1). The tributaries of Guthrie Creek currently do not provide substantial spawning area because of degraded conditions within the smaller channels. Within most tributaries the wetted channel narrows to less than 4 inches and is characterized by a steep incline and silt deposits that make it unsuitable for anadromous fish habitat (CDFG 1982). The lowest tributary is currently the only tributary considered to offer habitat for salmonids based on low to moderate IP values (<0.66). Based on survey data from the CDFG North Coast California Coho Salmon Investigation Project between 1982 and 2003 there were no observations of coho salmon in Guthrie Creek (CDFG 2002). Surveys were completed over three years during the study, with collected data being supplemented by literature research and anecdotal information. One streamside observation of a coho salmon exists but the year of that observation was undocumented. Currently, coho salmon abundance in the Guthrie Creek watershed is unknown and the population is presumed to be extirpated or consistently below historic levels because of habitat degradation and region-wide decline in coho salmon populations.

Based on IP habitat value, both Oil and Fleener Creeks also have potential to support coho salmon. Of the two watersheds, Fleener Creek has a larger proportion of IP habitat, with the majority of the mainstem having high IP (>0.66). The major tributary to Fleener Creek also has moderate to high IP (>0.33). Although little is known about fish use of Fleener Creek, the Bureau of Land Management in previous documents and in personal communications has stated that anadromous fish do not occupy this watershed (BLM 2005b). Residents along Fleener Creek support the claim that anadromous fish do not enter the creek, possibly because of the driftwood log jam that may act as a barrier to migration (Fuller 2010). High sediment loads and accretion along with heavy grazing in the lower mainstem may currently prevent use of any high IP habitat in this watershed

One young-of-the-year coho salmon was reported in Oil Creek in 1994 (CDFG 2004b) and the watershed has moderate IP habitat (0.33 to 0.66) throughout much of its mainstem. The stream has been significantly altered, however, and although few survey data exist, it likely is unable to support substantial numbers of coho salmon in its current state. Coho salmon that use Oil Creek must migrate upstream several miles to find suitable spawning and rearing habitat given that the lower part of the watershed has little if any riparian forest and has experienced high sedimentation. The last of the Guthrie Creek population area streams, Bear Creek, has a small amount (<0.5 miles) of moderate IP near its mouth, however the stream is likely unable to support coho salmon spawning due to its small size and degraded habitat conditions in the lower watershed. There are no records to indicate historic use of this stream by coho salmon.

Table 27-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Fleener Creek	Guthrie Creek	Oil Creek

27.3 Status of Guthrie Creek Coho Salmon

Spatial Structure and Diversity

The streams that are included in the Guthrie Creek population area are relatively short and have limited habitat available for spawning and rearing. Furthermore, the narrow and shallow qualities of most tributaries make them unsuitable for coho salmon. Although Fleener, Guthrie, and Oil Creek likely once supported coho salmon based on their IP values, there is little evidence to indicate that any of these creeks are currently used for coho spawning or rearing. The only observations of coho salmon over the past 20 years have been in Guthrie and Oil Creeks. Habitat degradation through erosion, aggradation, and loss of riparian cover likely has contributed to the decline of salmon in these streams. All of the high IP reaches in the population area have been heavily grazed over the past century and lack suitable spawning gravel and or complex rearing habitat. The upper and middle reaches of the creeks have fewer historical impacts; however, IP habitat values are lower in these regions reducing the suitability for coho salmon.

The location of the Guthrie Creek population between other larger populations, those in Eel River basin and the Mattole River, provides the potential for greater diversity within the population. The influx of genetic material and differences in life history traits from the Eel River populations to the north and the Mattole River to the south is common due to the straying that likely occurs into nearby coastal streams. Individuals who stray from nearby populations add diversity and genetic strength to the Guthrie Creek populations (Meffe 1986). Nonetheless, because the current extent of suitable spawning and rearing habitat is severely limited, the Guthrie Creek coho salmon population may not be able to support the opportunity for mixing, reducing overall diversity.

Population Size and Productivity

Guthrie Creek is known to have supported steelhead in numbers ranging from 15,000 to 25,000 in the 1930s (CDFG 1982) however the historic abundance of coho salmon in these streams is unknown. Along with steelhead populations, the current population is suspected to be either extirpated or on levels much lower than in past decades due to the apparent habitat degradation through these watersheds. In surveys conducted over the past 20 years in Guthrie Creek and Oil Creek, there have only been two records of coho salmon. Coho spawning in these watersheds is rare and likely the result of straying from either the Mattole or Eel River. If a spawning population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction.

As a dependent population, the population's abundance and productivity is highly influenced by nearby populations, which contribute spawners as strays. Both the Eel and Mattole River populations have been severely restricted and have low numbers of returning adults compared to historic runs. The lack of productivity in these systems and the associated reduction in strays entering Guthrie, Fleener, and Oil Creek impair its recovery potential.

Extinction Risk

Not applicable because Guthrie Creek is not an independent population.

Role in SONCC Coho Salmon ESU Viability

Although dependent populations such as the Guthrie Creek population are not viable on their own, they do increase connectivity in the ESU by allowing dispersal among independent populations and provide areas of refugia for other populations, acting as a source of colonists in some cases. Because nearby populations such as those in the Mattole and Eel Rivers have seen dramatic declines in productivity, there is likely far less interaction between populations. The individuals that do spawn in Guthrie, Fleener, or Oil Creek are likely strays from larger populations. Any restored habitat in Guthrie Creek population area provides potential connectivity that assists metapopulation function in the SONCC ESU.

27.4 Plans and Assessments

Bureau of Land Management (Arcata office)

Lost Coast Headlands Feasibility Study (BLM 2001)

In the process of first establishing the Lost Coast Headlands in 2001, the BLM conducted a feasibility study including potential acquisitions and management alternatives for the area. In this study they consulted with local residents, mapped significant resources in the area, and evaluated opportunities for protecting coastal resources, preserving coastal agriculture, and providing public coastal access.

State of California

CDFG Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon (CDFG 2004b) was adopted by the California Fish & Game Commission in February 2004. The Plan describes challenges for coho salmon recovery in the Mendocino hydrologic unit including deleterious summer water temperatures, high levels of fine sediment, lack of suitable spawning gravel, and lack of habitat complexity (deep pools, cover, and other elements).

27.5 Stresses

Table 27-2. Severity of stresses affecting each life stage of coho salmon in Guthrie Creek. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Sediment Supply[1]	High	High	High[1]	Medium	High	High
2	Lack of Floodplain and Channel Structure[1]	Low	High	High[1]	High	Medium	High
3	Degraded Riparian Forest Conditions	-	Medium	Medium	Low	Medium	Medium
4	Impaired Estuary/Mainstem Function	-	Low	Medium	Medium	Low	Medium
5	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low
6	Barriers	-	Low	Medium	Low	Low	Low
7	Impaired Water Quality	Low	Low	Low	Low	Low	Low
8	Altered Hydrologic Function	Low	Low	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.
[2] Increased Disease/Predation/Competition is not considered a stress for this population.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are altered sediment supply and lack of floodplain and channel structure, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. Little information exists regarding the habitat quantity and quality available in Guthrie Creek and its tributaries. Available data indicates that spawning and rearing habitat do exist in the watershed, but are likely limited in quality and abundance (CDFG 1982). No information exists regarding appropriate habitat for adult migration and holding, but given the small size of the stream channel, it is unlikely that there are many, if any, pools and deep areas for adult salmonids to use for holding. All life stages are affected by these stresses.

Within Guthrie, Fleener, and Oil Creek, the greatest potential refugia occurs in the middle and upper reaches where riparian cover is most extensive and the effects of sedimentation are least. Tributary streams within these reaches provide the greatest source of rearing and spawning habitat due to the lower levels of turbidity (CDFG 1982). Guthrie Creek in particular has the greatest potential for coho salmon productivity because it is both larger than the other streams and appears to have higher quality habitat. Fleener Creek has a relatively large amount of high IP habitat for its size and should be investigated for restoration opportunities such as exclusionary fencing as done by the BLM.

Sediment Supply

Altered sediment supply has been determined as the highest stress affecting all life history phases of coho salmon, imposing a high stress on eggs, fry, juveniles, and adults. High sediment loading, as a result of land use and geology, contributes to multiple problems including the simplification of stream habitat, increased turbidity, and increased embeddedness, which reduces emergence success. Areas along the stream near the coast are characterized by bare unstable slopes and eroding stream banks. A CDFG stream survey of Guthrie Creek from 1982 documented “steep and unstable” banks that were undercut and collapsing in many areas along the first 1,000 feet of the mainstem, upstream of the mouth (CDFG 1982). The mainstem was characterized by high silt content and cemented gravels for the entire length of the survey up to 3,000 feet from the mouth. The tributaries were noted to have considerably lower silt content.

Although there is no direct data on turbidity, the aquatic insect EPT parameter has been measured in Fleener Creek and was rated as poor (≤12). This parameter is a measure of the number of pollution intolerant insect taxa present (Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies)). The limiting factor for these species is generally the high turbidity and fine sediment in the streambed. Turbidity primarily affects juvenile salmonids by interfering with gill function, feeding, and other normal behaviors. Impaired water quality is considered a medium to high stress to this population.

Due to reductions in grazing on lower Guthrie Creek since the time of this survey it is likely that conditions have improved somewhat as banks have stabilized and riparian areas have recovered. However, high sediment loading likely continues throughout the watershed as a result of timber harvest and grazing that occurs on private land upstream.

Floodplain and Channel Structure

Lack of floodplain and channel structure is an overall high stress for coho salmon in the Guthrie Creek population. The history of timber harvest and grazing along with bank instability in riparian areas has eliminated large legacy trees in the riparian zone along with the supply of LWD to streams. Wood is essential for the maintenance of pools through scouring and the general complexity of stream habitats. In addition, an excess of sediment has filled pools and caused the shallowing and widening of channels through aggradation. The overall simplified stream habitat likely provides less places of refuge for fish and likely lacks deep pools and side channels for use during high flow events or times of low water.

Riparian Forest Conditions

Riparian forests in all four watersheds in the population area have been negatively impacted by timber harvest and grazing, however, have recently improved due to changes in land management. Survey data from Guthrie Creek in 1982 (CDFG 1982) indicates that riparian cover is lacking from the mouth to about 1,000 feet upstream. Then, riparian vegetation increases to mostly alder and willow until approximately 6,000 feet from the mouth upstream of which a conifer forest canopy provides about 50 percent canopy cover for the rest of the upland channel. Although grazing has been eliminated from riparian areas in Guthrie and Fleener Creeks, lower reaches are slow to recover and riparian vegetation is still limited. Timber harvest continues to limit riparian condition in middle and upper reaches. Overall degraded riparian condition is a medium stress to coho salmon in this population and limits the amount of cover, LWD, and rearing and spawning habitat in streams.

Impaired Estuary/Mainstem Function

The estuaries of Fleener, Guthrie, and Oil Creek are all small in size and contain little habitat for coho salmon rearing. Estuarine function has been impacted to some degree by elevated sediment aggradation which has led to decreased flows, a widened and shallowed channel, and the possible presence of fish passage barriers during low flow periods. The accumulation of driftwood, possibly due to changes in the geomorphology of the estuary in Fleener Creek, has potentially led to complete blockage of the watershed to anadromous fish (Fuller per comm. 2010). Guthrie Creek does not seem to accumulate driftwood at its mouth due to higher flows than Fleener Creek. One potential source of concern in the entire population area is the unstable headland geology, which can lead to mass wasting at the mouth of these streams. Currently, it is unknown if estuarine condition is a significant issue for this population.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Barriers

There may be stream crossing barriers associated with timber management roads on private timber land, but the extent of this issue is unknown. There are no documented fish passage barriers on Federal or County roads. Therefore, fish barriers pose an overall low stress to Guthrie Creek coho salmon. There are some known diversions that could act as fish passage barriers if not properly screened.

Impaired Water Quality

Temperature was recorded between July and October of 2005 in Guthrie Creek and was very good (<15 °C) to good (15 to 16 °C) for most of that time. The temperature exceeded 17 °C only a few days during the year.

Hydrologic Function

The hydrologic function in Guthrie Creek is good. Generally, the channel's morphology is that of a deep crevice and U-shaped channel, which maintains flow and sufficient water depth to sustain fish (CDFG 1982). The overall stress associated with hydrologic function is considered low.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Guthrie Creek population area. Hatchery-origin coho salmon may stray into Guthrie Creek; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

27.6 Threats

Table 27-3. Severity of threats affecting each life stage of coho salmon in Guthrie Creek. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Timber Harvest[1]	High	High	High[1]	High	Medium	High
2	Agricultural Practices[1]	High	High	High[1]	Medium	High	High
3	Roads	High	High	High	Medium	High	High
4	Fishing and Collecting	-	-	Low	Low	Low	Low
5	Channelization/Diking	Low	Low	Low	Low	Low	Low
6	Dams/Diversion	Low	Low	Low	Low	Low	Low
7	High Severity Fire	Low	Low	Low	Low	Low	Low
8	Climate	Low	Low	Low	Low	Low	Low
9	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
10	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key Limiting Threats and limited life stage
[2]Invasive Non-Native/Alien Species, and Mining/Gravel Extraction are not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are timber harvest and agricultural practices.

Timber Harvest

The Guthrie Creek population area is made up of nearly 97 percent private land, much of which is used for timber production. Most land is likely on a 30 to 50 year rotation with 25 to 35 percent of a watershed being harvested based on CalFire's Forest Practices GIS data (CalFire 2009). Poor riparian conditions in Guthrie Creek and throughout the population area have been attributed to timber harvest. The lack of mature riparian forest along streams and LWD in streams reflect the outcome of early harvest practices with no riparian buffers. Although some areas of the watershed have likely recovered some of their riparian structure and function, the cessation of timber harvest in riparian areas was too recent for many areas to progress to the late seral stage. Also, because the area is already prone to erosion and high turbidity, additional sediment inputs associated with timber harvest can have major consequences for coho salmon in this population (see sediment stress section above). The overall threat associated with timber harvests is considered high for all life stages except adults.

Agricultural Practices

The coastal areas of these watersheds are frequently used for cattle grazing. Except in the lowest reaches of Guthrie and Fleener Creeks, which have managed grazing allotments with exclusionary fencing, cattle in most areas have direct access to the creek. Grazing and trampling by livestock typically causes bank destabilization, loss of riparian habitat, sedimentation, and consequent changes in benthic prey, turbidity, and loss of stream connectivity. Because this area is particularly prone to bank destabilization and erosion, grazing is especially harmful to stream habitat and coho salmon. These adverse effects are considered an overall high threat to coho salmon. All life stages are affected.

Roads

These watersheds are predominantly private timberland and contain a network of private, unpaved timber management roads. The overall density of roads in the Guthrie Creek population area is very high (>3 miles road per square mile of watershed). These roads are built on unstable soils and are prone to erosion and washouts. Of particular concern are road-stream crossings, which typically contribute the most to sediment loading. Sediment that originates from roads accretes in stream channels and leads to high levels of turbidity. The shallowing and widening of stream channels, cementation of gravels, and suspended sediment loads lead to decreased survival of eggs and decreased growth and survival of juveniles. Adults are impacted by the lack of suitable spawning habitat. The cumulative threat from roads is considered moderate.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Channelization/Diking

Past and current channelization and diking on Guthrie Creek has not significantly affected the Guthrie Creek coho salmon populations. This practice currently poses a low threat to all life stages of coho salmon.

Dams/Diversions

Dams and diversions in the population area have not significantly affected the Guthrie Creek coho salmon population. There is only one documented diversion in the area, on Fleener Creek. Its impact is currently unknown. Based on current information, dams and diversions pose a low threat to all life stages of coho salmon in this watershed.

High Severity Fire

Fire currently poses a low threat to all life stages of coho salmon in this watershed. During the summer months of the California fire season, cool foggy days are common in Humboldt County and therefore the overall fire hazard for the area is low. Livestock grazing in the area further reduces fire risk by eliminating fuel sources.

Climate Change

Climate change poses a low threat to this population due to its cooler climate, low risk of average temperature increase, and expected precipitation change over the next 50 years (see Appendix B for modeling methods). Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. In addition, all populations will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Urban/Residential/Industrial Development

This watershed is presently not developed and is not likely to experience any urban, residential, or industrial development in the future. Although most land is privately owned, due to the rugged nature of the terrain, lack of infrastructure, and relative isolation, it will likely continue to be used for timber harvest in the future. Consequently, development poses a low threat to coho salmon in this population.

Road-Stream Crossing Barriers

There are no documented road-stream crossing barriers within the population area. The high density of roads, however, indicates the potential for barriers to exist on private timber land. Without proper upgrades to existing crossing barriers and prevention of future barriers this threat is likely to continue to increase in the future on private lands.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Guthrie Creek population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress

27.7 Recovery Strategy

The Guthrie Creek coho salmon population is either extirpated or has very low population abundance and productivity. For the past 100 years, grazing and timber harvest have been the dominant land uses. As a result, little spawning and rearing habitat remains within these watersheds. The acquisition of the lower portions of Guthrie and Fleener Creeks by the BLM is helping to remove some of the grazing pressure on the landscape; however issues in the remaining 97 percent of the watershed need to be addressed in order to recover this population. Minimizing the impacts from grazing and timber harvest should be a priority in reducing sedimentation and turbidity. Fencing riparian corridors and supplying adequate stock watering facilities away from creeks will prevent trampling and grazing in these areas.

Careful management of timber harvest in conjunction with decommissioning, improving, and maintaining roads will reduce sediment pollution and erosion, and improve riparian conditions.

The highly erodible character of the soils will likely hinder riparian rehabilitation and continue to add to sediment loads even with the absence of grazing and harvest near the stream channel.

Although ultimate recovery of this population will help provide connectivity and refugia for the important nearby populations of the Eel and Mattole rivers, there are many challenges that hinder recovery in this area. Guthrie Creek seems to have the most potential for habitat recovery of all four creeks containing IP habitat. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 27-4 on the following page lists the recovery actions for the Guthrie Creek population.

Table 27-4 Recovery action implementation schedule for the Guthrie Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-GutC.12.1.1	Agricultural Practices	Yes	Improve agricultural practices	Improve grazing practices	All streams where coho salmon would benefit immediately	2c
SONCC-GutC.12.1.1.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-GutC.12.1.1.2	*Develop a grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-GutC.12.1.1.3	*Implement the grazing management strategy*					
SONCC-GutC.12.1.20	Agricultural Practices	Yes	Improve agricultural practices	Improve grazing practices	Population wide	2d
SONCC-GutC.12.1.20.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-GutC.12.1.20.2	*Develop a grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-GutC.12.1.20.3	*Implement the grazing management strategy*					
SONCC-GutC.2.1.14	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2c
SONCC-GutC.2.1.14.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-GutC.2.1.14.2	*Place instream structures, guided by assessment results*					
SONCC-GutC.2.1.21	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-GutC.2.1.21.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-GutC.2.1.21.2	*Place instream structures, guided by assessment results*					
SONCC-GutC.8.1.3	Sediment	Yes	Reduce delivery of sediment to streams	Reduce stream bank erosion	All streams where coho salmon would benefit immediately	2c
SONCC-GutC.8.1.3.1	*Complete stream bank sediment source inventory and map unstable hillslopes. Develop a plan that prioritizes and locations for treatment*					
SONCC-GutC.8.1.3.2	*Treat priority sediment source sites, guided by the plan*					
SONCC-GutC.8.1.3.3	*Provide educational materials to land owners that describes alternative land management practices that will result in reduced erosion and impacts to riparian forests*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-GutC.8.1.24	Sediment	Yes	Reduce delivery of sediment to streams	Reduce stream bank erosion	Population wide	2d
SONCC-GutC.8.1.24.1	*Complete stream bank sediment source inventory and map unstable hillslopes. Develop a plan that prioritizes locations for treatment*					
SONCC-GutC.8.1.24.2	*Treat priority sediment source sites, guided by the plan*					
SONCC-GutC.8.1.24.3	*Provide educational materials to land owners that describes alternative land management practices that will result in reduced erosion and impacts to riparian forests*					
SONCC-GutC.7.1.11	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2c
SONCC-GutC.7.1.11.1	*Modify California Forest Practice Rules to include specific regulations which describe how landowners and CalFire will meet the requirements specified in 898.2(d) to ensure that "take" of federally listed species does not occur on timber harvest plans*					
SONCC-GutC.2.2.13	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	3c
SONCC-GutC.2.2.13.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-GutC.2.2.13.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-GutC.2.2.22	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	3d
SONCC-GutC.2.2.22.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-GutC.2.2.22.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-GutC.8.1.4	Sediment	Yes	Reduce delivery of sediment to streams	Minimize mass wasting	All streams where coho salmon would benefit immediately	3c
SONCC-GutC.8.1.4.1	*Assess roads and determine feasibility for relocation in priority sites*					
SONCC-GutC.8.1.4.2	*Relocate roads off of unstable land features, based on the assessment*					
SONCC-GutC.8.1.25	Sediment	Yes	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-GutC.8.1.25.1	*Assess roads and determine feasibility for relocation in priority sites*					
SONCC-GutC.8.1.25.2	*Relocate roads off of unstable land features, based on the assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-GutC.8.1.10	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All streams where coho salmon would benefit immediately	3c
SONCC-GutC.8.1.10.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-GutC.8.1.10.2	*Decommission roads, guided by assessment*					
SONCC-GutC.8.1.10.3	*Upgrade roads, guided by assessment*					
SONCC-GutC.8.1.10.4	*Maintain roads, guided by assessment*					
SONCC-GutC.8.1.23	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-GutC.8.1.23.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-GutC.8.1.23.2	*Decommission roads, guided by assessment*					
SONCC-GutC.8.1.23.3	*Upgrade roads, guided by assessment*					
SONCC-GutC.8.1.23.4	*Maintain roads, guided by assessment*					
SONCC-GutC.10.7.18	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-GutC.10.7.18.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-GutC.10.7.18.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-GutC.10.7.19	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-GutC.10.7.19.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-GutC.10.7.19.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-GutC.7.1.2	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase riparian vegetation	Population wide	3d
SONCC-GutC.7.1.2.1	*Plant native riparian species in denuded areas*					

28. Bear River Population

Southern Coastal Stratum

Non-Core 2, Potentially Independent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

83.61 mi^2 (0% Federal ownership)

48 IP-km (30 IP-mi) (27% High)

Dominant Land Uses are Timber Harvest and Agriculture

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Degraded Riparian Forest Conditions'

Key Limiting Threats are 'Roads' and 'Timber Harvest'

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, or other instream structure • Construct off-channel habitats, alcoves, backwater habitat, and old oxbows • Reduce road-stream hydrologic connection	• Improve timber harvest practices by revising California Forest Practice Rules • Improve grazing practices • Increase riparian vegetation

28.1 History of Habitat and Land Use

Bear River is a fourth order, 30 km-long coastal stream draining approximately 151.5 km^2 (53,287 acres) to the Pacific Ocean (Ricker 2002). The connection between the Bear River and the Pacific Ocean is periodically blocked by a temporary sand bar during summer low flow. The lagoon-type estuary is approximately one-quarter mile in length (Humboldt Redwood Company (HRC) 2008, Bliesner et al. 2006). The two major land uses in the basin consist of agricultural grazing and timber harvest. Humboldt Redwood Company (formerly Pacific Lumber) owns 16,537 acres of land in the upper portion of the watershed, all of which is covered by its 1999 Habitat Conservation Plan (HCP) (Wisniewski and Garinger 2006). One hundred and sixty one acres is owned by State Parks and the remaining 36,839 acres in the watershed are privately owned.

The headwaters of the watershed have been managed for timber production since 1950. Early timber harvest operations removed trees from large tracts and burned residual slash. Most of the trees in the riparian areas were harvested. Logs were skidded downhill with tractors, often utilizing watercourses for skid trails. There was little replanting of harvested sites during the 1950s and 1960s, and site regeneration was left to natural seeding or sprouting. Consequently, much of the area harvested during this period is now comprised primarily of hardwood (e.g., tanoak) (Blair et al. 2006). The flood of 1964 altered the morphology of the lower river, transporting large amounts of sediment, removing the majority of the remaining riparian vegetation and decreasing the size and depth of the estuary (Ricker 2002).

Land use in the lower watershed (Figure 28-2) is predominately rangeland and grazed primarily by cattle and sheep (Ricker 2002). No dams exist in the Bear River drainage, however small water diversions exist throughout the basin for domestic use, livestock watering, irrigation, and dust abatement (road watering). None of these diversions exceed 1 cubic foot per second (Bliesner et al. 2006).

Since 1998, CDFG (through the Fisheries Restoration Grants Program-SB 271) funded ten projects in the Bear River watershed, including landowner education, roads assessment, temperature monitoring, riparian enhancement and planting, log structure placement, livestock exclusionary fencing, and gully and streambank stabilization.

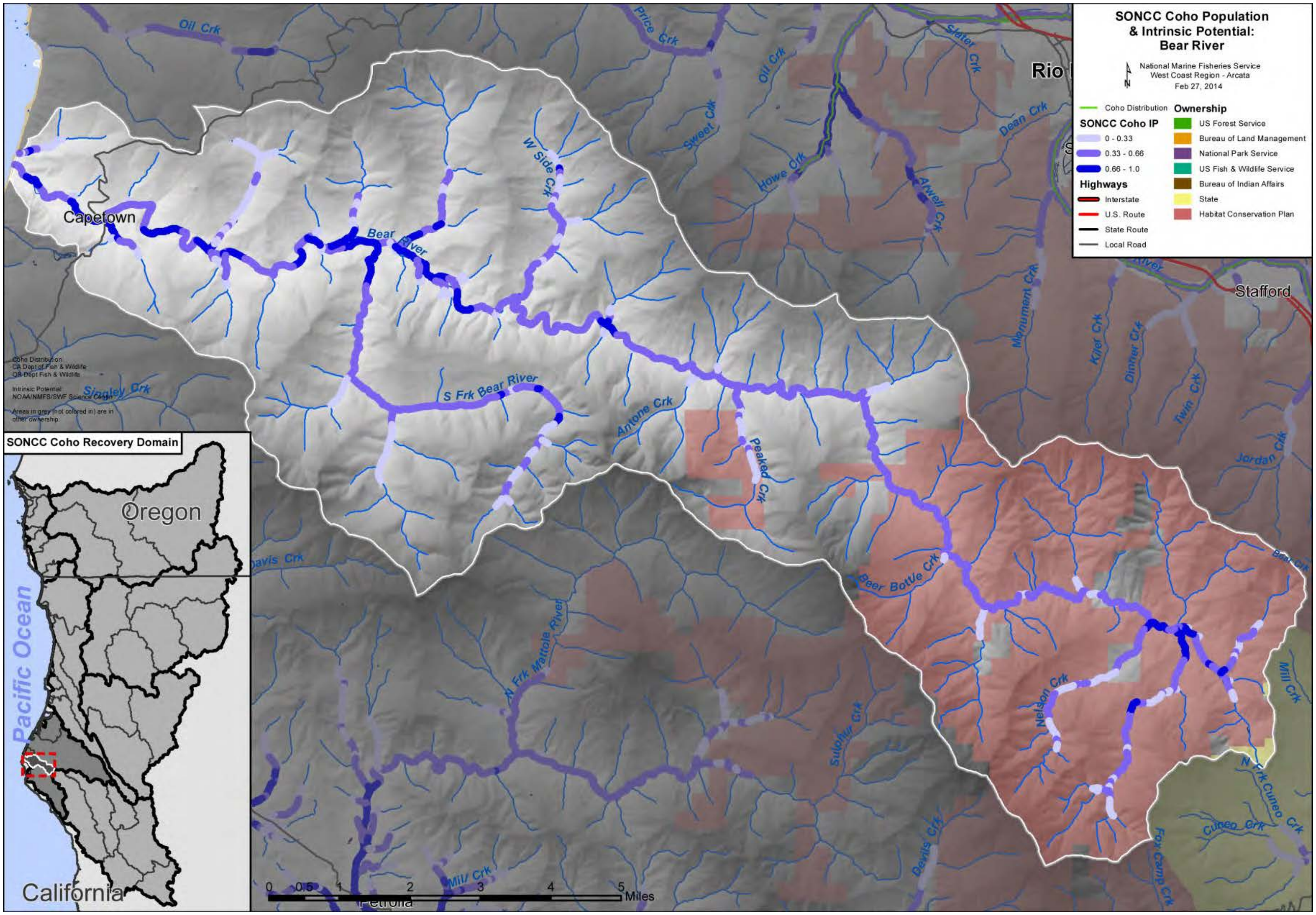

Figure 28-1. The geographic boundaries of the Bear River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Southern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

28.2 Historic Fish Distribution and Abundance

There is no historic documentation of coho salmon presence in Bear River (Bliesner et al. 2006); and no individuals were collected in juvenile outmigrant traps in 2000 to 2001 (Ricker 2002). Furthermore, CDFG's North Coast California Coho Salmon Investigation (NCCSI) detected no coho salmon when they sampled the mainstem and south fork Bear River between 2001 and 2003. Most recently, in the summer of 2012, HRC conducted a snorkel survey of Bear River including Upper Bear River, Middle Bear River, Harmonica Creek, and Pullen Creek, and no juvenile coho salmon were recorded (HRC 2013). CDFG habitat surveys indicated suitable habitat for coho salmon in lower Bear River and portions of South Fork Bear River (CDFG 2004b), including a high degree of sinuosity, low gradient, and deep pools in the lower river (Bliesner et al. 2006). The majority of the high IP reaches in the Bear River are in the lower river, in several reaches in South Fork Bear River, and in Upper Bear River near the mouths of Harmonica and Nelson Creeks (Figure 28-1, Figure 28-2 and Table 28-1) (Williams et al 2006). Bear River supports populations of CC Chinook and NC steelhead, and therefore likely historically supported SONCC coho salmon.

Figure 28-2. Location of lower and upper Bear River. Capetown HSA, Cape Mendocino HU.

Table 28-1. Tributaries with high IP reaches (IP > 0.66). (Williams et al. 2006).

Stream Name	Stream Name
Bear River	Harmonica Creek
South Fork Bear River	Nelson Creek

28.3 Status of Bear River Coho Salmon

Spatial Structure and Diversity

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 40 coho salmon per-IP-km of habitat are needed (1,900 spawners total) to approximate the historical distribution of Bear River coho salmon and habitat. Although CC Chinook salmon and NC steelhead are present, SONCC coho salmon have not been documented in Bear River. There are no documented barriers within the Bear River watershed that currently restrict the spatial structure of the population. Because no coho salmon have been documented, the population may be functionally extinct and therefore lacks diversity.

Population Size and Productivity

No adult or juvenile coho salmon have been documented in Bear River.

Extinction Risk

The Bear River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). However, because the population is a non-core 2 population, the recovery target for the population is not to reduce the risk of extinction; rather, 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival.

Role of Population in SONCC Coho Salmon ESU Viability

The Bear River population is considered to be a non-core 2 "Potentially Independent" population within the Southern Coastal diversity stratum meaning that it has a high likelihood of persisting in isolation over a 100-year time scale, but is too strongly influenced by immigration from other populations to exhibit independent dynamics. The demographic target for recovery is juvenile occupancy. Because the Bear River population may be functionally extinct, nearby populations such as the Mattole and Eel River populations are needed to provide a source of straying individuals that could recolonize the Bear River population area.

The Mattole, just south of Bear River is a Functionally Independent population. The Eel River basin is just to the north of Bear River and consists of eight populations, all of which are Functionally or Potentially Independent. Due to its location, Bear River should provide habitat to stray coho from neighboring populations. Habitat availability is important in populations like Bear River to provide connectivity between populations and throughout the ESU.

28.4 Plans and Assessments

Humboldt Redwood Company

Pacific Lumber Habitat Conservation Plan

The Pacific Lumber Company (PALCO) Habitat Conservation Plan (HCP) was finalized in 1999 and the associated Incidental Take Permit is effective through 2049. The HCP was adopted by the Humboldt Redwood Company upon acquisition of the PALCO lands in 2008. NMFS issued a Section 10(a)(1)(B) permit authorizing incidental take of SONCC coho salmon by PALCO and determined that this taking would not appreciably reduce the likelihood of survival and recovery of the species in the wild (PALCO 1999b). Although the goal of the HCP is to maintain or achieve, over time, a properly functioning aquatic habitat condition, the HCP acknowledges that not all essential habitat elements (e.g., large wood recruitment) will be attainable within the 50-year life of the plan (PALCO 1999a). Site-specific prescriptions, which are designed to promote a properly functioning aquatic habitat condition, are contained in the Bear River watershed analysis (HRC 2008).

The Bear River Watershed Analysis was completed in October 2006, and the Hillslope Management and Riparian Management Prescriptions were completed in April, 2007 (PALCO 2007). The hillslope management/mass wasting avoidance strategy uses a three-step approach for the identification and avoidance or mitigation of high hazard unstable areas during the planning and implementation of forestry activities. These steps are: slope stability training; site-specific and project-specific "screening" for unstable areas; and enforceable site-specific prescriptions for road construction, re-construction, or timber harvest on unstable areas designated as "High Hazard." Also required is review and approval of a professional licensed geologist.

In general, no timber harvest will occur within the Channel Migration Zone, defined as the flood-prone area in stream reaches with less than 4 percent gradient, which is generally the 100-year floodplain (PALCO 2007). In addition, all streams will have a riparian management zone. The riparian management zone for Class I (fish-bearing) streams is 150 feet wide, with no timber harvest permitted within the first 50 feet. More information about HCPs in the Bear River watershed can be found in Section 3.2.5.

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The Plan describes challenges for coho salmon recovery in the Mendocino hydrologic unit including deleterious summer water temperatures, high levels of fine sediment, lack of suitable spawning gravel, and lack of habitat complexity (deep pools, cover, and other elements).

28.5 Stresses

Table 28-2. Severity of stresses affecting each life stage of coho salmon in Bear River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	Medium	Very High	Very High[1]	Very High	Very High	Very High
2	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	Very High	High	Very High
3	Impaired Water Quality	Low	Very High	Very High	Very High	Low	High
4	Altered Sediment Supply	High	High	Very High	Medium	Very High	High
5	Impaired Estuary/Mainstem Function	-	Medium	High[1]	Very High	Medium	High
6	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low
7	Altered Hydrologic Function	Low	Low	Medium	Low	Low	Low
8	Barriers	-	Low	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage.
[2]Increased Disease/Predation/Competition is not considered a stress for this population.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are lack of floodplain and channel structure and degraded riparian conditions, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. A functioning riparian forest is essential to prevent excessive solar radiation that creates warm water temperatures. Historic timber harvest has degraded the riparian forest so that it no longer provides sufficient large wood inputs to Bear River. Lack of large woody debris combined with increased sediment supply; reduce complexity by filling in pools and simplifying the channel. Lack of floodplain and channel structure in Bear River is closely associated with the degraded riparian conditions and lack of large woody debris. There are very few deep pools, backwater alcoves, complex side channels and off channel ponds which are necessary to provide rearing habitat for juvenile coho salmon. If coho salmon were present in the Bear River, substrate embeddedness would limit their spawning success and the lack of instream cover and pool refugia would limit rearing success.

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure is ranked as a very high stress to nearly all life stages of coho salmon. In the high IP reaches, the pool depths in the Bear River mainstem average 3.3 feet or greater. However, in the South Fork Bear River and Nelson and Harmonica Creeks, pool depths are 2.0 feet or less, which is considered a poor condition for salmonid habitat function.

Pool frequency throughout the watershed is poor, less than 35 percent by length, due to the lack of instream wood structures throughout the mainstem and certain tributaries. Delivery of large wood to the majority of Class I streams is problematic and will continue to be so for a period of least 10 to 25 years. After 25 years, an estimated 75 percent of the HCP-covered riparian forest will be of sufficient size to benefit aquatic habitat conditions (Blair et al. 2006).

Degraded Riparian Forest Conditions

Riparian forest conditions are ranked as a high or very high stress to nearly all life stages of coho salmon, with an overall ranking of very high. The high IP habitat of lower Bear River, South Fork Bear River, as well as the upper watershed and its tributaries, generally lacks canopy cover and is dominated by hardwoods, which provide poor shading and decompose faster than conifers. On HRC lands, current riparian conditions are primarily the result of intensive mid-twentieth century timber harvest and two significant flood events of the same time period. Species composition is primarily a mixture of Douglas-fir, tanoak, red alder, willow, California bay-laurel, and big-leaf maple. Structurally, while large trees in excess of 24" diameter at breast height (dbh) occur throughout the Bear River, most stands consist of trees ranging from 12 to 24" dbh, with multiple canopy layers just beginning to develop (Blair et al. 2006).

Impaired Water Quality

Water quality is ranked as a high or very high stress to nearly all life stages of coho salmon. Seasonally warm air temperatures, at times exceeding 32° Celsius (C), emphasize the importance of maintaining over-stream shade canopy and cool riparian microclimate conditions to reduce solar heating of the water. Much of the Bear River, and the lower reaches of Harmonica Creek and Gorge Creek, have little over-stream shade canopy (Blair et al. 2006), and summertime water temperatures exceed 17°C.

Altered Sediment Supply

Sediment supply is ranked as a high or very high stress to nearly all life stages of coho salmon. The high IP habitat of lower Bear River, South Fork Bear River, as well as the upper watershed and its tributaries, have a high degree of embeddedness that reduces survival of eggs and fry, and the production of invertebrate prey, thereby diminishing rearing for 0+ and 1+ individuals (if present). The embeddedness of substrate in riffle habitat, as well as shallow pool depths described in the *Lack of Floodplain and Channel Structure* section, is caused in part by excess fine sediment, which also increases instream turbidity. Effects to coho salmon from elevated turbidity include an impaired ability to find food, gill abrasion, food assemblage changes, smothering of eggs and filling of pools with fine sediment.

Impaired Estuary/Mainstem Function

Estuary function is important to the population because of its unique role in the life history and survival of coho salmon. The Bear River estuary is considered by Wisniewski and Garinger (2006) to be suffering from changes in sediment, water, and wood. The lack of LWD, reduced pool frequency, and lack of riparian vegetation have decreased the availability of refugia. Accretion of sediment is widespread in the estuary and reduces pool and channel complexity. Juveniles and smolts are the most affected by the loss of estuarine function due to the lost opportunity for estuarine rearing and refuge. The loss of estuarine function is a medium threat for these life stages.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Altered Hydrologic Function

Hydrologic function ranks as a low or medium threat to all life stages of coho salmon. Timber harvest practices and road construction have altered the vegetation, which ultimately changed the timing and volume of runoff. Increased water velocity and increased suspended sediment diminish habitat suitability during times of high flow. Water drafting is a component of the activities covered under the PALCO HCP and is also covered under a Lake and Streambed Alteration Agreement under the California Fish and Game Code. However, no estimate of annual volume or location of water withdrawal is available.

Barriers

No fish passage barriers have been identified (CalFish 2009).

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Bear River population area. Hatchery-origin coho salmon may stray into Bear River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

28.6 Threats

Table 28-3. Severity of threats affecting each life stage of coho salmon in Bear River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	High	Very High	Very High[1]	Very High	Very High	Very High
2	Timber Harvest[1]	High	High	High[1]	High	Medium	High
3	Agricultural Practices	Medium	High	Very High	High	High	High
4	High Severity Fire	Low	Medium	Medium	Medium	Medium	Medium
5	Climate Change	Low	Low	Medium	Medium	Medium	Medium
6	Fishing and Collecting	-	-	Low	Low	Low	Low
7	Channelization/Diking	Low	Low	Low	Low	Low	Low
8	Dams/Diversion	Low	Low	Low	Low	Low	Low
9	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
10	Mining / Gravel Extraction	-	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and life stage
[2]Urban/Residential/Industrial Development, and Invasive and Non-Native Species are not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and timber harvest.

Roads

Road density, which serves as part of the water and sediment transport system, is high (greater than 3 miles of road per square mile of watershed) throughout the majority of the watershed and ranked as a very high threat to the majority of coho life stages. Roads accelerate delivery of sediment to the riparian and aquatic habitat, and alter the stream hydrograph. The majority of roads are associated with land managed for industrial timber under the HRC HCP, which requires HRC to stormproof roads at a rate of 75 miles per year on their land.

Timber Harvest

Timber harvest is ranked as a high threat to the majority of coho life stages. Legacy effects of past harvest practices, such as accelerated sediment transport, lack of wood recruitment, and lack of riparian canopy, reduce the habitat quality in Bear River and its tributaries. Effects of industrial timber harvest are expected to be reduced under the HCP measures. The remaining areas within the watershed are privately owned, where timber harvest is regulated by the State of California's Forestry Practice Regulations.

Agricultural Practices

Grazing in the lower watershed provides an overall high threat ranking for coho salmon, as it contributes to degraded riparian and aquatic habitat. Grazing-related increases in bank erosion and suspension of sediments increase turbidity and reduces light penetration, thereby interfering with visual feeding of juveniles (0+ and1+) and smolts. Production of prey is also limited by increased turbidity levels and elevated nutrient loading.

High Severity Fire

Based on information in the Humboldt County General Plan (2008), a fire in the Bear River watershed would likely be severe due to climate, vegetation characteristics, and remote location. However, because Bear River is located within the coastal zone of influence, high severity fire is expected to be a medium threat.

Climate Change

Climate change poses a medium threat, primarily to juveniles, smolts, and adults. Although the current climate is generally cool, modeled regional average temperature shows a moderate increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 1 °C in the summer and by the same amount in the winter. Annual precipitation in this area is predicted to trend downward over the next century. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. The vulnerability of the estuary and coast to sea level rise is low in this population. Rearing and migratory habitat is most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation will impact water quality and hydrologic function in the summer. As with all populations in the ESU, adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Channelization/Diking

There is little evidence of channelization or diking in the watershed. Because the watershed is relatively undeveloped, the threat for channelization and diking is ranked as low for all life stages.

Dams/Diversions

There are no appropriative water rights in the Bear River watershed according to the NCRWQCB. The extent of riparian water rights is unknown. There are no dams in the watershed.

Road-stream Crossing Barriers

No road-crossing barriers have been identified in the Bear River watershed, resulting in a low threat ranking.

Mining / Gravel Extraction

Historically, small-scale gravel mining has occurred in the Bear River, and the Humboldt County Public Works is currently permitted to extract 3,000 $yards^3$ per year and 10,000 $yards^3$ per three to five year period from their Branstetter Bar sites (RM 1.5). Due to the low level of extraction, and likely future extraction, mining/gravel extraction is believed to be a low threat to coho salmon.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Bear River population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

28.7 Recovery Strategy

The numbers of coho salmon in the Bear River are severely depressed, as evidenced by their apparent absence. The Bear River population is highly dependent on straying from the Mattole and Eel rivers for recolonization. Recovery activities in the watershed should promote recolonization by improving the habitat function for spawning and rearing in high IP habitat. Actions that improve spawning and rearing habitat include those that reduce sediment delivery, improve stream temperatures, improve long term prospects for large wood recruitment, and promote increased floodplain and channel structure. These actions should be a priority in the watershed, especially in the high IP reaches. Reducing sediment upstream of the high IP reaches is a priority since the sediment will be transported downstream. Activities that accomplish these goals will have beneficial effects on the estuary as well, although the time for these effects to be observed will likely be several decades and possibly much longer. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 28-4 on the following page lists the recovery actions for the Bear River population.

Table 28-4. Recovery action implementation schedule for the Bear River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-BeaR.7.1.7	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	2c
SONCC-BeaR.7.1.7.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan)*					
SONCC-BeaR.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2c
SONCC-BeaR.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-BeaR.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-BeaR.2.1.41	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-BeaR.2.1.41.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-BeaR.2.1.41.2	*Place instream structures, guided by assessment results*					
SONCC-BeaR.2.2.25	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2c
SONCC-BeaR.2.2.25.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-BeaR.2.2.25.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-BeaR.2.2.42	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-BeaR.2.2.42.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-BeaR.2.2.42.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-BeaR.8.1.2	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All streams where coho salmon would benefit immediately	2c
SONCC-BeaR.8.1.2.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-BeaR.8.1.2.2		*Decommission roads, guided by assessment*				
SONCC-BeaR.8.1.2.3		*Upgrade roads, guided by assessment*				
SONCC-BeaR.8.1.2.4		*Maintain roads, guided by assessment*				
SONCC-BeaR.8.1.44	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2d
SONCC-BeaR.8.1.44.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-BeaR.8.1.44.2		*Decommission roads, guided by assessment*				
SONCC-BeaR.8.1.44.3		*Upgrade roads, guided by assessment*				
SONCC-BeaR.8.1.44.4		*Maintain roads, guided by assessment*				
SONCC-BeaR.7.1.6	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	3b
SONCC-BeaR.7.1.6.1		*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*				
SONCC-BeaR.7.1.6.2		*Develop watershed-specific guidance for managing riparian vegetation*				
SONCC-BeaR.7.1.5	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	All streams where coho salmon would benefit immediately	3c
SONCC-BeaR.7.1.5.1		*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*				
SONCC-BeaR.7.1.5.2		*Develop a grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*				
SONCC-BeaR.7.1.5.3		*Implement the grazing management strategy*				
SONCC-BeaR.7.1.43	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-BeaR.7.1.43.1		*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*				
SONCC-BeaR.7.1.43.2		*Develop a grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*				
SONCC-BeaR.7.1.43.3		*Implement the grazing management strategy*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-BeaR.7.1.27	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3c
SONCC-BeaR.7.1.27.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-BeaR.7.1.27.2	*Thin, or release conifers, guided by the plan*					
SONCC-BeaR.7.1.27.3	*Plant conifers, guided by the plan*					
SONCC-BeaR.2.2.32	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	3c
SONCC-BeaR.2.2.32.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-BeaR.2.2.32.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-BeaR.2.2.32.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-BeaR.2.2.36	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	3c
SONCC-BeaR.2.2.36.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-BeaR.8.1.3	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3c
SONCC-BeaR.8.1.3.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-BeaR.10.2.28	Water Quality	No	Reduce pollutants	Reduce pesticides	All streams where coho salmon would benefit immediately	3c
SONCC-BeaR.10.2.28.1	*Develop a pesticide management plan*					
SONCC-BeaR.10.2.28.2	*Implement pesticide management plan and technical assistance program*					
SONCC-BeaR.10.2.39	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-BeaR.10.2.39.1	*Develop a pesticide management plan*					
SONCC-BeaR.10.2.39.2	*Implement pesticide management plan and technical assistance program*					
SONCC-BeaR.10.7.38	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-BeaR.10.7.38.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-BeaR.10.7.38.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-BeaR.10.7.40	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-BeaR.10.7.40.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-BeaR.10.7.40.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-BeaR.1.2.26	Estuary	No	Improve estuarine habitat	Restore estuarine habitat	Estuary	3d
SONCC-BeaR.1.2.26.1	*Assess factors limiting coho rearing and passage in the estuary including temperature, excess sediment, and size of estuary*					
SONCC-BeaR.1.2.26.2	*Develop a plan to restore the estuary*					
SONCC-BeaR.1.2.26.3	*Implement the estuary restoration plan*					
SONCC-BeaR.16.1.10	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-BeaR.16.1.10.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-BeaR.16.1.10.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-BeaR.16.1.11	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-BeaR.16.1.11.1	*Determine actual fishing impacts*					
SONCC-BeaR.16.1.11.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-BeaR.16.2.12	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-BeaR.16.2.12.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-BeaR.16.2.12.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-BeaR.16.2.13	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-BeaR.16.2.13.1	*Determine actual impacts of scientific collection*					
SONCC-BeaR.16.2.13.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-BeaR.10.1.33	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Develop and implement TMDLs	Population wide	3d
SONCC-BeaR.10.1.33.1	*Develop temperature TMDL for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-BeaR.10.1.33.2	*Implement temperature TMDL for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-BeaR.3.1.9	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-BeaR.3.1.9.1	*Provide education and training on conserving water while diverting*					
SONCC-BeaR.3.1.9.2	*Provide incentives to landowners to reduce water consumption during low flow periods*					
SONCC-BeaR.3.1.8	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	BR
SONCC-BeaR.3.1.8.1	*Identify alternative water sources, storage means, or seasonal withdrawal restrictions to increase streamflow during low flow periods*					
SONCC-BeaR.3.1.8.2	*Reduce diversions, using alternative sources that were identified*					
SONCC-BeaR.8.1.4	Sediment	No	Reduce delivery of sediment to streams	Reduce stream bank erosion	Population wide	BR
SONCC-BeaR.8.1.4.1	*Inventory sediment sources, and prioritize for treatment*					
SONCC-BeaR.8.1.4.2	*Treat priority sediment source sites, guided by the plan*					

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29. Mattole River Population

Southern Coastal Stratum

Non-Core 1, Functionally Independent Population

High Extinction Risk

1,000 Spawners Required for ESU Viability

Population likely below depensation threshold

296 mi² (21 % Federal ownership)

250 IP-km (155 IP-mi) (24% High)

Dominant Land Uses are Timber Harvest and Rural Residential

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Dams/Diversions' and 'Urban/Residential/Industrial Development'

Highest Priority Recovery Actions

• Implement an enhancement program (e.g. captive broodstock, rescue rearing, or conservation hatchery) • Construct off-channel habitats, alcoves, backwater habitat, and old oxbows • Secure and maintain sufficient instream flows	• Determine effects of marijuana cultivation and reduce if necessary • Increase water retention (i.e. storage and recharge) • Increase large woody debris (LWD), boulders, or other instream structure

29.1 History of Habitat and Land Use

Euro-American settlers arrived in the Mattole River basin in the early 1850s, and with their arrival came land use practices that altered instream conditions for coho salmon. Initial land use consisted primarily of agriculture and sheep grazing. High intensity timber harvest and associated road building peaked throughout the basin during the 1950s and 1960s. Two significant storm events and wide-spread flooding occurred in 1955 and 1964, resulting in large scale mass-wasting that choked channels with sediment and filled deep pools (MRC 2008). The Mattole River basin is especially susceptible to landsliding and erosion due to widespread unstable bedrock and soils combined with relatively high levels of seismic activity.

As an example of the level of disturbance from the peak in timber harvest activity, Figure 29-2 shows Dry Creek in 1942, when it had forest cover that was typical of the Mattole basin prior to extensive Douglas-fir timber harvest (Figure 29-3) [Mattole Restoration Council (MRC) 2008]. The aerial photos show a significant amount of deforestation and road construction in this basin by 1965. This rate of activity was typical throughout much of the Mattole River population area.

Failure of timber harvest operations to replant Douglas-fir seedlings after harvesting allowed for the establishment of more aggressive hardwood species, primarily tanoak. Tractor and haul roads cut into logged hillsides, along with high amounts of rainfall, increased erosion and sediment delivery to Mattole River streams. The lack of reforestation likely contributed to increased sediment loads, which in combination with other disturbances, left streams shallower, warmer, and more prone to flooding (Bodin et al. 1982). Figure 29-4 shows how the Upper North Fork Mattole River, at the confluence with the mainstem Mattole River, accumulated large amounts of sediment and lost riparian forests as a result of post-WWII disturbances (PALCO 2006b). These dramatic changes in stream conditions suggest there were likely significant reductions to the coho salmon population by the late 1960s. Currently, timber harvest continues on private and industrial timberlands throughout the Mattole River basin at a much reduced rate and under much stricter regulations. The largest industrial timberland owner in the population area, Humboldt Redwood Company (HRC), operates under a state and federal Habitat Conservation Plan (HCP) on 18,350 acres in the western and northern basin (PALCO 1999a). The HRC HCP has a requirement to maintain a minimum of 10 percent late-seral stands on covered lands until 2049 (PALCO 1999b) and HRC is also managing several late-seral stands as "high conservation value forest," which will be protected as long as the company remains the landowner.

The effects of timber harvest on wood recruitment were exacerbated by the "stream cleaning" that occurred during the 1980s. During this time large woody debris (LWD) was removed from many of the productive coho salmon streams in the southern sub-basin (MRRP 2010). In some streams, more wood was removed than exists in the stream channel today (MRRP 2010).

As a result of historical disturbances, as well as some ongoing disturbances, a river and estuary that likely once ran cold and deep now runs warm and shallow and the impacts to coho salmon and their habitat are severe (Downie *et al.* 2003). Overall, the current landscape is comprised of either small-diameter conifer forest, or hardwood-dominated forests that provide less shade and reduced large wood recruitment than the former old-growth forests. Remaining late-seral conifer stands are fragmented and occur primarily on the public lands in the western and eastern sub-basins.

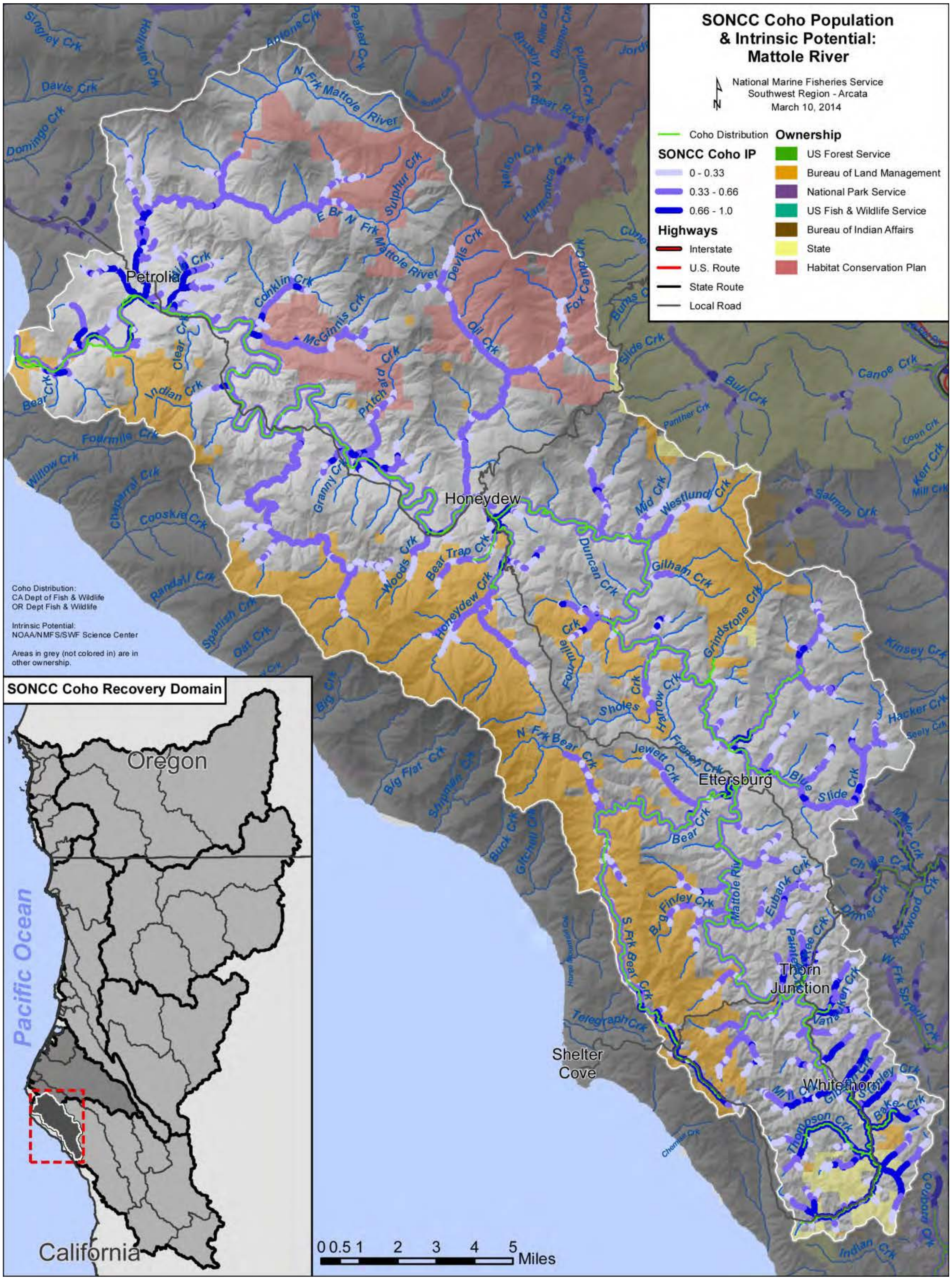

Figure 29-1. The geographic boundaries of the Mattole River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Southern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

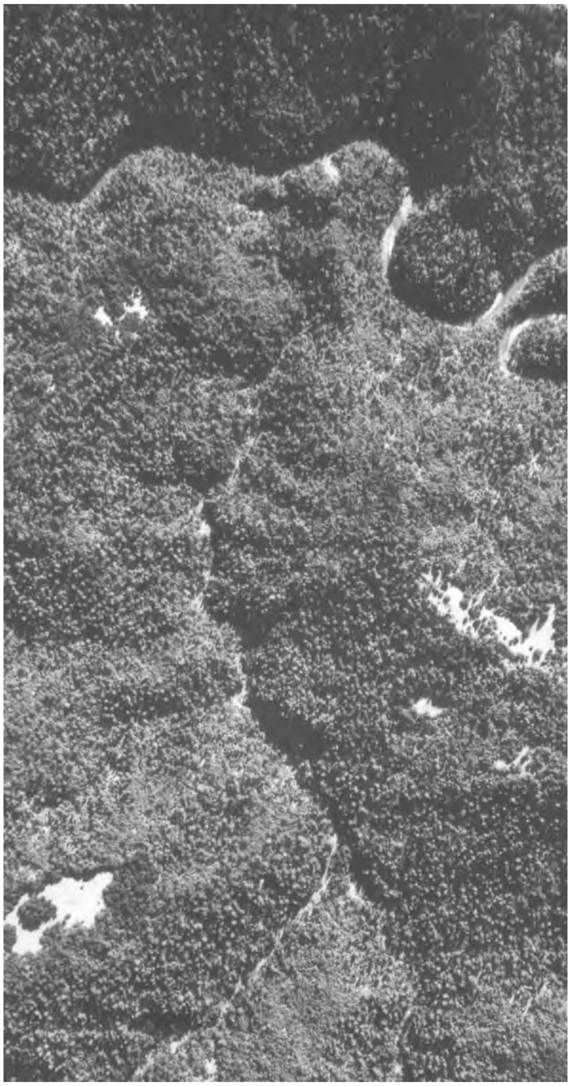

Figure 29-2 Aerial photo of Dry Creek, February 1942. Late-seral and mixed-aged stands of timber with good riparian and hill slope forest cover. Little evidence of increased sediment delivery to water courses (MRC 2008).

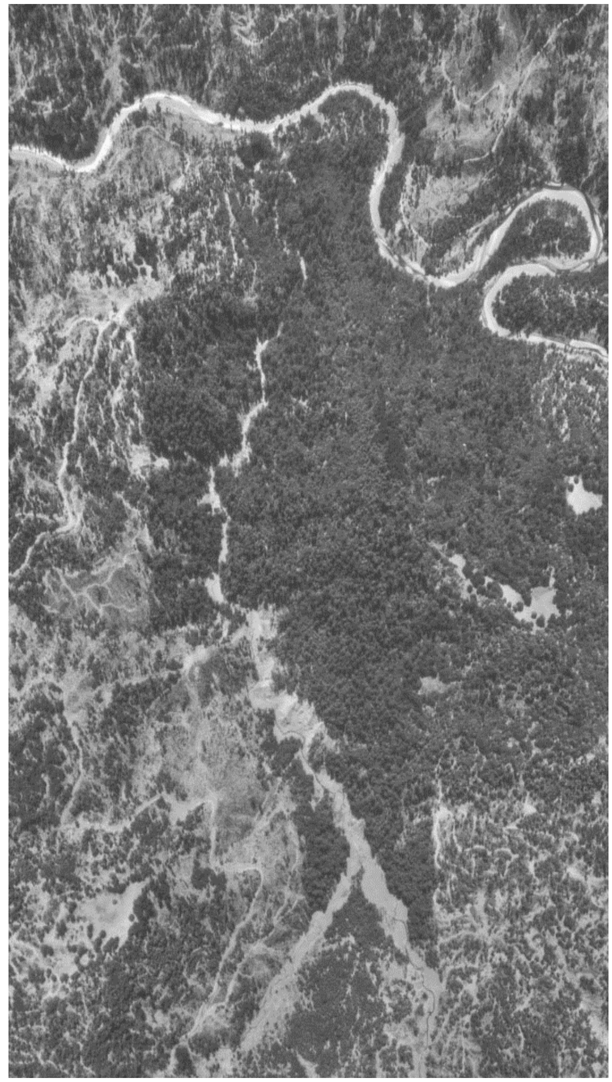

Figure 29-3. Aerial photo of Dry Creek, August 1965. High-grade and clear-cut timber harvest exposed bare ground to rains. Tributary channel widening and aggradation is evident (MRC 2008*)*

Livestock grazing continues at various locations throughout the basin including lands managed by the Bureau of Land Management (BLM) King Range National Conservation Area (BLM 2004d). Although not widespread, livestock grazing within some geologically sensitive areas of the basin has likely led to erosion, suppressed vegetative growth, and streambank instability.

Figure 29-4. Aerial photos from 1948 and 2003 showing wider, aggraded channel in 2003 of the Upper North Fork near its confluence with the mainstem.

With the establishment of rural residences and smaller ranches, water use has increased over the last 50 years. Currently, much of the demand for residential and agricultural use is accommodated through in-stream diversions or shallow wells which diminish streamflows during summer low-flow periods. Much of the demand occurs in the southern sub-basin where the last known stronghold on coho salmon spawning occurs. Additionally, the southern sub-basin has experienced increasing levels of marijuana cultivation. Many of these operations require water sources during the summer, which coincides with juvenile coho salmon rearing. Water withdrawals in the mid- to late-summer may play a factor in late summer drying of stream reaches and stranding of juvenile coho salmon. Unscreened water diversions using motorized pumps may entrain or impinge juvenile coho salmon.

The Mattole River basin is unique in the level of attention to natural resource conservation it has received for many decades. Although the human population size in the basin is relatively small and rural, the commitment from the local community to protecting and maintaining their natural environment is significant. Conservation-oriented non-profit groups such as the Mattole Salmon

Group, Mattole Restoration Council, and Sanctuary Forest have taken actions to protect and restore the river's salmonid populations. Completed projects include barrier removal, road upgrade and decommissioning, instream habitat restoration, fisheries monitoring, water quality monitoring, and stream bank stabilization.

29.2 Historic Fish Distribution and Abundance

Little data exists regarding run size or characteristics of coho salmon in the Mattole River prior to the 1950s. CDFG estimated an average run size of 8,000 coho salmon in the mid-to late 1950s, and in 1960 the United States Fish and Wildlife Service (USFWS) estimated an average run size of 2,000 coho salmon and a potential population abundance of 20,000 coho salmon based on habitat characteristics at the time.

High intrinsic-potential (IP) habitat is scattered throughout the basin's numerous tributaries; however, the southern basin headwater tributaries have the highest concentration of high IP values. The Mattole River is somewhat unique in the SONCC coho salmon ESU because low gradient stream reaches suitable for coho spawning and rearing occur in headwater reaches (e.g., near the town of Whitethorn) where water temperature is consistently favorable to coho salmon growth and survival. Concentrations of high IP habitat also exist in the western portion of the northern basin such as the lower North Fork Mattole and East Mill Creek. However, surveys have not documented consistent coho salmon presence in these reaches.

Table 29-1 lists Mattole River tributaries with high IP values.

Table 29-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name	Stream Name
Thompson Creek	Honeydew Creek	Indian Creek
Mainstem Mattole upstream of Whitethorn	Unnamed tributaries near estuary (Jim Goff Gulch)	Bear Creek (near Estuary) Stansberry Creek
Unnamed tributary on right bank approx. 1.5 miles downstream of Whitethorn (Ravasoni Creek)	Unnamed tributary on right bank approx. 1 mile downstream of McKee Creek (Buck/Sinkyone Creek)	Unnamed tributary approx. 1 mile upstream of Pritchard Creek on right bank (Thornton Creek)
Stanley Creek	McKee Creek	Pritchard Creek
Gibson Creek	Eubank Creek	McGinnis Creek
Harris Creek	Blue Slide Creek	Conklin Creek
Mill Creek	Mattole Canyon	East Mill Creek
Baker Creek	Dry Creek	Lower North Fork Mattole River
Anderson Creek	Fourmile Creek	Jeffry Gulch
Vanauken Creek	Bear Creek (near Ettersburg)	Lost River
Bridge Creek	McNasty Creek	
Ancestor Creek	Granny Creek	

29.3 Status of Mattole River Coho Salmon

Spatial Structure and Diversity

The diversity and complexity of the environmental conditions within the Mattole River basin have contributed to the evolutionary legacy of coho salmon. The Mattole River population is considered functionally independent within the ESU (Williams et al. 2008). As a functionally independent population, the Mattole River population is sufficiently large to be historically viable-in-isolation and its demographics and extinction risk are minimally influenced by immigrants from adjacent populations (Williams et al. 2006). The Mattole River population is unique in that it is relatively isolated from other functionally independent populations in the ESU, and due to its location at the southern extent of the ESU, sources of straying spawners are likely limited to populations from the north.

Coho salmon currently utilize a small fraction of their historic habitat in the basin. Recently, the only known occurrences of coho salmon in the lower 27 miles of the Mattole have been in Lower Mill Creek (MRC 2008) and Squaw Creek (Queener, N., pers. comm. 2013).

Snorkel surveys conducted in the summer of 2013 documented successful spawning in four tributaries (Baker, Thompson, Ancestor, and Squaw creeks) (MSG 2013). As the current distribution of spawning adults is limited to just a few tributaries with suitable habitat, the Mattole River coho salmon population's spatial structure and diversity are very limited compared to estimated historical conditions.

Population Size and Productivity

Williams et al. (2008) determined at least 250 coho salmon must spawn in the Mattole River population area each year to avoid effects of extremely low population sizes. As recently as 1987-88 the Mattole River was believed to support as many as 1,000 coho salmon spawners (MRRP 2011). However, no more than 11 live fish or 10 redds have been documented in the five most recent spawning seasons (2008-09 to 2012-13), with an all-time low of three live adults and one redd in the basin in 2009-10 (MSG 2010). Although the spawner and redd counts do not represent a population abundance estimate, the population's rapid decline is evident (Figure 29-5). Due to extremely low catches of coho salmon juveniles during outmigrant trapping efforts, outmigrant population estimates have not been calculated.

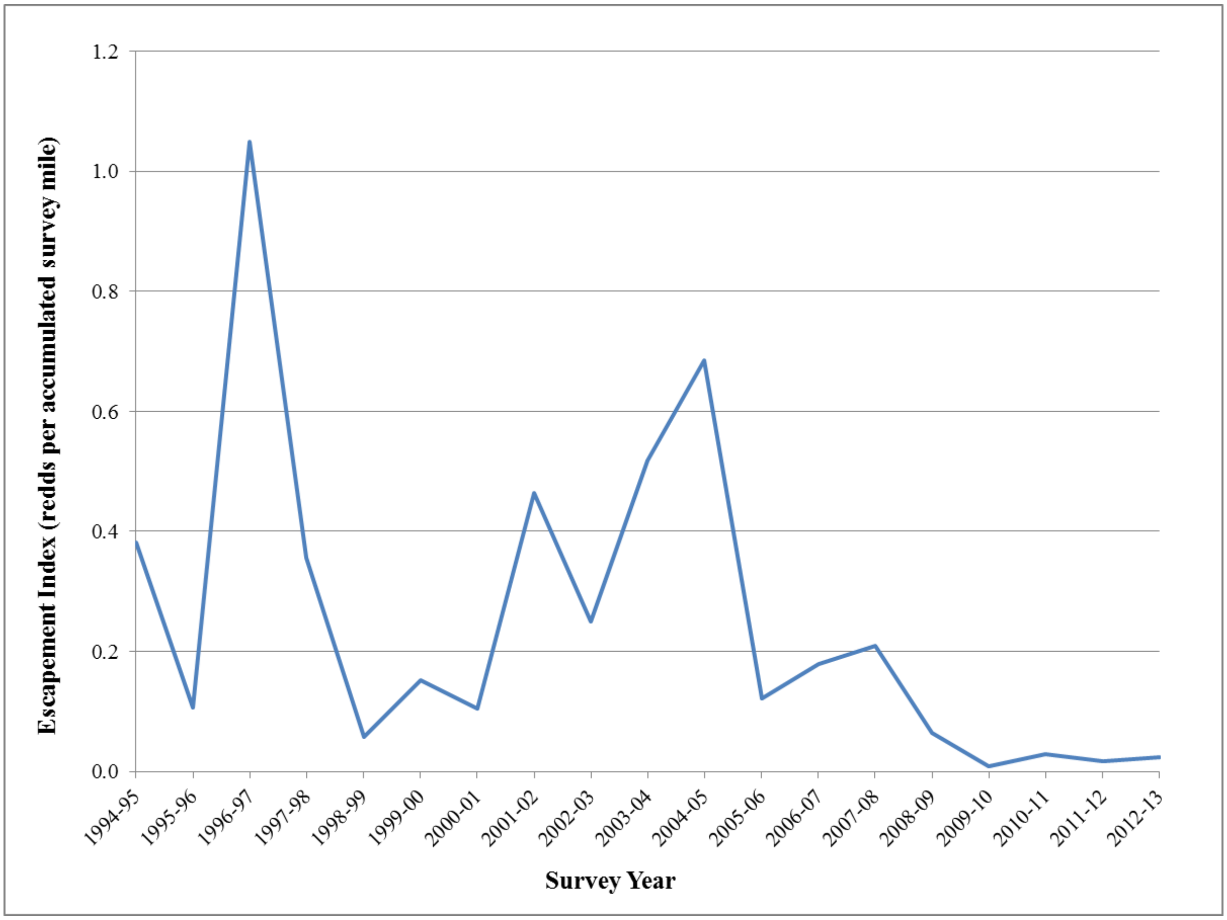

Figure 29-5. Escapement index (redds per survey mile) for the Mattole River coho salmon population. Data from Mattole Salmon Group (2013).

Extinction Risk

The Mattole River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Mattole River population is a non-core 1, Functionally Independent population within the Southern Coastal diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Mattole River core population needs to have at least 1,000 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. The Mattole River population will also contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to nearby populations.

29.4 Plans and Assessments

Mattole River and Range Partnership (MRRP)

Mattole Coho Recovery Strategy

The MRRP was formed between three watershed groups active in the basin. The partnership developed a coho salmon recovery strategy for coho salmon in the Mattole River basin. The strategy discusses population status, recovery targets, limiting factors, strategies for recovery, and a prioritized list of recovery actions.

State of California

CDFG Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish and Game Commission in February 2004. The strategy contains numerous recovery actions designed to improve coho salmon habitat in the Mattole River.

The North Coast Watershed Assessment Program (NCWAP)
http://www.coastalwatersheds.ca.gov

The NCWAP Mattole River basin Assessment identifies limiting factors for anadromous salmonids, including estuarine conditions, lack of habitat complexity, increased sediment levels, high water temperatures, and inadequate flows during the summer.

Bureau of Land Management (BLM)

Mattole River Watershed Assessments

The BLM has conducted several watershed assessments and developed Resource Management Plans for BLM managed lands within the Mattole River basin. These assessments and plans describe current conditions and needed actions in these watersheds.

The King Range National Conservation Area Resource Management Plan (BLM 2004d)

Mill Creek Watershed Analysis (BLM 2001a)

Honeydew Creek Watershed Analysis (BLM 1996c)

Bear Creek Watershed Analysis (BLM 1995a)

29.5 Stresses

Table 29-2. Severity of stresses affecting each life stage of coho salmon in the Mattole River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Hydrologic Function[1]	Low	Medium	Very High[1]	Medium	Medium	Very High
2	Lack of Floodplain and Channel Structure[1]	Medium	High	Very High[1]	High	Medium	Very High
3	Altered Sediment Supply	High	High	High	High	Medium	High
4	Impaired Water Quality	Medium	Medium	High	Medium	Medium	High
5	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
6	Impaired Estuary/Mainstem Function	-	Low	High	High	Low	High
7	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
8	Barriers	-	Low	Low	Low	Low	Low
9	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.
[2] Increased Disease/Predation/Competition is not considered a stress for this population.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for the Mattole River population are altered hydrologic function and lack of floodplain and channel structure, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. The juvenile life stage is most limited, primarily due to reductions in quality and quantity of summer and winter rearing habitat. Juvenile summer rearing habitat is impaired by low flow conditions exacerbated by water withdrawals and a reduced water table. The lack of flow results in dried stream reaches during the summer season, thereby reducing the extent of available habitat and nutrient transport through drift. High flow refugia habitat is severely lacking for winter rearing juveniles due to disconnected floodplains and a lack of instream complexity.

Altered Hydrologic Function

Altered hydrologic functions are most stressful for summer rearing juveniles. Low stream flows are problematic for coho salmon throughout the population area. These conditions are most severe when little or no rainfall occurs during summer months and where agricultural and residential water use is the highest. Low flows can result in stranding of individuals in disconnected pools, where high water temperature and low dissolved oxygen may become lethal, and juveniles are at increased risk of exposure to terrestrial predators.

Reaches in the southern sub-basin are prone to seasonal drying, and in many years it has become necessary to rescue and relocate juvenile coho salmon from drying pools. Some southern sub-basin streams with very little human water use (e.g., Baker Creek) have lower per-unit area flows in the summer when compared to other southern sub-basin streams with relatively high human water use. Therefore, other factors, such as young forest stands and degraded stream channels may be contributing to diminished flows.

Klein (2009) conducted a study of low flow conditions in the headwater reaches of the Mattole River and found that small amounts of rainfall (0.25") and multiple days of fog in the driest part of summer can provide relief to low or no flow conditions in the Mattole River headwaters. This study found that one inch of rainfall in July 2007 elevated subsequent mainstem flows for almost two weeks. Another finding of the study was that mainstem discharges in the Upper Mattole River were less than the sum of upstream tributary discharges and concluded that, among other things, water withdrawal in the mainstem may be a contributing factor to frequent low flow conditions downstream.

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure is most stressful for winter rearing juveniles. Pool depths are generally poor to fair throughout most of the basin, with the exception of the headwaters region. Pool frequency varies widely, with most of the very good ratings occurring in the smaller tributaries of the southern sub-basin. Data on instream large wood is limited, but lack of large wood does not appear to be a significant limiting factor in headwater tributaries. However, many headwater tributaries are incised and therefore potential for large wood recruitment is low. Increasing levels of instream wood would improve rearing conditions and result in higher egg to smolt survival rates. In many of the middle and lower mainstem tributaries a lack of large, pool forming wood does appear to be a problem (PALCO 2006b). Given the extensive timber harvest that has occurred in the basin and the changes in riparian vegetation characteristics, lack of large wood is likely limiting the development of complex stream habitat throughout the lower two thirds of the basin. The lack of complex overwintering habitat throughout much of the system may be a significant factor in the historical population decline and current low population abundance.

Impaired Water Quality

High water temperatures are problematic in many areas of the Mattole River population area, including the estuary. Water quality is most stressful for the juvenile life history stage because they are present during the summer and early fall when temperatures are highest. The coolest water temperatures are found in the southern sub-basin, near the community of Whitethorn, where headwater tributaries (e.g., Thompson, Mill, Bridge, and Buck creeks) consistently provide cold water to the mainstem Mattole.

Lethal dissolved oxygen (DO) levels add to the stresses of low flow and stranding in dry years. A DO level of 0.2 mg/L was recorded in an extremely dry year in 2002, which is well below the 6.0 mg/L threshold considered adverse to salmonids (MRRP 2009).

Altered Sediment Supply

Altered sediment supply presents a high stress across all life stages, except adults. Increased sediment delivery has filled pools, widened channels, and simplified stream habitat throughout the basin including the estuary. The widening of channels in the mainstem and major tributaries has likely exacerbated the rates of streambank failures as thalwegs shift and result in channel braiding.

In many reaches stream beds have aggraded, reducing surface flows and limiting access for migrating juveniles. Measurements suggest that pools in the southern basin may be mostly free of fine sediment accumulation. However, the preponderance of poor rankings throughout the population area suggests that sediment delivery to stream channels is a stress affecting the population.

Riparian Forest Conditions

Degraded riparian forest conditions exist across the basin and are a high stress for many life stages. Streamside canopy cover in the southern tributaries is primarily very good, but elsewhere in the population area canopy cover is either hardwood dominated or of insufficient size to provide large wood.

Impaired Estuary/Mainstem Functions

Prior to major land disturbances, the Mattole estuary/lagoon was notable for its depth and numerous functioning slough channels on both the north and south banks of the river (MRC 1995). Currently, the estuary is severely aggraded and lacks channel complexity, riparian cover, and fully functioning slough habitat.

Water temperatures in the estuary during late summer have been found to be poor for juvenile salmonids and may be impairing their survival at ocean entry (MRRP 2009). The lack of habitat complexity in the estuary may also be a stress for the population as juveniles and smolts may be more susceptible to predation due to inadequate cover.

Although formation of a sand bar across the mouth of the Mattole River is a natural phenomenon, the timing and duration of bar closure is also affected by legacy and current anthropogenic factors which influence the hydrology and stream flow into the estuary. At times in the recent past, efforts have been made to artificially breach the river mouth bar due to concerns of low survival rates for salmonids from an extended period of residence time in the estuary.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Barriers

Barriers are a low stress to the Mattole River population. Over the last two decades substantial funding has been provided to remove the barriers of most concern; however, there are five remaining barriers that are potentially limiting coho salmon distribution. The barriers (in order of priority for remediation) occur on the following creeks: Baker Creek, Painter Creek, Harris Creek, High Prairie Creek, and Granny Creek.

Adverse Hatchery-Related Effects

Small-scale hatch box and captive rearing programs were conducted in the past, but were discontinued in the 1980s. Hatchery-origin coho salmon may stray into Mattole River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

29.6 Threats

Table 29-3. Severity of threats affecting each life stage of coho salmon in the Mattole River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Dams/Diversions[1]	Low	Medium	Very High[1]	High	High	Very High
2	Urban/Residential/Industrial Dev.[1]	High	High	High[1]	High	Medium	High
3	Roads	High	High	High	High	Medium	High
4	Timber Harvest	High	High	High	High	Medium	High
5	High Severity Fire	High	High	High	High	Medium	High
6	Agricultural Practices	Medium	Medium	High	Medium	Medium	Medium
7	Channelization/Diking	Medium	Medium	Medium	Medium	Medium	Medium
8	Climate Change	Low	Low	Medium	Low	Medium	Medium
9	Fishing and Collecting	-	-	Low	Low	Medium	Low
10	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low
12	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage
[2]Invasive Non-Native/Alien Species is not considered a threat to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are dams/diversions and urban/residential/industrial development.

Dams/Diversions

Numerous wells and diversions for agricultural and domestic uses occur throughout the basin and reduce streamflows during critical low-flow periods. Of particular concern is the southern sub-basin where many of the highest IP reaches occur coincident with numerous rural residences. Bear Creek and the North Fork Mattole River may also be influenced by agricultural and residential withdrawals. An ongoing forbearance program led by Sanctuary Forest, where water is stored in tanks during the wet season for summer use, will continue to reduce the number of dry season water diversions. However, the program alone is likely not sufficient to eliminate this threat.

Marijuana cultivation has continued to expand in many areas of the Mattole River population area. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Urban/Residential/Industrial Development

Rural population growth will continue to present a high threat to coho salmon in the Mattole River as there is no water development agency in the basin and landowners are left to find their own sources of water. The lack of a structured water right permitting program is a significant deficiency in this basin for the protection of summer rearing coho salmon juveniles. Additionally, development results in removal of vegetation, increased sediment generation and delivery, increased road density, and introduction of exotic species. Subdivision of existing parcels is likely to exacerbate this threat.

Roads

Roads are a threat across all life stages. Although significant efforts have been made in the basin to upgrade and decommission roads to reduce their sediment generating potential, road density remains high throughout the basin, with some areas having greater than 5 road miles/square mile of basin (PALCO 2006b). Given the extensive problem of sedimentation, roads throughout the basin should continue to be considered for removal or treatments to reduce sediment delivery.

Road building for access to marijuana cultivation sites is common in many areas of the Mattole River population area. It is likely that many of these roads are unpermitted and contribute excessive amounts of fine sediment to coho salmon streams.

Roads in the northern and western basin should continue to receive high priority as they occur in the region most susceptible to mass-wasting and significant landslide events. The continuation of such occurrences impedes the ability of important tributaries to route sediment, and return to more balanced states of channel and riparian stability.

Timber Harvest

Timber harvest is most concentrated in the North Fork Mattole River, Oil Creek, and the southern sub-basin. Numerous small non-industrial timber harvesting activities occur throughout the population area. Many of the changes in stream and riparian conditions are the result of more intensive historic harvest. However, given the percentage of the basin that is in private ownership, future timber harvest is still considered a high threat and should be carefully considered with regards to its effects on coho salmon, particularly in the southern sub-basin and other tributaries known to support coho salmon. A program-level environmental impact report for timber harvesting practices is available for landowners in the Mattole River population area when preparing timber harvest plans.

High Severity Fire

Young, dense forests throughout the population area present a high threat for high severity fires. High severity fires can significantly contribute to large-scale mass-wasting events if not properly treated with high levels of erosion control devices after the fire has ended. Even with the best efforts made at controlling post-fire erosion, the first rains typically produce much higher rates of sediment delivery than pre-fire conditions and can contribute to high sediment loading in affected watercourses.

Agricultural Practices

Marijuana cultivation has become common in many areas of the Mattole River population area. Although the number of plants grown each year is unknown, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality in coho salmon streams.

Livestock grazing occurs throughout the basin and can result in increased erosion and sediment delivery if not properly managed. However, specific information on the magnitude of grazing impacts is limited. Water withdrawals for agricultural uses were considered in the “Dams/Diversions” threat.

Channelization/Diking

Although channelization and diking is not widespread, localized restrictions may occur where roads that run parallel to streams (e.g. Lower Bear Creek) reduce floodplain connectivity and function. Other instances of channelization near tributary confluences should be identified and considered for alteration to improve floodplain function and potentially provide off-channel habitat.

Climate Change

Climate change modeling indicates climate change poses a medium threat to this population. As mentioned previously, air temperatures in this basin depend on proximity to the coastline. Along the coastal areas of the basin (essentially west of Petrolia), summertime temperatures are strongly influenced by the coastal marine layer (fog) and remain relatively cool throughout the summer. East of Petrolia, with the King Range blocking marine influence, daytime summer temperatures often remain above 80° F. Generally, as inland temperatures rise the marine layer becomes thicker and moves farther inland (the fog "belt"). If climate modeling proves correct, the impacts of climate change in this region will have the greatest impact on juveniles and adults. Modeled regional average temperature shows an increase over the next 50 years (see Appendix B for modeling methods). Average air temperature could increase by up to 1° C in the summer and by the same amount in the winter.

Annual precipitation in this area is predicted to trend downward over the next century; however, a critical factor is how precipitation is distributed over critical seasons. For example, if rains end sooner and begin later in the fall, the threat to coho salmon in this region is significant as the expectation would be that cool, rearing pools would be more susceptible to drying resulting in increasing mortality events as previously described. If, on the other hand, climate change results in slightly higher air temperatures, but more frequent instances of cool summer storms that generate overland flow, the opposite effect may be experienced (reduced rates of low or no flow events) potentially expanding the rearing habitat for juveniles.

Changes in precipitation patterns may not be beneficial in the estuary if changes to natural cycles of river mouth breaching and closing are a result. Early breaching events could negatively affect ocean survival of smolts to adults if smolts have not had enough time in the estuary to achieve optimal growth in preparation for ocean entry. In addition, these alterations in the freshwater input cycle to the marine environment could alter near-shore ecology and salmonid prey species. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, as with all populations in the ESU adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Mining/Gravel Extraction

Gravel extraction and mining was ranked as a low threat as very little in-stream gravel mining occurs in the Mattole. The County of Humboldt infrequently removes gravel from a single bar on the lower North Fork Mattole River. Currently, upslope mining is minimal to non-existent in the basin. Due to the remote location of the basin and the high cost of trucking gravel out of the basin, increased rates of gravel extraction are not anticipated.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Mattole River population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Road-Stream Crossing Barriers

Much work has been done to remove barriers in the basin and as such, barriers are a low threat. As mentioned previously, five barriers exist but block a small amount of coho salmon habitat.

29.7 Recovery Strategy

Coho salmon abundance in the Mattole River is severely depressed with constricted distribution. Recovery activities in the basin should promote increased spatial distribution as well as increased productivity and abundance. Activities should occur basin-wide, with a focus on the high-potential tributaries listed in Table 29-1. Activities that reduce the instances of low or no flow conditions, decrease sediment delivery, improve stream temperatures, improve long term prospects for large wood recruitment, and promote increased floodplain and channel structure should be a priority in the basin. Recovery actions for the estuary should enhance riparian functions to provide cover and moderate stressful water temperatures, and increase instream complexity for flow refugia and protection against predation. If suitable habitat exists but population recovery is limited by small population size, an enhancement program may be necessary. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 29-4 on the following page lists the recovery actions for the Mattole River population.

Table 29-4. Recovery action implementation schedule for the Mattole River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	1
SONCC-MatR.3.1.6.1	*Identify and cease unauthorized water diversions*					
SONCC-MatR.3.1.3	Hydrology	Yes	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	1
SONCC-MatR.3.1.3.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-MatR.3.1.3.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-MatR.3.1.3.3	*Implement coho salmon instream flow needs plan.*					
SONCC-MatR.26.1.1	Low Population Dynamics	No	Increase population abundance	Implement an enhancement program	Population wide	1
SONCC-MatR.26.1.1.1	*Assess impacts and benefits associated with different enhancement programs such as captive broodstock, rescue rearing, and conservation hatcheries*					
SONCC-MatR.26.1.1.2	*If enhancement is determined to be beneficial, acquire necessary permits for enhancement program*					
SONCC-MatR.26.1.1.3	*If enhancement is determined to be beneficial, develop a facility to rear fish*					
SONCC-MatR.26.1.1.4	*Operate enhancement program as a temporary strategy to prevent extirpation*					
SONCC-MatR.26.1.1.5	*Monitor fish populations at all life stages including juvenile snorkel counts, downstream migrant counts, spawning surveys, and Passive Integrated Transponder (PIT) tagging*					
SONCC-MatR.26.1.47	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	1
SONCC-MatR.26.1.47.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-MatR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2a
SONCC-MatR.3.1.7.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-MatR.3.1.7.2	*Implement water dedications to increase instream flows using the streamlined process*					
SONCC-MatR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2a
SONCC-MatR.3.1.8.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MatR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-MatR.3.1.5.1		*Increase participation in forbearance program through education and incentives*				
SONCC-MatR.3.1.5.2		*Monitor forbearance compliance*				
SONCC-MatR.3.1.61	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	Population wide	2b
SONCC-MatR.3.1.61.1		*Increase participation in forbearance program through education and incentives*				
SONCC-MatR.3.1.61.2		*Monitor forbearance compliance*				
SONCC-MatR.2.1.12	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2a
SONCC-MatR.2.1.12.1		*Assess habitat to determine beneficial location and amount of instream structure needed*				
SONCC-MatR.2.1.12.2		*Place instream structures, guided by assessment results*				
SONCC-MatR.2.1.58	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-MatR.2.1.58.1		*Assess habitat to determine beneficial location and amount of instream structure needed*				
SONCC-MatR.2.1.58.2		*Place instream structures, guided by assessment results*				
SONCC-MatR.2.1.68	Floodplain and Channel Structure	Yes	Increase channel complexity	Re-connect channel to mainstem	Lower Bear Creek (lower mainstem)	2a
SONCC-MatR.2.1.68.1		*Assess feasibility of long-term solutions to re-connect Lower Bear Creek to the mainstem Mattole River*				
SONCC-MatR.2.1.68.2		*If feasible, develop plan to re-connect Lower Bear Creek to mainstem Mattole River*				
SONCC-MatR.2.1.68.3		*Re-connect Lower Bear Creek to the mainstem Mattole River*				
SONCC-MatR.3.2.10	Hydrology	Yes	Increase water storage	Increase water retention	All streams where coho salmon would benefit immediately	2a
SONCC-MatR.3.2.10.1		*Develop water storage and recharge plan*				
SONCC-MatR.3.2.10.2		*Implement projects identified in water storage and recharge plan*				
SONCC-MatR.3.2.10.3		*Maintain water storage structures*				
SONCC-MatR.3.2.62	Hydrology	Yes	Increase water storage	Increase water retention	Population wide	2b
SONCC-MatR.3.2.62.1		*Develop water storage and recharge plan*				
SONCC-MatR.3.2.62.2		*Implement projects identified in water storage and recharge plan*				
SONCC-MatR.3.2.62.3		*Maintain water storage structures*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.2.2.13	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-MatR.2.2.13.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MatR.2.2.13.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MatR.2.2.59	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-MatR.2.2.59.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MatR.2.2.59.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MatR.3.1.48	Hydrology	Yes	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2b
SONCC-MatR.3.1.48.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-MatR.3.1.48.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-MatR.3.1.48.3	*Implement plan*					
SONCC-MatR.22.2.49	Urban, Residential, Industrial Development	Yes	Improve flow timing or volume	Ensure adequate summer base flow	All areas where coho salmon would benefit immediately	2b
SONCC-MatR.22.2.49.1	*Ensure sub-division of existing parcels does not result in increased water demand during low-flow season*					
SONCC-MatR.22.2.60	Urban, Residential, Industrial Development	Yes	Improve flow timing or volume	Ensure adequate summer base flow	Population wide	2c
SONCC-MatR.22.2.60.1	*Ensure sub-division of existing parcels does not result in increased water demand during low-flow season*					
SONCC-MatR.22.3.45	Urban, Residential, Industrial Development	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve regulatory mechanisms	Population wide	2b
SONCC-MatR.22.3.45.1	*Develop ordinance, permit requirements, and guidance to maintain open space*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MatR.5.2.43	Passage	No	Decrease mortality	Screen all diversions	All areas where coho salmon would benefit immediately	2b
SONCC-MatR.5.2.43.1	*Assess diversions and develop a screening program*					
SONCC-MatR.5.2.43.2	*Screen all diversions*					
SONCC-MatR.5.2.64	Passage	No	Decrease mortality	Screen all diversions	Population wide	2d
SONCC-MatR.5.2.64.1	*Assess diversions and develop a screening program*					
SONCC-MatR.5.2.64.2	*Screen all diversions*					
SONCC-MatR.1.2.35	Estuary	No	Improve estuarine habitat	Assess estuary and tidal wetland habitat	Estuary	2b
SONCC-MatR.1.2.35.1	*Identify parameters to assess condition of estuary and tidal wetland habitat*					
SONCC-MatR.1.2.35.2	*Determine amount of estuary and tidal wetland habitat needed for population recovery*					
SONCC-MatR.1.2.35.3	*Restore estuary and tidal wetland habitat guided by the plan*					
SONCC-MatR.1.2.56	Estuary	No	Improve estuarine habitat	Restore estuarine habitat	Population wide	2d
SONCC-MatR.1.2.56.1	*Assess factors limiting coho rearing in the estuary including temperature, excess sediment, complexity, and size of estuary*					
SONCC-MatR.1.2.56.2	*Develop a plan to restore the estuary including restoration of the north and south sloughs, and potentially removing excess sediment*					
SONCC-MatR.1.2.56.3	*Implement the estuary restoration plan*					
SONCC-MatR.10.7.55	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All areas where coho salmon would benefit immediately	2b
SONCC-MatR.10.7.55.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MatR.10.7.55.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MatR.10.7.57	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	2d
SONCC-MatR.10.7.57.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MatR.10.7.57.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MatR.3.1.9	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3a
SONCC-MatR.3.1.9.1	*Establish a comprehensive groundwater permit process*					
SONCC-MatR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	3b
SONCC-MatR.3.1.4.1	*Develop an educational program about water conservation programs and instream leasing programs*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MatR.5.1.19	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	3b
SONCC-MatR.5.1.19.1		*Inventory and prioritize barriers*				
SONCC-MatR.5.1.19.2		*Remove barriers, based on assessment*				
SONCC-MatR.5.1.63	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-MatR.5.1.63.1		*Inventory and prioritize barriers*				
SONCC-MatR.5.1.63.2		*Remove barriers, based on assessment*				
SONCC-MatR.7.1.14	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands where coho salmon would benefit immediately	3b
SONCC-MatR.7.1.14.1		*Assess grazing contribution to sediment delivery, pollutants, and riparian condition*				
SONCC-MatR.7.1.14.2		*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*				
SONCC-MatR.7.1.14.3		*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*				
SONCC-MatR.7.1.65	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-MatR.7.1.65.1		*Assess grazing contribution to sediment delivery, pollutants, and riparian condition*				
SONCC-MatR.7.1.65.2		*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*				
SONCC-MatR.7.1.65.3		*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*				
SONCC-MatR.8.1.18	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	All areas where coho salmon would benefit immediately	3b
SONCC-MatR.8.1.18.1		*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*				
SONCC-MatR.8.1.18.2		*Implement plan to stabilize slopes and revegetate areas based on assessment*				
SONCC-MatR.8.1.67	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-MatR.8.1.67.1		*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*				
SONCC-MatR.8.1.67.2		*Implement plan to stabilize slopes and revegetate areas based on assessment*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.8.1.17	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	3b
SONCC-MatR.8.1.17.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MatR.8.1.17.2	*Decommission roads, guided by assessment*					
SONCC-MatR.8.1.17.3	*Upgrade roads, guided by assessment*					
SONCC-MatR.8.1.17.4	*Maintain roads, guided by assessment*					
SONCC-MatR.8.1.66	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MatR.8.1.66.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MatR.8.1.66.2	*Decommission roads, guided by assessment*					
SONCC-MatR.8.1.66.3	*Upgrade roads, guided by assessment*					
SONCC-MatR.8.1.66.4	*Maintain roads, guided by assessment*					
SONCC-MatR.3.1.2	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-MatR.3.1.2.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-MatR.3.1.46	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-MatR.3.1.46.1	*Provide tax and permit incentives for protection of coho salmon and their habitat*					
SONCC-MatR.7.1.16	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
SONCC-MatR.7.1.16.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan)*					
SONCC-MatR.7.1.15	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3d
SONCC-MatR.7.1.15.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MatR.7.1.15.2	*Thin, or release conifers, guided by the plan*					
SONCC-MatR.7.1.15.3	*Plant conifers, guided by the plan*					
SONCC-MatR.7.1.40	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Re-establish natural fire regime	Population wide	3d
SONCC-MatR.7.1.40.1	*Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime*					
SONCC-MatR.7.1.40.2	*Carry out fuel reduction or modification projects such as thinning, prescribed burning, and piling, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MatR.16.1.21	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MatR.16.1.21.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MatR.16.1.21.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-MatR.16.1.22	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MatR.16.1.22.1	*Determine actual fishing impacts*					
SONCC-MatR.16.1.22.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-MatR.16.2.23	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MatR.16.2.23.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-MatR.16.2.23.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-MatR.16.2.24	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MatR.16.2.24.1	*Determine actual impacts of scientific collection*					
SONCC-MatR.16.2.24.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-MatR.8.1.42	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	Population wide	3d
SONCC-MatR.8.1.42.1	*Identify and cease unauthorized road building or grading*					
SONCC-MatR.10.2.41	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	3d
SONCC-MatR.10.2.41.1	*Identify pollution sources, and develop a strategy to minimize runoff to streams*					
SONCC-MatR.10.2.41.2	*Implement strategy to minimize pollution runoff to streams*					

30. Illinois River Population

Interior Rogue River Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely above depensation threshold

11,800 Spawners Required for ESU Viability

400 mi^2 watershed (82% Federal ownership)

590 IP-km (367 IP-mi) (47% High)

Dominant Land Uses are Agriculture and Urban/Residential/Commercial Development

Key Limiting Stresses are 'Altered Hydrologic Function' and 'Degraded Riparian Forest Conditions'

Key Limiting Threats are 'Roads' and 'Dams/Diversions'

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, and instream structure • Improve suction dredging practices • Re-connect floodplains, wetlands, and off-channel habitat	• Improve agricultural practices • Improve timber harvest practices by revising Oregon Forest Practices Act • Reduce road-stream hydrologic connection

30.1 History of Habitat and Land Use

From 1780 to 1840, trappers swept Oregon coastal rivers, including the Rogue River basin, reducing the robust beaver population to remnant levels (Oregon Department of Fish and Wildlife (ODFW) 2005b). Beaver ponds provide excellent rearing habitat for coho salmon, and thus beaver trapping was likely the first negative effect of European settlers on coho salmon. Gold mining in the Illinois Valley began in the 1850s (U.S. Bureau of Land Management (BLM) 2003). Flood terraces were turned over, which disrupted riparian areas and in some cases unleashed large quantities of sediment (U.S. Forest Service (USFS) 1999a).

The first agricultural development arose to support the community of miners. After the gold rush, agriculture continued to expand in the fertile lowlands surrounding the river. Meadows and valley bottom forests were converted to pasture where thousands of cows grazed, and more than 100,000 sheep occupied upland meadows of the Illinois sub-basin and other watersheds in Siskiyou Mountains (USFS 1999a).

Timber harvest on a large scale began in the Illinois Valley after World War II (USFS 1997a, USFS and BLM 2000), when there were few restrictions on harvesting near streams or using stream beds to skid logs. Channel damage from the 1964 flood was widespread and exacerbated by timber harvest and road building activities. Affected areas included the East Fork Illinois River and its tributaries Chicago and Dunn creeks (USFS and BLM 2000), and Sucker Creek and its tributaries Grayback, Cave, Tannen creeks (USFS 1997a).

Less ground-disturbing methods of timber harvest were used by the USFS and U.S. Bureau of Land Management (BLM) in the 1970s and 1980s, but many landslides still occurred as a result from failures on steep harvested slopes (USFS 2000b) and extensive road networks (BLM 1997, USFS 1998c). This triggered another sediment pulse that compounded adverse effects to habitat.

Alluvial valley reaches near the mouth of the Illinois River that strongly overlap with extensive high IP (>0.66) coho salmon habitat (Williams et al. 2006) were formerly winding channels with complex wetlands and likely numerous beaver ponds (BLM 2005a). These reaches would have had substantial groundwater and surface water connections (Oregon Department of Environmental Quality (ODEQ) 2008) as well as slow water habitats suitable for both summer and winter rearing of coho salmon juveniles. These mainstem summer and winter refugia for coho salmon juveniles have been largely lost.

Although federal ownership covers 81 percent of the Illinois River population, the vast majority of stream reaches on USFS and BLM lands are too steep or otherwise unsuitable for coho salmon. Both the USFS and BLM have adopted new timber harvest practices which are less detrimental to salmonid habitat. Forests are now being thinned to meet conservation and recreation objectives (USFS 2007), rather than cleared for timber sale. Aquatic habitat on federal lands in the Illinois River sub-basin is recovering in response to these land use changes.

Rural residential growth in the watershed has followed a pattern similar to other areas of Josephine and Curry counties, with related increased demand on surface and groundwater (Southwest Oregon Resource Conservation and Development Council (SORC&D) 2003).

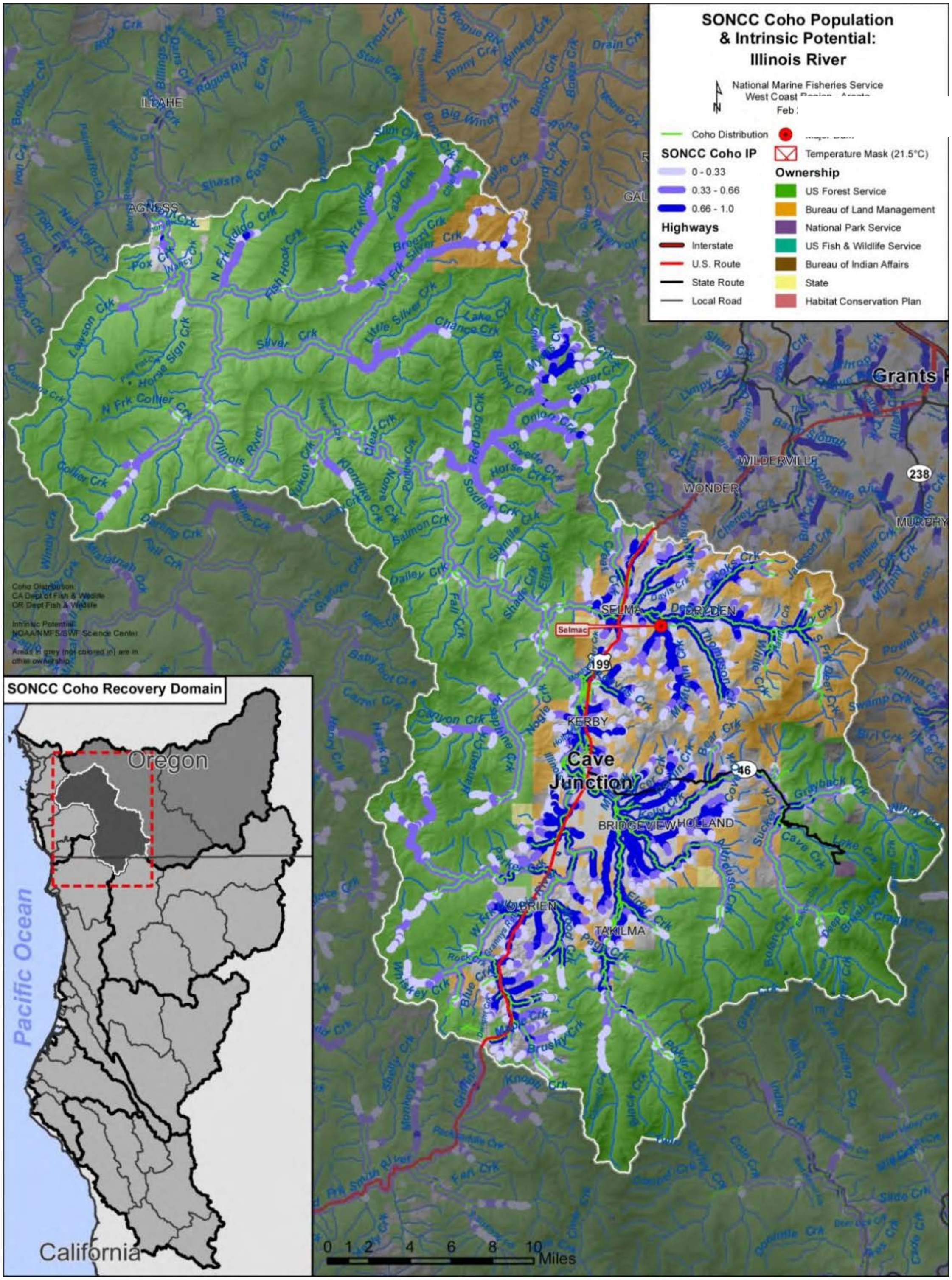

Figure 30-1. The geographic boundaries of the Illinois River coho salmon population. Figure shows modeled Intrinsic Potential habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Rogue River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership. Map does not show falls 0.7 miles from mouth of Briggs Creek which are complete natural barriers to coho salmon.

30.2 Historic Fish Distribution and Abundance

Historically, coho salmon were widely distributed in the Illinois River watershed; however most of the high intrinsic potential (IP >0.66) coho salmon habitat (Williams et al. 2008) is in low gradient tributaries in the upper portion of the sub-basin (Figure 30-1). Coho salmon production potential is limited in other areas. Tributaries of the lower Illinois River sub-basin, such as Silver, Lawson, and Indigo creeks, are too steep and confined for coho salmon to flourish. High IP coho salmon habitat occurs on a bench in the upper North Fork of Silver Creek (Figure 30-1) but coho salmon access to that reach is blocked (BLM 2004a) by a series of culverts; natural falls downstream are additional potential impediments to passage. Briggs Creek Valley near the headwaters of Briggs Creek contains high IP habitat (Figure 30-1), but is inaccessible to coho salmon due to a longstanding natural barrier. That barrier is a steep boulder canyon with at least two 6-foot falls located approximately 0.7 miles from the mouth (Siskiyou Research Group 2003). A substantial portion of the western Illinois River sub-basin has serpentine soils that naturally support sparse riparian conditions (USFS 2000b) that likely result in warm stream temperatures. Therefore, streams that flow from this terrain, such as Rough and Ready and Josephine creeks, are unsuitable for coho salmon. This profile focuses on the upper Illinois River sub-basin where tributaries with high IP coho salmon habitat exist: the mainstem Illinois River, East Fork Illinois River, West Fork Illinois River, Althouse Creek, Sucker Creek, and Deer Creek.

A cannery operated at the mouth of the Rogue River beginning in 1876. Records from that cannery were used to estimate an annual run size of approximately 114,000 adult coho salmon in the late 1800s (Meengs and Lackey 2005). There is no way to know how many of these fish were returning to the Illinois River sub-basin, rather than elsewhere in the 5,600 square mile Rogue River basin. The Illinois River sub-basin contains 25 percent of the basin-wide IP kilometers of habitat (Williams et al. 2008), suggesting possible returns of 28,500 fish during the time of cannery operation if fish were distributed in proportion to IP kilometers.

Table 30-1. Tributaries with high IP reaches (IP > 0.66) in the Illinois River (Williams et al. 2006).

Watershed	Stream Name	Watershed	Stream Name
West Fork Illinois	Brushy Creek	Mainstem and East Fork Illinois	Althouse Creek
	Dwight Creek		Althouse Slough
	Elk Creek		Bear Creek
	Gilligan Creek		Chapman Creek
	Logan Creek		Democrat Gulch
	Mendenhall Creek		Elder Creek
	Trapper Gulch		Free and Easy Creek
	West Fork Illinois River		George Creek
	Whiskey Creek		Grayback Creek
	Woodcock Creek		Holton Creek
Deer Creek	Anderson Creek		Horse Creek
	Clear Creek		Kelly Creek
	Crooks Creek		Khoeery Creek
	Davis Creek		Little Elder Creek
	Deer Creek		Long Gulch
	Draper Creek		Mill Creek
	Haven Creek		Myers Creek
	McMullin Creek		North Fork Silver Creek
	North Fork Deer Creek		Page Creek
	Potter Gulch		Poker Creek
	Salt Gulch		Reeves Creek
	South Fork Deer Creek		Senior Gulch
	Thompson Creek		Scotch Gulch
	Whites Creek		Skagg Creek
			Sucker Creek
			Tycer Creek

30.3 Status of Illinois River Coho Salmon

Spatial Structure and Diversity

ODFW (2005a) surveys from 1998 to 2004 confirmed that coho salmon still migrate to Illinois River tributaries in an extensive area, but rearing is concentrated in small patches in upper reaches of Illinois Valley streams, just below federal land. Comparatively high densities of juvenile coho salmon have been found in Deer, Sucker, and Althouse creeks as well as the East and West Forks of the Illinois River (Figure 30-2). During the 2004 to 2009 run years, on average about 70 percent of sites were occupied by adult coho salmon with an estimated average of 25 spawners per mile (hatchery or wild origin unstated) (Lewis et al. 2009). In most cases, coho salmon are naturally absent from steep lower Illinois River tributaries and those that drain the serpentine bedrock area of the western part of the sub-basin (e.g., Rough and Ready and Josephine creeks).

Population Size and Productivity

ODFW (2011b) estimated the abundance of wild adult coho salmon from 2002 to 2008 in the Illinois River (Figure 30-3). Wild adult coho salmon spawner abundance for the Illinois population was estimated to be 2,117 in 2007 and 745 in 2008 (Figure 30-3). Data were not collected in 2005, 2009, and 2010 which complicated efforts to track the strength of year classes. The lowest three-year running average of the number of spawners was 1431. Therefore, the Illinois River population of coho salmon is at moderate risk of extinction with regard to the spawner abundance because the spawner abundance is above the depensation threshold of 590 but below the low risk threshold of 11,800 adults.

The number of adult coho salmon is estimated using a seine-recapture method at Huntley Park in the Lower Rogue River (river mile 8). These data provide the most robust and precise estimates of adult coho salmon abundance in the Rogue River (ODFW 2013b). It is impossible to determine, with existing information, how many of the estimated coho salmon at Huntley Park were returning to the Illinois River, but if the trend in abundance is assumed to reflect trends in the Illinois River, the data can inform whether the population is at high risk of extinction due to the population decline criterion (Williams et al. 2008). The number of spawners at Huntley Park has declined at an annual rate of 11 percent over the last 12 years (Figure 30-4), greater than the 10% decline associated with a high risk of extinction (Williams et al. 2008). Therefore, the population is likely at high risk of extinction due to its sharply declining productivity.

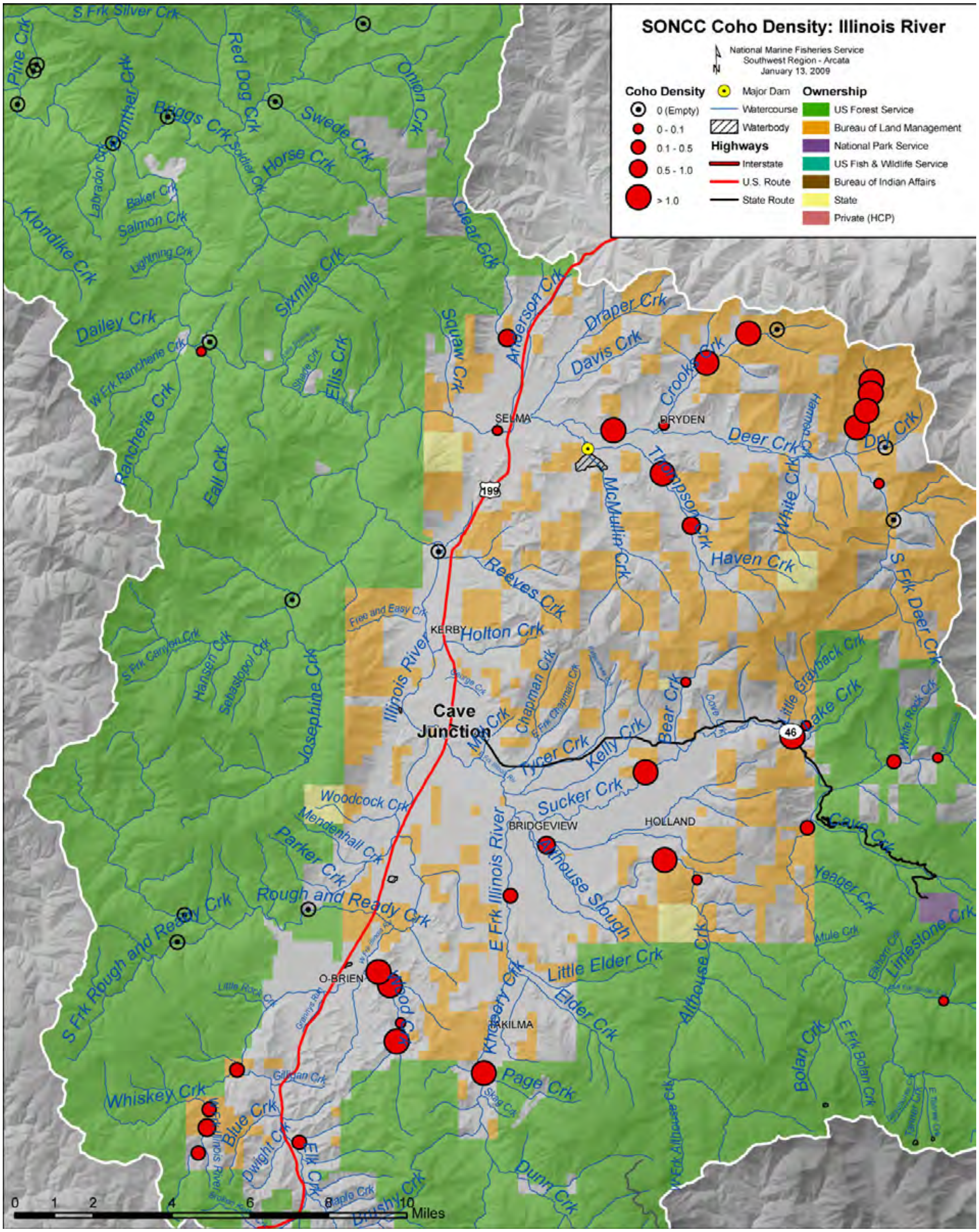

Figure 30-2. Upper Illinois River juvenile coho salmon survey results. Data are from 1998 to 2004 and show presence, absence and density of fish per square meter. (ODFW 2005a).

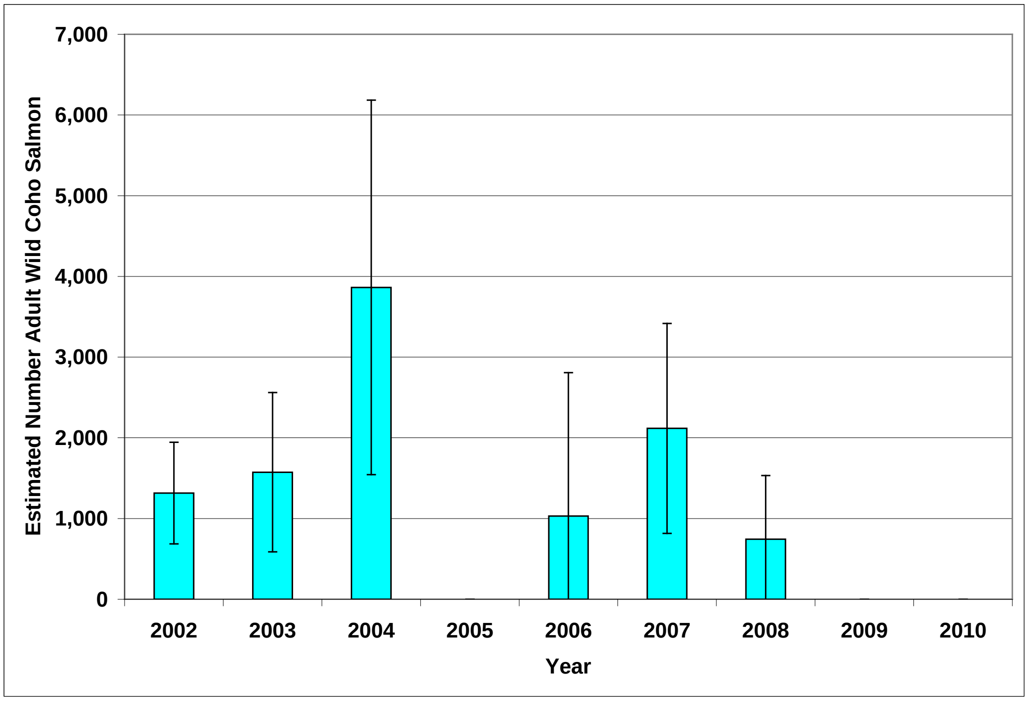

Figure 30-3. Estimated number of wild adult coho salmon in the Illinois River, from 2004 through 2010. No sampling occurred in 2005, 2009, or 2010 (ODFW 2011).

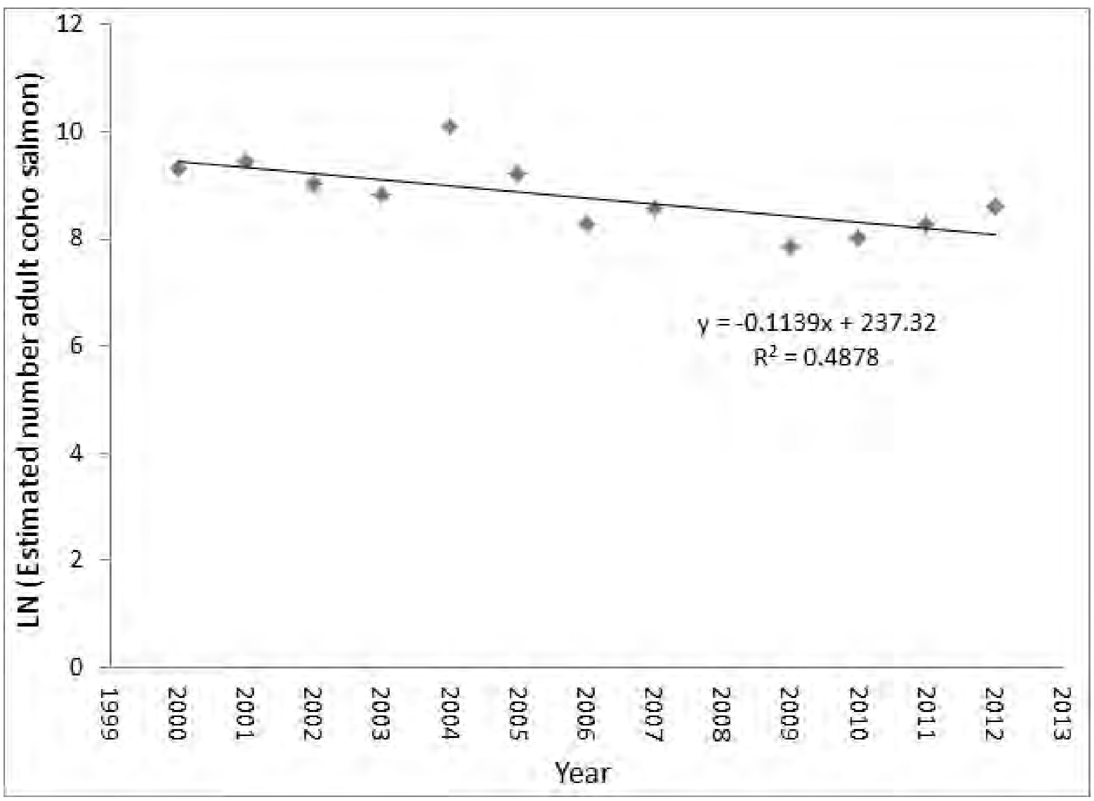

Figure 30-4. Rate of decline of estimated population abundance at Huntley Park (data from ODFW 2013b).

Using seine mark-recapture data from Huntley Park, ODFW (2005c) calculated productivity for wild adult coho salmon in the Illinois, Middle, and Upper Rogue populations aggregated together for each year from 1980 to 2000. Recruits per spawner were less than replacement levels in eight of the years, indicating low productivity during those years (Figure 30-5).

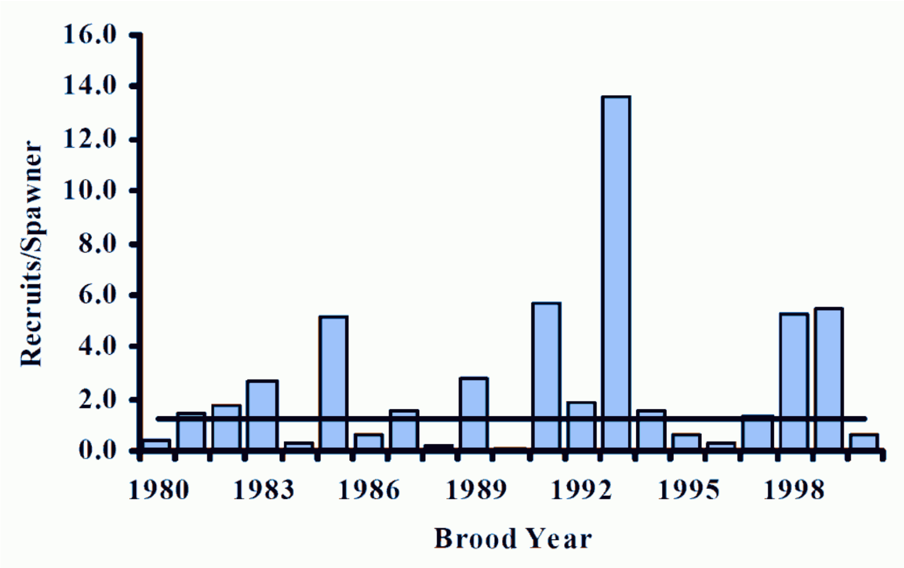

Figure 30-5. Recruit per spawner for brood years 1980 through 2000. Data are for the Rogue River, which includes the Middle Rogue, Upper Rogue, and Illinois River populations. Figure from ODFW 2005c.

Extinction Risk

The Illinois River population is at high risk of extinction. The ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one; however, the population declined at a rate of ≥10% per year over the last two-to-four generations (both criteria described by Williams et al. (2008)). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria are related to population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Illinois River population is a core, Functionally Independent population within the Interior Rogue River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Illinois River core population needs to have at least 11,800 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Illinois population may serve as a source of spawner strays for other populations in the Rogue River basins: the Lower Rogue, Middle Rogue/Applegate, and Upper Rogue river populations.

30.4 Plans and Assessments

U.S. Forest Service, Rogue River-Siskiyou National Forest

Sucker Creek Watershed Aquatic Restoration Plan (USFS 2007)

This plan proposes to improve aquatic habitat in the Sucker Creek watershed through placing instream large wood, planting disease resistant Port Orford cedar, riparian thinning, increasing beaver supplementation populations, replacing culverts, and upgrading and decommissioning roads.

Sufficiency Assessment: Forest Service and Bureau of Land Management Programs in Support of SONCC Coho Salmon Recovery (USFS and BLM 2011)

The USFS has adopted a Watershed Condition Framework assessment and planning approach (USFS and BLM 2011). The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, Middle Sucker Creek, Grayback Creek, and Dunn Creek were identified as high priority 6th field sub-watersheds in Rogue-Siskiyou National Forest (USFS and BLM 2011). Watershed Restoration Action Plans (WRAPs), which update existing watershed analyses, are part of the WCF and were completed for each priority sub-watershed. USFS and BLM (2011) summarizes these WRAPs and describes, for each sub-watershed: the rationale for its priority status, key issues, essential projects, and partnership opportunities.

U.S. Bureau of Land Management (Medford District)

Lower East Fork Illinois Watershed Water Quality Restoration Plan (BLM 2006)

West Fork Illinois Watershed Water Quality Restoration Plan (BLM 2007)

These plans describe base flow, riparian condition, and channel condition in the watersheds and identify goals, objectives, and proposed management measures to improve water quality.

State of Oregon

Expert Panel on Limiting Factors for Oregon's SONCC coho salmon populations

ODFW (2008b) convened a panel of fisheries and watershed science experts as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on perceived limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the concerns for the Illinois River are as follows:

Key concerns were related to loss of over-winter tributary habitat complexity and access and over-summer water temperatures and habitat access. Over-winter tributary habitat, especially in the lowlands, has been impacted by past and current agricultural practices and an interruption in the transport and presence of large wood. Access to habitat has been limited by road crossings. Summer habitat is limiting because high water temperatures have resulted from land management actions in the riparian zone and straightening of channels and water management actions for agricultural purposes. Water withdrawals and diversions have also limited the amount of, and access to, summer habitat and thermal refuge.

Secondary concerns spanned a number of life history stages and locations. Unscreened diversions and non-criteria screens at diversions affect fry, summer parr, and out-migrating smolts. Summer juvenile habitat has been impacted by a loss of tributary habitat complexity, especially in the lowlands, caused by past and current agricultural practices and an interruption in the transport and presence of large wood. Access to summer thermal refuge habitat by juveniles has also been affected by road crossings. Non-native vegetation is a secondary factor contributing to higher water temperatures affecting summer parr by limiting native riparian vegetation. A reduction in floodplain connectivity has affected winter parr. Access to spawning habitat by returning adults is limited by road crossings and diversion structures. Finally, reduced estuarine habitat for smolts due to past and current forestry practices and rural residential development is another impact.

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The state of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is comprehensive and includes voluntary actions for all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary. The action plans, implementation, and annual reports can be found at the web site.

ODFW Coastal Salmonid Inventory Project

ODFW has monitored coho salmon in the Illinois River as part of their Coastal Salmonid Inventory Project. From 1998 to 2004, ODFW conducted dives to count juvenile coho salmon in the Illinois Valley (ODFW 2005a) (Figure 30-2). ODFW also estimated the abundance of adult coho salmon in the Illinois River from 2002 to 2004 and from 2006 to 2008 (ODFW 2011).

Southwest Oregon Salmon Restoration Initiative

The Southwest Oregon Salmon Restoration Initiative (Prevost et al. 1997) was created to help fulfill a memorandum of understanding between ODFW and the National Marine Fisheries Service (NMFS) to recover coho salmon. The initiative provides the framework for recovery in southwest Oregon and helped foster formation of watershed councils. The initiative designated

Sucker/Grayback Creek, East Fork Illinois, Althouse Creek, Elk Creek/Broken Kettle Creek, and Dunn Creek as "core areas" in the Illinois River watershed that are the highest priority for restoration in the Oregon component of the SONCC coho ESU.

Water Requirements of Rogue River Fish and Wildlife

ODFW fisheries biologists (Thompson and Fortune 1970) conducted widespread surveys of the Rogue River basin to assess water flow and its effect on fish habitat and carrying capacity for salmonids. The study was designed to inform the Oregon Water Resources Board so that a "beneficial water use program" could be developed. Thompson and Fortune (1970) contains comprehensive flow tables for all major coho salmon producing tributaries in the Rogue River basin, including recommended minimum flows. It also provides a summary of the Rogue River basin fish community, including the Illinois River. The report identified flow depletion as a major cause of stress, disease, and predation to Pacific salmonids.

Illinois River Total Maximum Daily Load Reports

Total Maximum Daily Load (TMDL) reports have been completed for lower (ODEQ 2002c) and upper Sucker Creek (ODEQ 1999). In addition, a TMDL for the remainder of the Illinois and Rogue River basin was recently completed (ODEQ 2008).

Illinois Valley Watershed Council

Rogue River Watershed Health Factors Assessment

The Rogue Basin Coordination Council (RBCC) produced the Rogue River Watershed Health Factors Assessment on behalf of the watershed councils within the basin (RBCC 2006). The assessment rates aquatic health and watershed conditions, including wildfire risk. Key problems in different Rogue River watersheds are identified and potential solutions are proposed. Recognized problems in the Illinois River sub-basin are related to low stream flows and high summer water temperature.

30.5 Stresses

Table 30-2. Severity of stresses affecting each life stage of coho salmon in the Illinois River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Hydrologic Function[1]	Medium	Very High	Very High[1]	Very High	High	Very High
2	Degraded Riparian Forest Conditions[1]	Medium	Very High	Very High[1]	Very High	Very High	Very High
3	Lack of Floodplain and Channel Structure	Medium	High	Very High	High	High	Very High
4	Impaired Water Quality	Low	High	Very High	High	Low	High
5	Altered Sediment Supply	High	High	High	Medium	High	High
6	Impaired Estuary/Mainstem Conditions	-	High	High	Very High	High	Very High
7	Barriers	-	Medium	High	High	High	High
8	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
9	Increased Disease/Predation/Competition	Low	Medium	Medium	Medium	Low	Medium
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low

[1]Key limiting stresses and limited life stage.

Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking. Juvenile summer rearing habitat is impaired by deficient floodplain and channel structure, high temperatures resulting from degraded riparian conditions, and altered hydrologic function from water withdrawals. Furthermore, degraded riparian forests inhibit future potential input of large wood and cannot provide bank stability that assists in a stable and complex channel. Finally, barriers throughout the sub-basin limit access to rearing habitat. These findings are consistent with those of the Oregon Expert Panel (ODFW 2008b) (Section 30.4).

Altered Hydrologic Function

Hydrologic function in the Illinois River sub-basin is severely altered by water diversion. The USFS (1999a) noted that Reeves Creek, a tributary with high IP habitat, was dry in three of five reaches surveyed in 1994, likely due to diversion. Thompson and Fortune (1970) assessed flows in 1967 and found that sections of the Illinois River system become seriously low and warm, or even dry, during the summer when irrigation diversions were particularly active and runoff was low. The extent to which these conditions persist is unknown.

High road density and widespread clear cutting, especially in rain-on-snow terrain, have somewhat altered peak flows (USFS 1997a, BLM 2004b). Base flows may decrease when dense stands of young trees that consume large amounts of water are established after clear cuts (Murphy 1995).

Lake Selmac, on Deer Creek tributary McMullin Creek, blocks several miles of coho salmon habitat (Figure 30-6). Channelization in portions of Deer and Thompson has resulted in disconnected floodplains in areas known to support juvenile coho salmon. Filling of wetlands and elimination of beaver caused loss of water storage capacity and reduced the areas of contact between surface water and groundwater.

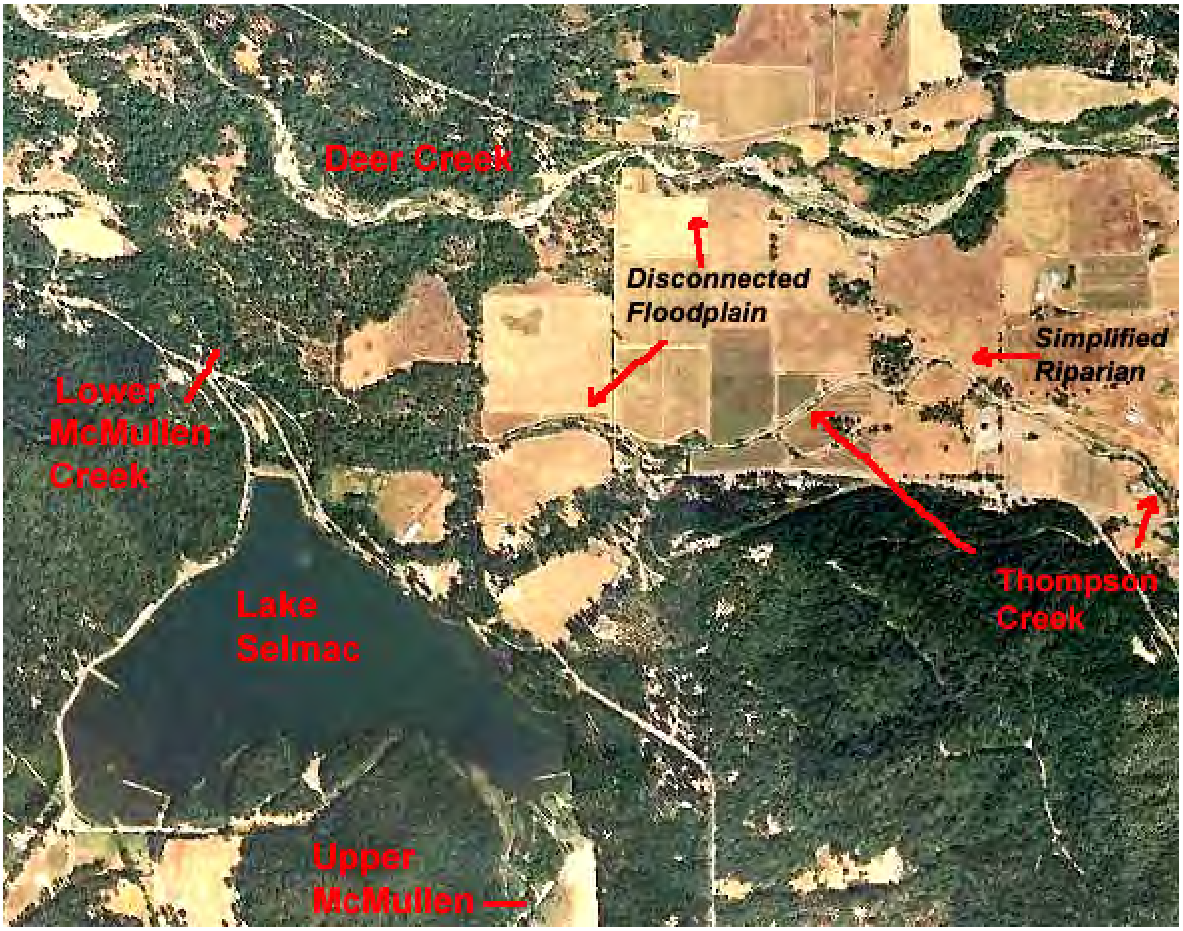

Figure 30-6. Lake Selmac blocks access to high IP coho salmon habitat. The habitat is in upper McMullin Creek. Hydrologic alteration is apparent in Thompson and Deer creeks, which have simplified channels disconnected from floodplains. June 2005.

Degraded Riparian Forest Conditions

Degraded riparian forest condition is one of the most significant stresses affecting coho salmon recovery in the Illinois River watershed. Reduction of riparian trees and gallery forests that once covered the alluvial valley floor led to reduced pool frequency and habitat simplification, has increased bank erosion, and contributed to stream warming by widening the waterways (BLM 1997, 2006, USFS 1997a). ODFW surveyed extensive reaches of coho salmon-bearing Illinois River reaches and tributaries (e.g., East Fork Illinois, West Fork Illinois, Deer, Sucker, Althouse, Elk) and found poor conifer density with fewer than 75 trees (>36” dbh) per 1000 feet. Only one upper Sucker Creek reach and the lower North Fork Deer Creek had 75 to 125 trees of this size, which rates as fair riparian conditions. Recent aerial photos show very simplified conditions in both tributary and mainstem Illinois River riparian zones. The riparian zones have been cleared or substantially modified along the mainstem Illinois River and at the mouth of Free and Easy Creek. Overall, there is a very low amount/volume of large wood in channels throughout the Illinois River sub-basin (USFS 1997a, BLM 2005a).

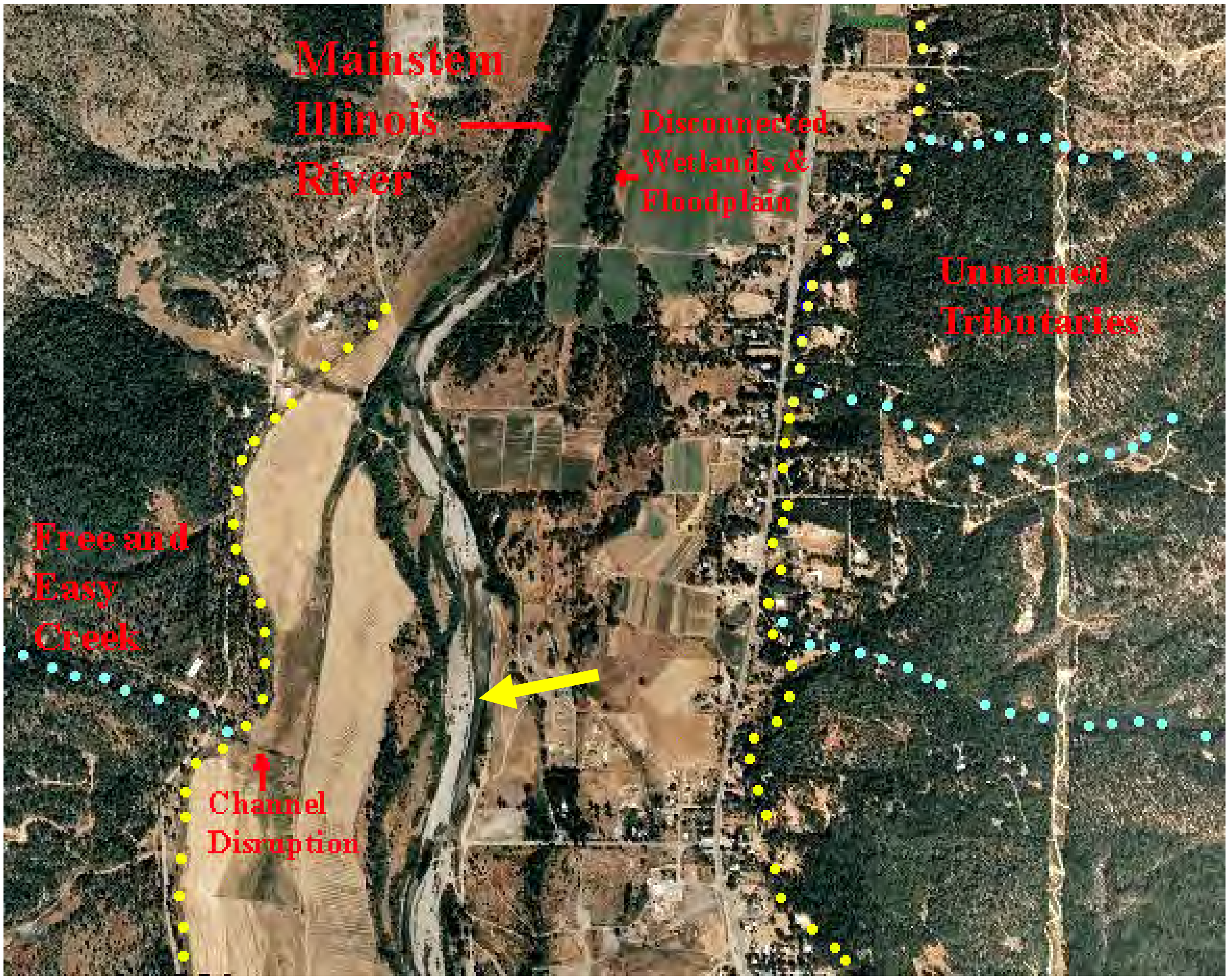

Figure 30-7. Aerial photo of Mainstem Illinois River. Free and Easy Creek (at left) appears to flow subsurface or into a ditch as it crosses the flood terrace. Wetlands and the floodplain of the mainstem are disconnected and there are few riparian trees (shown by large arrow at bottom of photograph). Dots aligned in an east/west configuration are USGS (1984) streams, and dots aligned in a south/north configuration are ditches.

Lack of Floodplain and Channel Structure

The straightening and simplification of streams has reduced the amount of slow, cool edgewater habitats where coho salmon fry and juveniles thrive (ODEQ 2008). Beaver have been greatly reduced along with the pools they create (ODFW 2005b). Although there are patches of functional coho salmon habitat, many Illinois River reaches and tributary channels do not support coho salmon (BLM 1997, USFS 1997a). Channelization of the mainstem Illinois River has disconnected it from much of its floodplain, reducing the physical processes that form coho salmon rearing and spawning habitat. These processes include side channel formation, accumulation of large wood jams, formation of slower water velocities, formation of pools, and lower shear stress. Smaller alluvial valley tributaries that cross the Illinois River floodplain have been channelized, which increases bed shear stress, causes down cutting, and can also trigger upstream gully erosion.

ODFW habitat surveys indicate poor wood levels (< 1 key piece per 100 meters) in most surveyed areas of the Illinois River watershed. Exceptions are Sucker Creek below Grayback Creek and headwater stream reaches, mostly on USFS or BLM lands, such as South and North Fork Deer, Bear, Elk, Crooks, Draper and White creeks. USFS large wood surveys found relatively higher wood levels in some lower and middle Illinois River watersheds; however, these reaches lack high IP habitat, In the upper portion of the Illinois River sub-basin, USFS surveys indicate higher levels of wood in much of Grayback, Left Fork Sucker, Sucker, and Bolan creeks, as well as the upper East Fork Illinois and its tributary Poker Creek. While the December 1996 storms washed out some large wood habitat improvement structures, natural large wood recruitment increased (USFS 1998c).

Impaired Water Quality

While the Illinois River has better ambient water quality than many other Rogue River sub-basins, it has widespread temperature impairment (ODEQ 1999, 2002c, 2008). Low summer flows contribute to warming as well as stagnation, algae blooms, elevated pH, and depressed dissolved oxygen (Thompson and Fortune 1970, ODEQ 1996). Pesticides and herbicides have the potential to harm coho salmon (NMFS 2008), but data are lacking for the Illinois River sub-basin. Poor water quality is a high stress to juvenile coho salmon and a low stress to adults.

Sixty-two percent of 126 stream miles surveyed by ODEQ failed to meet water quality standards (SO RC&D 2003). Headwaters streams in the Illinois River watershed often flow from federal lands where cool water temperatures allow high densities of coho salmon in the summer. ODEQ maximum weekly maximum temperature (MWMT) data shows that when streams cross onto private land they generally become too warm for coho salmon rearing within a short distance and can rise to nearly lethal temperatures as they are progressively dewatered. Variations between locations in streams like lower Sucker Creek show that temperatures are cooler where flows are replenished by springs or tributaries, then warm again as flows are diverted by downstream land owners. This pattern is also apparent in Deer Creek, Althouse Creek and the upper East and West forks of the Illinois River. Cold groundwater contributions may also be reduced or eliminated by groundwater pumping, but groundwater withdrawals have not been quantified (BLM 2004b).

Altered Sediment Supply

Sediment contribution from landslides and erosion occurs naturally in the Illinois River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. Excess fine sediment directly impacts egg viability and can reduce food for fry, juveniles and smolts. Key reaches of the West and East Fork Illinois River, Sucker Creek, Anderson and Draper creeks all have poor scores for fine sediment (<1 mm) in ODFW habitat surveys because spawning gravels have greater than 17 percent fines (Appendix B).

Extensive reaches of Deer Creek, Crooks Creek, lower Sucker Creek, and Althouse Creek have very good fine sediment scores (<12 percent fines) (Appendix B), indicating suitable coho salmon spawning conditions. Poor pool frequency and depth throughout the Illinois River sub-basin are likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening (Appendix B).

Impaired Estuary/Mainstem Function

Modification of the Rogue River estuary resulted in a loss of much of its historic function. Some portion of coho salmon fry and juveniles migrate out of their stream of origin in search of viable habitat patches, and these fish opportunistically use estuarine and slough habitats (Miller and Sadro 2003, Koski 2009). The lack of rearing habitat in the estuary limits the potential productivity of the entire Rogue River basin and NMFS ranked Impaired Estuary/Mainstem Function as an overall very high stress for coho salmon. The Lower Rogue River population profile contains a discussion of the causes of reduced estuarine function.

Barriers

The high level of stress caused by barriers to migration in the Illinois River basin is a result of high numbers of road stream crossings (i.e., as shown in Bredensteiner et al. 2003 maps); small, temporary agricultural dams (Prevost et al. 1997); permanent diversion structures; and large mainstem diversion dams. The Illinois River Watershed Council has worked cooperatively with diverters in the Illinois River sub-basin to decrease use of “push-up” gravel dams to divert irrigation water, which often blocks adult and juvenile movement (Prevost et al. 1997). In addition, unscreened diversions and non-criteria screens at diversions affect fry, juveniles, and smolts (ODFW 2008b). Pomeroy Dam, used to divert water just below the convergence of the East and West forks of the Illinois River, was identified as a fish passage barrier at some flow levels (USFS 1999a). Road stream crossings that prevent juvenile and adult access to habitat are also a concern (ODFW 2008b).

Adverse Hatchery-Related Effects

Cole Rivers Hatchery is located upstream of the Illinois population area in the Upper Rogue River sub-basin, and produces approximately 200,000 coho salmon smolts annually in addition to millions of hatchery spring Chinook, winter steelhead, and summer steelhead (ODFW 2008d). Straying into the Illinois River is thought to be uncommon (Good et al. 2005). From 1996 to 1998, none of the adults observed in spawner surveys of the Illinois River were of hatchery origin (Jacobs et al. 2002). Adverse hatchery-related effects pose a medium risk to all life stages, due to the presence of Cole Rivers Hatchery in the Rogue River basin (Appendix B).

Increased Disease/Competition/Predation

Salmonids in the Rogue River basin, including the Illinois River, had higher incidences of the fish diseases *furunculosis* and *columnaris* in reaches that were warm due to flow depletion (Thompson and Fortune 1970). Largemouth bass and other warm water species are stocked in Lake Selmac and private farm ponds (USFS 1999a). These fish can escape and pose the risk of competition with, and predation on, salmonids in the mainstem Illinois River (USFS 1999a).

Umpqua pikeminnow, are present in the lower reaches of Sucker Creek (USFS 1999a) as well as other warm, low-elevation streams of the Illinois River, and prey upon coho salmon. Exotic redside shiners also occur in these streams. Japanese knotweed, an invasive plant, has also been documented in the basin (Oregon Department of Agriculture 2010). Port Orford Cedar root-rot is a disease which is negatively impacting this important riparian species region-wide (Frissell 1992).

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

30.6 Threats

Table 30-3. Severity of threats affecting each life stage of coho salmon in the Illinois River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

Threats		Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	High	Very High	Very High[1]	Very High	Very High	Very High
2	Dams/Diversion[1]	Low	Very High	Very High[1]	Very High	High	Very High
3	Mining/Gravel Extraction	High	Very High	Very High	High	High	Very High
4	Agricultural Practices	Medium	High	High	High	High	High
5	Timber Harvest	High	High	High	High	Medium	High
6	Channelization/Diking	Medium	Medium	High	High	High	High
7	Climate Change	Low	Low	High	High	Medium	High
8	Road-Stream Crossing Barriers	-	Low	High	High	High	High
9	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
10	Urban/Residential/Industrial Dev.	Low	Medium	Medium	Medium	Medium	Medium
11	High Severity Fire	Low	Medium	Medium	Medium	Medium	Medium
12	Invasive and Non-Native/Alien Species	Medium	Medium	Medium	Low	Low	Medium
13	Fishing and Collecting	-	-	Low	Low	Medium	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and dams/diversions.

Roads

Road density is high in many areas of the Illinois River sub-basin. Roads were built to support timber harvest, residential and urban development, and highway systems. An extensive network of small, unpaved roads exists in many areas of the Illinois River watershed (Figure 30-8 and Figure 30-9). Many of these roads run alongside streams, and are known to yield chronic fine sediment and to pose elevated risk of catastrophic failure on steep slopes (USFS 1998c). NMFS (1995) recommended a road density limit of 2 miles of road per square mile of watershed (mi/sq. mi) to protect anadromous salmonids in interior Columbia River basins to limit sediment and cumulative watershed effects. Road density in the Illinois River sub-basin (Figure 30-10) is typically 2 to 4 mi/sq. mi on federal land (Prevost et al. 1997, USFS and BLM 2000, BLM 2005a), but may be higher than 8 mi/sq. mi on private timberlands and over 10 mi/sq. mi in rural residential areas (BLM 1997). Landslides triggered by roads during the November and December 1996 storms resulted in extensive sedimentation in Sucker and Grayback creeks (USFS 1998c). Damage resulted from road crossing failures and diversion of streams onto roadways, which increased fine sediment delivery to levels 2 to 3 times higher than unaffected watersheds (USFS 1998c).

Hydrologic effects of extensive road networks persist even when the roads are no longer used, because roads often continue to contribute fine sediment to streams and alter hydrology by intercepting ground water, channelizing water and transporting sediment down inboard ditches, or both. Erosive geology may require lower road density targets in some watersheds. For example, upper Sucker Creek has decomposed granitic soils that are prone to landsliding as well as chronic gully and surface erosion (USFS 1998c).

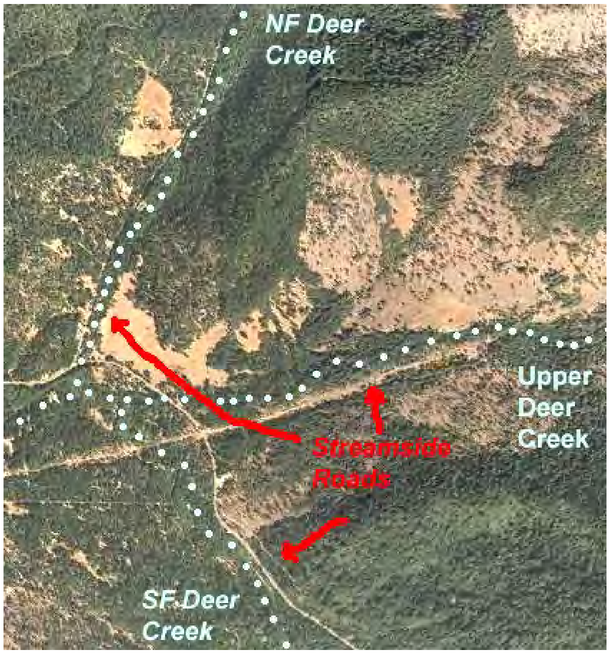

Figure 30-8. Aerial photo showing stream side roads. Roads parallel upper Deer Creek as well as the NF and SF. These roads chronically leach fine sediment into Deer Creek. Dots are USGS (1984) stream courses (1:24 K). Photo from 2005.

Figure 30-9. Aerial photo showing very high road densities in upper Thompson Creek. All of upper Deer Creek, which includes Thompson Creek, has a road density of 4 mi./sq. mi. Photo from 2005.

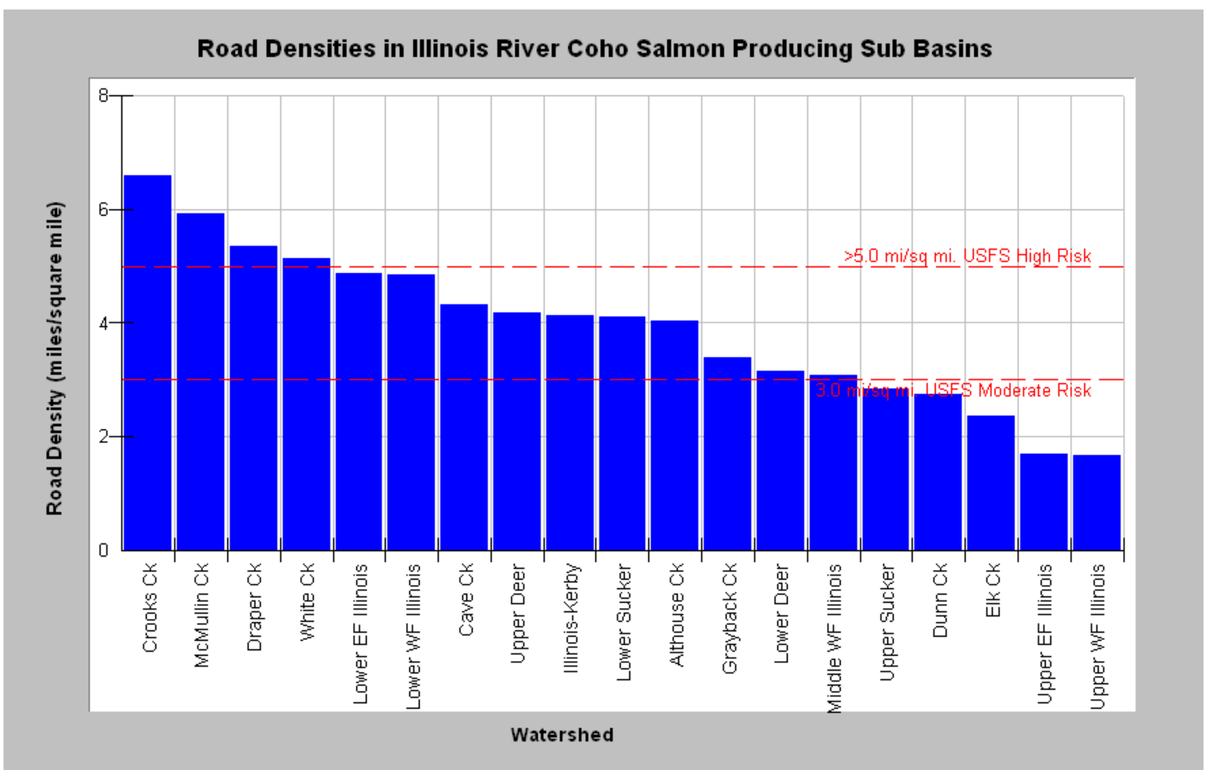

Figure 30-10. Road density in Illinois River coho salmon producing watersheds.

Dams/Diversions

Dams and diversions pose a very high threat to Illinois River coho salmon. Many diverted streams have the potential of drying during low flow periods (Thompson and Fortune 1970). Dry reaches were documented in Illinois River tributaries in late summer and fall 1967 including Deer, Anderson, Thompson, Elder, Little Elder, and Parker creeks. Many stream reaches still go dry annually. Figure 30-11 shows Deer Creek, which falls within high IP coho salmon habitat, running dry. Studies of the Illinois River watershed conclude that flows are the most limiting factor for fisheries, coho salmon habitat continues to be dewatered, and water quality impairment continues as a result of flow depletion (Thompson and Fortune 1970; USFS 1997a, 1999a; BLM 2004b, 2005, 2006, 2007).

The two large dams in the Illinois River sub-basin are at Lake Selmac (Figure 30-6) and the Pomeroy Diversion Dam approximately 0.5 miles below the convergence of the East Fork and West Fork Illinois. Pomeroy Dam is known to hinder salmonid migration in some seasons, particularly for downstream migrating juveniles (USFS 1999a). While passage has been improved, some small diversions still pose the risk of entraining juvenile coho salmon and smolts.

Figure 30-11. A high IP coho salmon reach of Deer Creek, a tributary to the Illinois River. Photo taken September 22, 2009.

Mining/Gravel Extraction

Potential impacts of mining on Illinois River salmonids may alter the ecological integrity of the area (Bredensteiner et al. 2003). The majority of the occupied IP in the Illinois River watershed occurs on federal lands (Figure 30-1), where mining access is permitted under the 1872 Mining Law. Gold mining on federal lands often occurs on those lower gradient stream reaches that are located just upstream of private lands; these reaches are very important to coho salmon and they represent the best low gradient habitat available. The USFS alone has 385 active mining claims within one mile of SONCC coho salmon critical habitat (USFS 2013), the impacts of which will continue into the future for at least the next ten years. There are two gold mining claims under consideration on lower gradient federal lands in Sucker Creek, an area with high IP that currently supports juvenile coho salmon (Section 30.3). The location of such mining contributes to the severity of the threat to coho salmon in the Illinois River. Gravel mining has intensified along the mainstem East Fork Illinois River and pits that can capture juvenile coho salmon, coho salmon smolts, and adult coho salmon during high flows events have been excavated in the floodplain. Most of these stranded fish perish could perish if no outlet is available when flows recede.

Agricultural Practices

The extent of agriculture, while not large, coincides with broad alluvial valleys associated with high IP (>0.66) coho salmon habitat (Williams et al. 2008). Agricultural impacts include water diversion (BLM 1997, USFS 1997a), grazing, wetland filling, channelization and diking, riparian removal, channel simplification, and chemical application. It is likely that pesticides known to harm salmonids (NMFS 2008) are used in the region. However, information regarding pesticide and herbicide use in the Illinois River sub-basin and the SONCC coho salmon ESU is unavailable (Riley, S., pers. comm. 2009). Herbicide use in the nearby Upper Rogue sub-basin has resulted in fish kills that included coho salmon (Ewing 1999). The USFS and BLM have permitted grazing allotments in the Illinois River population area and grazing occurs on private lands as well.

Timber Harvest

Timber harvest levels were estimated to be between 10 to 25 percent on USFS and BLM lands in the East Fork Illinois River and Sucker, Grayback and Althouse creeks according to Landsat comparisons between 1972 and 1992 imagery. Many Illinois River tributaries are surrounded by harsh terrestrial conditions, such as decomposed granitic soils in upper Sucker Creek (USFS 1997a), that make re-establishing forests problematic. Timber harvest in these types of locations can lead to very dry soil conditions if duff is removed or burned. Failure to re-establish forest cover can lead to increased fine sediment delivery to streams for decades. In addition, the Independent Multidisciplinary Science Team (IMST 1999) concluded that the Oregon Forest Practice Rules for riparian protection, large wood management, sedimentation, and fish passage are not adequate to recover depressed stocks of wild salmonids. Approximately 81 percent of the land in the Illinois River population area is managed by the federal government; therefore, the threat from ongoing and future timber harvest on these lands will likely decrease over the next ten years. However, the vast majority of stream reaches on USFS and BLM lands are too steep or otherwise unsuitable for coho salmon. Most habitat with potential to support coho salmon is privately owned and managed under Oregon's Forest Practices Act, which NMFS' analysis determined has the lowest score for watershed protection measures of all management methods evaluated (Appendix B). Therefore, although much of the habitat in the Illinois River is federally owned, the future threat of timber harvest in the next ten years is high because much of the habitat with the best potential to support coho salmon will be harvested using less protective management actions than those used on Federal lands.

Channelization/Diking

Channelization and confinement of mainstem and tributary reaches of the Illinois River is widespread. Disconnecting high IP coho salmon streams from their floodplains and constricting their channels into straight, narrow stream courses greatly diminishes their summer and winter habitat carrying capacity (BLM 1997). These activities also tend to reduce surface-groundwater connections that help maintain cool stream temperatures (ODEQ 2008).

Climate Change

The current climate is generally warm and modeled regional average air temperature suggests a large increase over the next 50 years (see Appendix B for climate change threat ranking methodology). Average air temperature could increase by over 2 ^{o}C in the summer and by 1 ^{o}C in the winter. Annual precipitation in this area is predicted to stay within the natural range of current variability; however seasonal patterns in precipitation may change (Mote and Salathe 2010). Van Kirk and Naman (2008) documented decreasing snow pack below 6,000 feet over the last 20 years in the Klamath Mountains. If this trend continues, the water supply will be affected in watersheds such as Deer, Grayback and Sucker creeks, and the upper East and West Fork Illinois rivers. Coho salmon juvenile and smolt rearing and migratory habitat are most at risk to climate change. Rising sea level may affect the quality and extent of wetland rearing habitat. Adult Illinois River coho salmon will be negatively affected by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Road-Stream Crossing Barriers

Road densities in portions of the Illinois River sub-basin are very high and stream-side roads are common. Culverts under road-stream crossings may block upstream migration for adults or passage for juveniles and smolts during low flow periods.

Hatcheries

Hatcheries pose a medium threat to all life stages of coho salmon in the Illinois River. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Urban/Residential/Industrial Development

Rural residential development is expanding and may have a substantial impact on water supply in the Illinois River sub-basin. Each landowner may use surface water from nearby streams or drill a well, which may in some cases be connected to, and deplete, surface flows (BLM 2004b). Rural residences can also contribute to pollution due to extensive road networks, leakage from septic systems, and the use of pesticides and herbicides.

High Severity Fire

The potential for fire is great due to high summer air temperatures and degraded forest conditions. Early seral stage forests lead to dry site conditions and increased fire risk (SO RC&D 2003). Recent extensive fires include the 1987 Silver Fire and the 2002 Biscuit Fire, which was the largest fire in Oregon history and burned a great deal of the western part of the watershed (Azuma et al. 2004). Much of the area that burned is serpentine terrain within the Kalmiopsis Wilderness, which has frequent fires due to sparse vegetation and dry site conditions resulting from naturally poor soils (USFS 1999a). However, the shallow soil depth and low topographic relief in this terrain lessen risk of mass wasting and sediment pulses to streams below. Coho salmon are not commonly found in serpentine watersheds, so fires in those watersheds do not directly impact the species.

Invasive Non-Native/Alien Species

Thompson and Fortune (1970) documented widespread presence of introduced warm water game fish in the Rogue River basin. Lake Selmac and private agricultural ponds in the Illinois River sub-basin are noted as sources of these fish and ponds may be increasing in number with continued residential development (USFS 1999a). Competition or predation on juvenile coho salmon by most non-native warm water species is likely limited in the winter because warm water species are washed downstream by high winter flows. However, in the summer, warm water conditions created by flow depletion give these introduced species a competitive advantage over salmonids. Umpqua River pikeminnow have been documented in lower Sucker Creek (USFS 1999a). This species is of particular concern because it is adapted to swift rivers and may pose a risk of competition and predation on coho salmon smolts during spring out-migrations. A similar situation occurs in the Eel River basin in California where the introduction of the Sacramento pikeminnow has caused major ecological problems (Brown and Moyle 1990).

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

30.7 Recovery Strategy

The most immediate need for habitat restoration and threat reduction in the Illinois River sub-basin is in those areas currently occupied by coho salmon in the following watersheds: West Fork Illinois River, Wood Creek, East Fork Illinois River, Althouse Creek, Sucker Creek, and Deer Creek. Currently unoccupied habitat must also be restored to provide sufficient habitat to achieve coho salmon recovery.

The degraded condition of habitat in the Illinois River sub-basin, combined with the depressed coho salmon population size and distribution, increases the risk of extinction of this inland coho salmon population which is expected play a critical role in recovery of the Interior Rogue River diversity stratum. The most important factor limiting recovery of coho salmon in the Illinois River is a deficiency in the amount and distribution of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by restoring flow, increasing habitat complexity within the channel, restoring off-channel rearing areas, and reducing identified threats to instream habitat. The effects of fishing on this population’s ability to meet its viability criteria should be evaluated.

Table 30-4 on the following page lists the recovery actions for the Illinois River population.

Table 30-4. Recovery action implementation schedule for the Illinois River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-IIIR.7.3.52	Riparian	No	Improve agricultural practices	Improve regulatory mechanisms	Population wide	1
SONCC-IIIR.7.3.52.1	*Determine the best way to revise the Agricultural Water Quality Management Act (AWQMAP) so that it does not limit recovery of SONCC coho salmon and recommend appropriate revisions*					
SONCC-IIIR.7.3.52.2	*Ensure basin rules are specific and linked to implementing AWQMAP recommendations, including developing specific standards for riparian buffers*					
SONCC-IIIR.7.3.52.3	*Ensure that AWQMA plans address both impaired areas and proactive prevention of water quality impairment*					
SONCC-IIIR.7.3.52.4	*Adopt interim buffers equal to the buffer standards NMFS is recommending in Washington state until the state establishes its own buffers*					
SONCC-IIIR.7.3.52.5	*Develop a process in the AWQMA Program that tracks and evaluates implementation*					
SONCC-IIIR.7.3.52.6	*Change the complaint-based compliance monitoring process to a focused compliance program*					
SONCC-IIIR.7.2.53	Riparian	No	Improve timber harvest practices	Improve regulatory mechanisms	Population wide	1
SONCC-IIIR.7.2.53.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-IIIR.7.2.53.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-IIIR.7.2.53.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-IIIR.7.2.53.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-IIIR.7.2.53.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams, increased shade on perennial streams, and protective buffers on intermittent streams*					
SONCC-IIIR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	East and West Forks of the Illinois, Deer, Sucker, Elk, Althouse creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-IIIR.3.1.4.1	*Quantify groundwater withdrawal and determine maximum amount available for use without significantly reducing instream flows*					
SONCC-IIIR.3.1.4.2	*Quantify groundwater withdrawal and ensure urban/residential/industrial development does not limit recovery of SONCC coho salmon*					
SONCC-IIIR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	East and West Forks of the Illinois, Deer, Sucker, Elk, Althouse creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-IIIR.3.1.5.1	*Establish a comprehensive groundwater permit process*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-IIIR.3.1.77	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-IIIR.3.1.77.1	*Quantify groundwater withdrawal and determine maximum amount available for use without significantly reducing instream flows*					
SONCC-IIIR.3.1.77.2	*Quantify groundwater withdrawal and ensure urban/residential/industrial development does not limit recovery of SONCC coho salmon*					
SONCC-IIIR.3.1.79	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-IIIR.3.1.79.1	*Establish a comprehensive groundwater permit process*					
SONCC-IIIR.3.1.46	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	All streams with ODFW water rights for fish and all streams where coho salmon would benefit immediately	2a
SONCC-IIIR.3.1.46.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-IIIR.3.1.78	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-IIIR.3.1.78.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-IIIR.2.1.9	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve suction dredging practices	All streams where coho salmon would benefit immediately	2a
SONCC-IIIR.2.1.9.1	*Assess the impacts of suction dredging and develop suction dredging regulations that minimize or prevent impacts to coho salmon. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-IIIR.2.1.72	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve suction dredging practices	Population wide	2b
SONCC-IIIR.2.1.72.1	*Assess the impacts of suction dredging and develop suction dredging regulations that minimize or prevent impacts to coho salmon. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-IIIR.2.1.34	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2a
SONCC-IIIR.2.1.34.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-IIIR.2.1.34.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-IIIR.2.1.71	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-IIIR.2.1.71.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-IIIR.2.1.71.2	*Place instream structures, guided by assessment results*					
SONCC-IIIR.2.2.7	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-IIIR.2.2.7.1	*Assess habitat to determine where potential exists for floodplain reconnection. Prioritize sites and determine best means for reconnection at each site using tools such as hydrologic analysis*					
SONCC-IIIR.2.2.7.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-IIIR.2.2.74	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-IIIR.2.2.74.1	*Assess habitat to determine where potential exists for floodplain reconnection. Prioritize sites and determine best means for reconnection at each site using tools such as hydrologic analysis*					
SONCC-IIIR.2.2.74.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-IIIR.2.2.64	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2a
SONCC-IIIR.2.2.64.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-IIIR.2.2.8	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	All streams where coho salmon would benefit immediately	2a
SONCC-IIIR.2.2.8.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for landowners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-IIIR.2.2.8.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-IIIR.2.2.8.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-IIIR.2.2.75	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2b
SONCC-IIIR.2.2.75.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for landowners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-IIIR.2.2.75.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-IIIR.2.2.75.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-IIIR.28.1.1	Roads	Yes	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	All basins with road densities greater than 3 mi/sq. mi	2a
SONCC-IIIR.28.1.1.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-IIIR.28.1.1.2	*Decommission roads, guided by assessment*					
SONCC-IIIR.28.1.1.3	*Upgrade roads, guided by assessment*					
SONCC-IIIR.28.1.1.4	*Maintain roads, guided by assessment*					
SONCC-IIIR.28.1.76	Roads	Yes	Reduce sediment delivery to streams	Reduce road-stream hydrologic connection	Population wide	2b
SONCC-IIIR.28.1.76.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-IIIR.28.1.76.2	*Decommission roads, guided by assessment*					
SONCC-IIIR.28.1.76.3	*Upgrade roads, guided by assessment*					
SONCC-IIIR.28.1.76.4	*Maintain roads, guided by assessment*					
SONCC-IIIR.3.1.67	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-IIIR.3.1.67.1	*Identify and cease unauthorized water diversions*					
SONCC-IIIR.3.1.69	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-IIIR.3.1.69.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-IIIR.3.1.69.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-IIIR.3.1.80	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-IIIR.3.1.80.1	*Identify and cease unauthorized water diversions*					
SONCC-IIIR.3.1.81	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-IIIR.3.1.81.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-IIIR.3.1.81.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-IIIR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-IIIR.3.1.6.1	*Develop an educational program about water conservation programs and instream leasing programs*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-IIIR.28.2.50	Roads	Yes	Reduce pollutants and stormflow	Increase regulatory oversight	Population wide	2b
SONCC-IIIR.28.2.50.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-IIIR.28.2.50.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-IIIR.28.2.50.3	*Develop local regulatory mechanisms that limit development and reduce amount of total impervious area through incentives*					
SONCC-IIIR.28.1.2	Roads	Yes	Reduce sediment delivery to streams	Improve regulatory mechanisms	Population wide	2b
SONCC-IIIR.28.1.2.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-IIIR.2.3.43	Floodplain and Channel Structure	Yes	Reduce sediment mobilization and effects to channel morphology	Improve placer mining practices	Population wide	2b
SONCC-IIIR.2.3.43.1	*Educate miners regarding the ESA, coho salmon, and effects to habitat from proposed placer mining activities*					
SONCC-IIIR.2.3.43.2	*Revise regulations applicable to placer mining to minimize effects to SONCC coho salmon, including consideration of regulations specific to moderate and high IP streams*					
SONCC-IIIR.7.1.47	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands where coho salmon would benefit immediately	2b
SONCC-IIIR.7.1.47.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-IIIR.7.1.47.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-IIIR.7.1.47.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-IIIR.7.1.83	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	2c
SONCC-IIIR.7.1.83.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-IIIR.7.1.83.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-IIIR.7.1.83.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-IIIR.26.1.68	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-IIIR.26.1.68.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-IIIR.7.1.48	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Federal lands	2d
SONCC-IIIR.7.1.48.1	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-IIIR.7.1.11	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Grayback, Sucker, Elk, Althouse, Deer Creeks, Federal forest lands	2d
SONCC-IIIR.7.1.11.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-IIIR.7.1.11.3	*Plant conifers, guided by the plan*					
SONCC-IIIR.2.2.51	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Mainstem Illinois River and all streams where coho salmon would benefit immediately	3a
SONCC-IIIR.2.2.51.1	*Develop a plan to remove levees and reconnect priority channelized stream reaches to historic side channels and wetlands*					
SONCC-IIIR.2.2.51.2	*Remove levees, guided by the plan*					
SONCC-IIIR.2.2.51.3	*Reconnect historic side channels and wetlands, guided by the plan*					
SONCC-IIIR.2.2.73	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Population wide	3b
SONCC-IIIR.2.2.73.1	*Develop a plan to remove levees and reconnect priority channelized stream reaches to historic side channels and wetlands*					
SONCC-IIIR.2.2.73.2	*Remove levees, guided by the plan*					
SONCC-IIIR.2.2.73.3	*Reconnect historic side channels and wetlands, guided by the plan*					
SONCC-IIIR.5.1.16	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately, not including BLM lands	3b
SONCC-IIIR.5.1.16.1	*Assess and prioritize barriers using the ODFW fish passage barrier database*					
SONCC-IIIR.5.1.16.2	*Remove barriers, guided by the assessment*					
SONCC-IIIR.5.1.36	Passage	No	Improve access	Remove barriers	BLM lands	3b
SONCC-IIIR.5.1.36.1	*Evaluate and prioritize barriers for removal*					
SONCC-IIIR.5.1.36.2	*Remove barriers, based on evaluation*					
SONCC-IIIR.5.1.82	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-IIIR.5.1.82.1	*Assess and prioritize barriers using the ODFW fish passage barrier database*					
SONCC-IIIR.5.1.82.2	*Remove barriers, guided by the assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-IIIR.10.7.66	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3b
SONCC-IIIR.10.7.66.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-IIIR.10.7.66.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-IIIR.10.7.70	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-IIIR.10.7.70.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-IIIR.10.7.70.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-IIIR.1.2.35	Estuary	No	Improve estuarine habitat	Improve estuary condition	Rogue River Estuary	3d
SONCC-IIIR.1.2.35.1	*Implement recovery actions for Lower Rogue River population that address estuary habitat*					
SONCC-IIIR.7.1.10	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	3d
SONCC-IIIR.7.1.10.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-IIIR.7.1.10.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat*					
SONCC-IIIR.7.1.33	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	BLM lands	3d
SONCC-IIIR.7.1.33.1	*Manage timber harvest (and associated activities) on Federal lands in accordance with the Aquatic Conservation Strategy of the NWFP, or with the updated ACS guidance contained in newly revised Resource Management Plans or Land and Resource Management Plans, in order to achieve riparian and stream channel improvements for coho salmon*					
SONCC-IIIR.7.1.49	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho salmon bearing streams	3d
SONCC-IIIR.7.1.49.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-IIIR.7.1.49.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					
SONCC-IIIR.16.1.17	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-IIIR.16.1.17.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-IIIR.16.1.17.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-IIIR.16.1.18	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-IIIR.16.1.18.1	*Determine actual fishing impacts*					
SONCC-IIIR.16.1.18.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-IIIR.16.2.19	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-IIIR.16.2.19.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-IIIR.16.2.19.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-IIIR.16.2.20	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-IIIR.16.2.20.1	*Determine actual impacts of scientific collection*					
SONCC-IIIR.16.2.20.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-IIIR.10.2.13	Water Quality	No	Reduce pollutants	Educate stakeholders	Population wide	3d
SONCC-IIIR.10.2.13.1	*Develop an educational program that promotes Salmon Safe methods for agricultural operations and Integrated Pest Management for rural residents*					
SONCC-IIIR.10.2.45	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	3d
SONCC-IIIR.10.2.45.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-IIIR.10.2.45.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					
SONCC-IIIR.10.2.41	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-IIIR.10.2.41.1	*Develop a pesticide management plan*					
SONCC-IIIR.10.2.41.2	*Implement pesticide management plan and technical assistance program*					
SONCC-IIIR.14.2.15	Invasive, Non-native Species	No	Reduce predation and competition	Manage non-native species	Population wide	3d
SONCC-IIIR.14.2.15.1	*Assess feasibility and benefits of eradicating non-native fish species and develop a plan*					
SONCC-IIIR.14.2.15.2	*Manage non-native fish species, guided by the plan*					

31. Middle Rogue / Applegate Population

Interior Rogue Stratum

Non-Core 1, Functionally Independent Population

High Extinction Risk

Population likely above depensation threshold

2,400 Spawners Required for ESU Viability

1,561 mi^2 watershed (67% Federal ownership)

603 IP-km (375 IP-mi) (45% High)

Dominant Land Uses are Agriculture and Urban/Residential/Commercial Development

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Dams/Diversions' and 'Urban/Residential/Industrial Development'

Highest Priority Recovery Actions

• Improve agricultural practices • Improve timber harvest practices by revising Oregon Forest Practices Act • Improve flow timing and volume by managing water withdrawals	• Increase large woody debris (LWD), boulders, or other instream structure • Increase conifer riparian vegetation • Re-connect channel to existing off-channel ponds, wetlands, and side channels

31.1 History of Habitat and Land Use

From 1780 to 1840, trappers swept Oregon coastal rivers, including the Rogue River basin, reducing the robust beaver population to remnant levels (Oregon Department of Fish and Wildlife (ODFW) 2005b). Historically, beaver were so prevalent that the Takelma native people called the Applegate River valley "the beaver place" (U.S. Bureau of Land Management (BLM) 1998a). In the mid-to-late 1800s, extensive gold mining in the Rogue and Applegate valleys resulted in major changes to coho salmon habitat that is still evident today. In the 1850s, settlers began developing the flat alluvial valley bottoms and filling wetlands to increase agricultural productivity. Over a period of 150 years, these ideal coho salmon reaches were straightened and disconnected from their floodplains, wetlands and meanders were filled, beaver and their ponds were eliminated, flows were diverted, and riparian shade was reduced (BLM 1998a).

The remoteness of the Rogue River basin delayed widespread forest harvest until railroad lines made it possible to export timber. Profound changes in watershed and streams associated with timber harvest occurred after World War II, when availability of heavy equipment and the high demand for wood led to extensive timber harvest in the Rogue River basin. Channel damage and erosion from the 1964 flood was widespread, exacerbated by timber harvest activities (including using stream channels for skidding logs) and road building activities (USFS 1999b).

For example, gravel beds were scoured down to bedrock on Steves Fork and Sturgis Fork (upper Applegate River tributaries now above Applegate Dam) and Galice Creek (tributary to the Rogue River) (Thompson and Fortune 1970), and large alluvial fans formed at the mouth of Middle Rogue tributaries Billings, Foster, and Shasta Costa creeks (USFS 1999b). Clear-cut timber harvest continued on public lands into the 1970s and 1980s and although harvest technology improved, this activity resulted in another pulse of sediment that further degraded water quality and coho salmon habitat in downstream reaches (BLM 1996a, USFS 1999b). The USFS and BLM manage their lands more conservatively since the adoption of the Northwest Forest Plan (U.S Department of Agriculture (USDA) and U.S. Department of the Interior (USDI) 1994, USFS and BLM 1995a). The eastern portion of the Middle Rogue sub-basin has a checkerboard pattern of BLM and private ownership. Timber harvest is the most common activity on private land.

In 1980, the U.S. Army Corps of Engineers completed construction of the Applegate Dam, on the upper mainstem of the Applegate River. The dam, which was built for irrigation, flood control, and recreation, blocks 154.7 km of high intrinsic potential coho salmon habitat (Williams et al. 2006). Although the dam prevents damaging winter floods which can scour redds, the timing of flow releases, especially in spring, is very different from historic patterns.

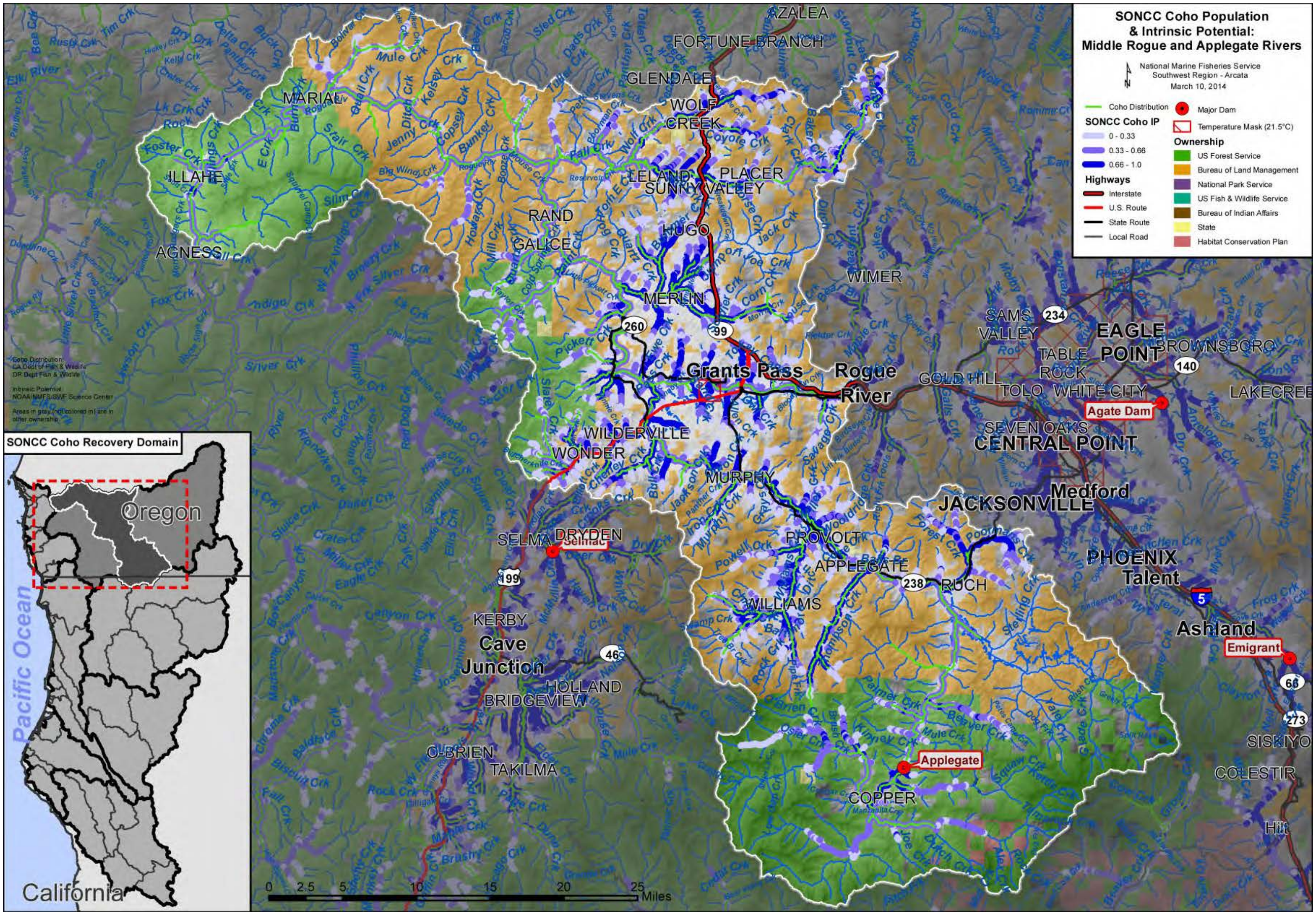

Figure 31-1. The geographic boundaries of the Middle Rogue / Applegate rivers coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern Oregon/Northern California Coast Coho Salmon ESU and the Interior Rogue River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The Middle Rogue River flows through Josephine and Jackson Counties, an area which includes the city of Grants Pass, one of the urban growth centers in southern Oregon (Figure 31-1 and Figure 31-2). In addition, there has been substantial residential development in many parts of the sub-basin, accompanied by surface water and groundwater extraction. Water supply for human, fish, and wildlife use is a critical issue in the entire Rogue River basin.

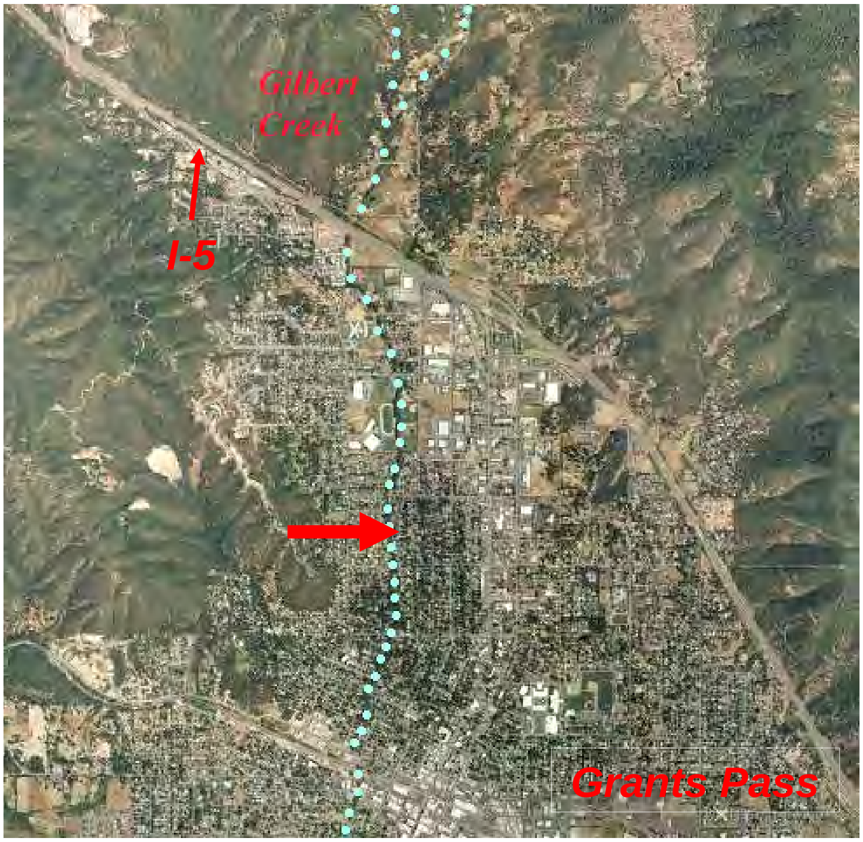

Figure 31-2. Middle Rogue tributary Gilbert Creek. Large arrow points to the creek, flowing south through Grants Pass, Oregon. Dots represent USGS (1984) stream lines. June 2005.

31.2 Historic Fish Distribution and Abundance

There are 603 intrinsic potential (IP) kilometers (km) in the Middle Rogue-Applegate sub-basin (Figure 31-1). Much of the high IP habitat is concentrated in low gradient reaches of Grave, Wolf, Coyote, and Jumpoff Joe creeks, which extend east from the mainstem Middle Rogue between Grave Creek and the Applegate River. Western tributaries important for coho salmon are Taylor, Galice, and Limpy creeks. The Middle Rogue from the Applegate River to its upper boundary at Evans Creek has a number of tributaries with high IP that are now urbanized, including Allen, Fruitdale, Gilbert, Jones, Savage, and Sand creeks. Other concentrations of high IP habitat occur in alluvial reaches of the Applegate River and tributaries such as Slate, Cheney, Murphy, Thompson, Little Applegate, and Beaver Creek. While much of the Rogue River from Grave Creek to Agness is public land and managed under the Northwest Forest Plan, most tributaries do not support coho salmon, likely because they are too steep. Streams with high IP habitat organized by sub-areas are listed below.

Table 31-1. Tributaries with high IP habitat (IP > 0.66) (Williams et al. 2006).

Sub-basin	Stream Name	Sub-basin	Stream Name
Lower Middle Rogue River (Agness to Grave Creek)	Mule Creek	Applegate River	Little Cheney Creek
	Mid Rogue-Lower (Mule Cr. – Agness)		Minnie Creek
Middle Rogue River (Tributaries of Grave Creek)	Benjamin Gulch		Munger Creek
	Brushy Gulch		Murphy Creek
	Coyote Creek		Ninemile Creek
	Flume Gulch		Onion Creek
	Grave Creek		Osler Creek[1]
	Mackin Gulch		Palmer Creek
	Poorman Creek		Poorman Creek
	Salmon Creek		Powell Creek
	Shanks Creek		Rocky Creek
	Sourdough Creek		Round Prairie Creek
	Tom East Creek		Slate Creek
	Unnamed Creek (Trib. of Wolf Cr. below I-5)		Squaw Creek[1]
	Wolf Creek		Sterling Creek
Upper Middle Rogue River (Evans Creek to Applegate River)	Allen Creek		Thompson Creek
	Fruitdale Creek		Williams Creek
	Gilbert Creek		Wooldridge Creek
	Jones Creek		Yale Creek
	Lathrop Creek	Main Middle Rogue (Grave Creek to Applegate River)	Bummer Creek
	Middle Rogue – Upper (Applegate to Evans Creek)		Mid Rogue – Lower (Grave Cr. to Mule Cr.)
	Sand Creek		Dutcher Creek
	Savage Creek		Galice Creek
	Vannoy Creek		Harris Creek
Applegate River	Applegate - Mainstem		Jacks Creek
	Beaver Creek		Jumpoff Joe Creek
	Bishop Creek		Limpy Creek
	Board Shanty Creek		Little Pickett Creek
	Branch Gulch[1]		Louse Creek
	Brush Creek[1]		Madams Creek
	Bull Creek		Cove Creek
	Caris Creek		Pass Creek
	Cheney Creek		Pickett Creek
	Forest Creek		Quartz Creek
	Grays Creek		Shan Creek
	Grouse Creek		Slate Creek
	Humbug Creek		Taylor Creek
	Little Applegate River		Tunnel Creek

[1]Upstream of Applegate Dam

A cannery operated at the mouth of the Rogue River beginning in 1876. Records from that cannery were used to estimate an annual run size of approximately 114,000 adult coho salmon in the late 1800s (Meengs and Lackey 2005). There is no way to know how many of these fish were returning to the Middle Rogue-Applegate area, rather than elsewhere in the 5,600 square mile Rogue River basin such as the Upper Rogue River. The Middle Rogue/Applegate River sub-basin contains 33 percent of the basin-wide IP kilometers of habitat, suggesting possible returns of 38,000 fish during the time of cannery operation, if fish were produced in proportion to IP kilometers.

31.3 Status of Middle Rogue/Applegate River Coho Salmon

Spatial Structure and Diversity

Williams et al. (2006) estimated 760 IP-km of coho salmon habitat in the Middle Rogue-Applegate, but 52 IP-km of that habitat are currently inaccessible due to Applegate Dam. Data for the Middle Rogue sub-basin (Figure 31-3) and the Applegate River sub-basin (Figure 31-4) from 1998 to 2004 show that juvenile coho salmon presence is fragmented and occurs mostly in small patches in upper reaches of alluvial valley streams, just below federal land (ODFW 2005a). Middle Rogue-Applegate reaches currently used by coho salmon represent a fraction of the high IP habitat. High IP habitat farther downstream is substantially dewatered, too warm, or has channels too simplified to support coho salmon rearing. Coho salmon are also mostly absent from Wolf and Coyote creeks, and are present only in the upper-most reaches of Grave Creek (ODFW 2005a). Coho salmon are naturally absent from many steep, lower Middle Rogue tributaries between Mule Creek to Agness; however, coho salmon are present in Foster and Shasta Costa creeks in the lower Middle Rogue (USFS 1999b). Coho salmon are also present in Taylor and Galice creeks, tributaries that join the Middle Rogue from the west below the Applegate River (ODFW 2005a). The spatial distribution of the Middle Rogue-Applegate coho salmon population has been significantly reduced through dam construction and habitat degradation.

During the 2004 to 2009 run years, on average about 47 percent of surveyed sites were occupied by wild adult coho salmon, with an estimated average of 9 spawners per mile (hatchery or wild origin unstated) (Lewis et al. 2009).

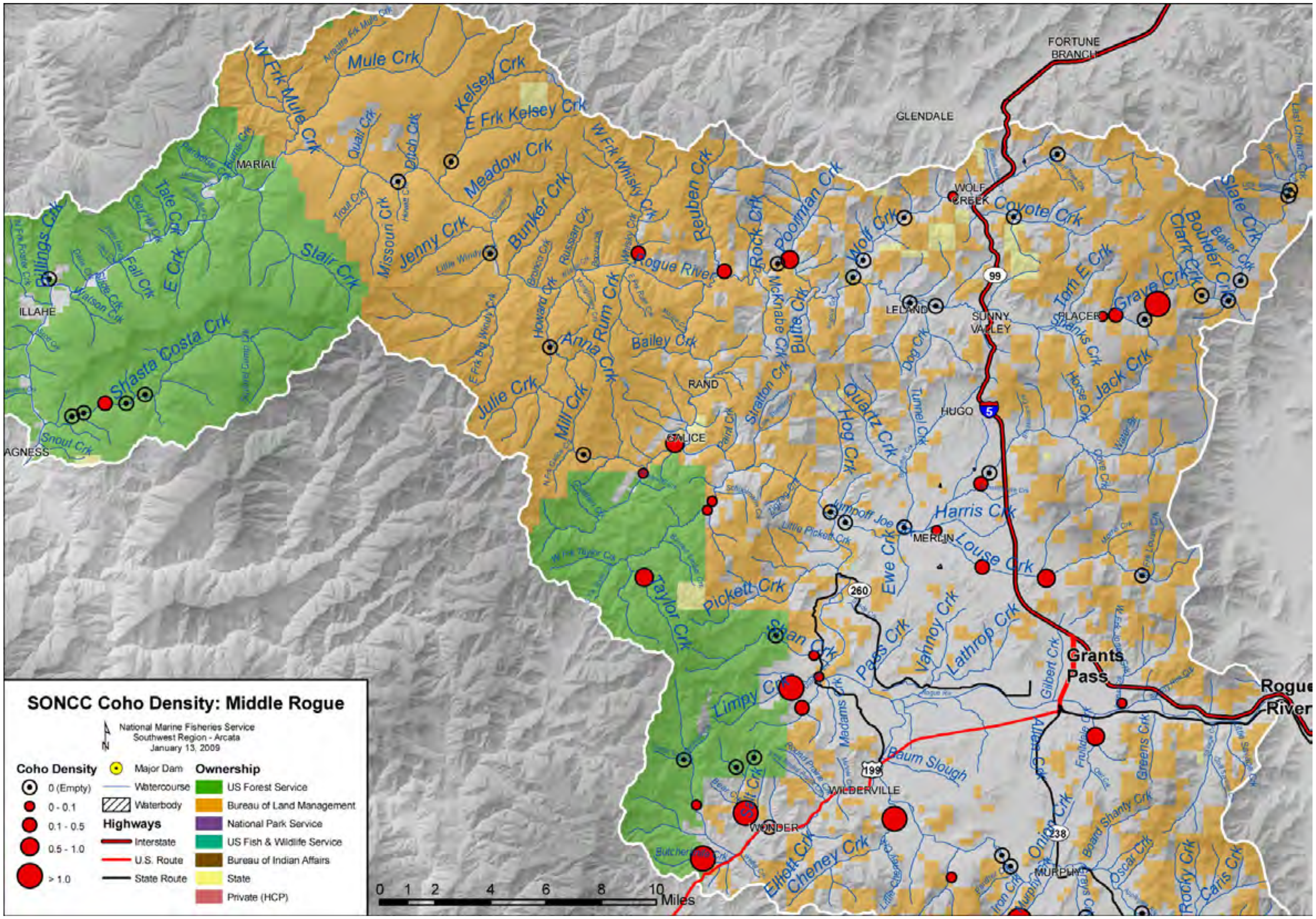

Figure 31-3. Juvenile coho salmon density (fish per square meter) for the Middle Rogue River watershed (ODFW 2005a). Stations with highest densities are in Grave, Taylor, Galice, Limpy and Louse creeks. Note that coho salmon are largely missing from urbanized areas west of I-5.

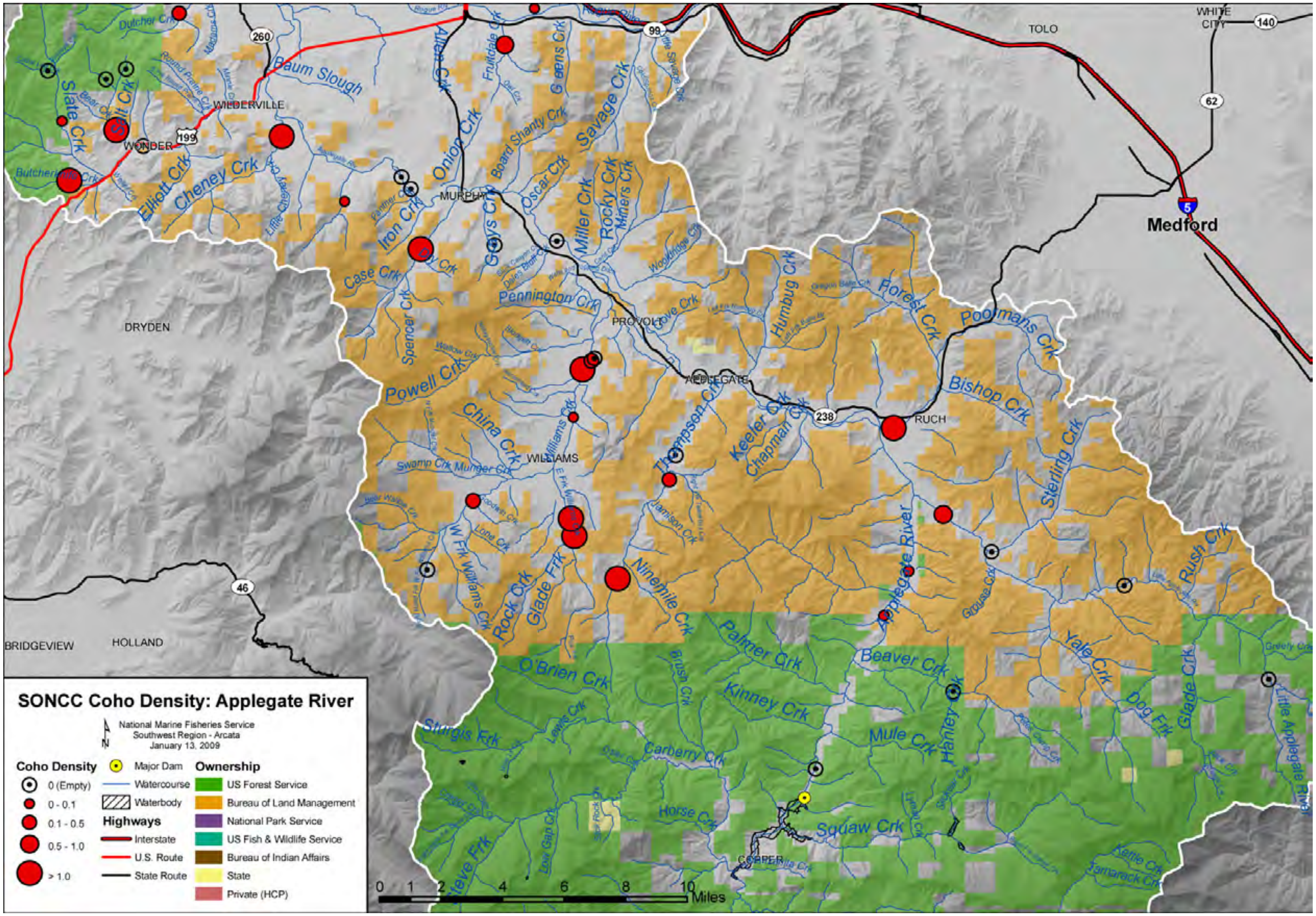

Figure 31-4. Juvenile coho salmon density (fish per square meter) for the Applegate River watershed (ODFW 2005a). Stations with highest densities are located in Williams, Cheney, Slate, and Forest creeks.

Population Size and Productivity

The depensation threshold for the Middle Rogue/Applegate River population is 734 spawners, and the spawner target is 2,400 spawners. Wild adult coho salmon spawner abundance for the Middle Rogue - Applegate population was estimated to be 1,930 in 2007 and 459 in 2008 (ODFW 2013b). The number of coho salmon adults in the Middle Rogue-Applegate river population was likely below the depensation threshold in two of the four years surveyed (Figure 31-5). The Middle Rogue-Applegate population of coho salmon is at moderate risk of extinction in regards to population size because it is above the depensation threshold of 734 and it is below the spawner target of 2,400.

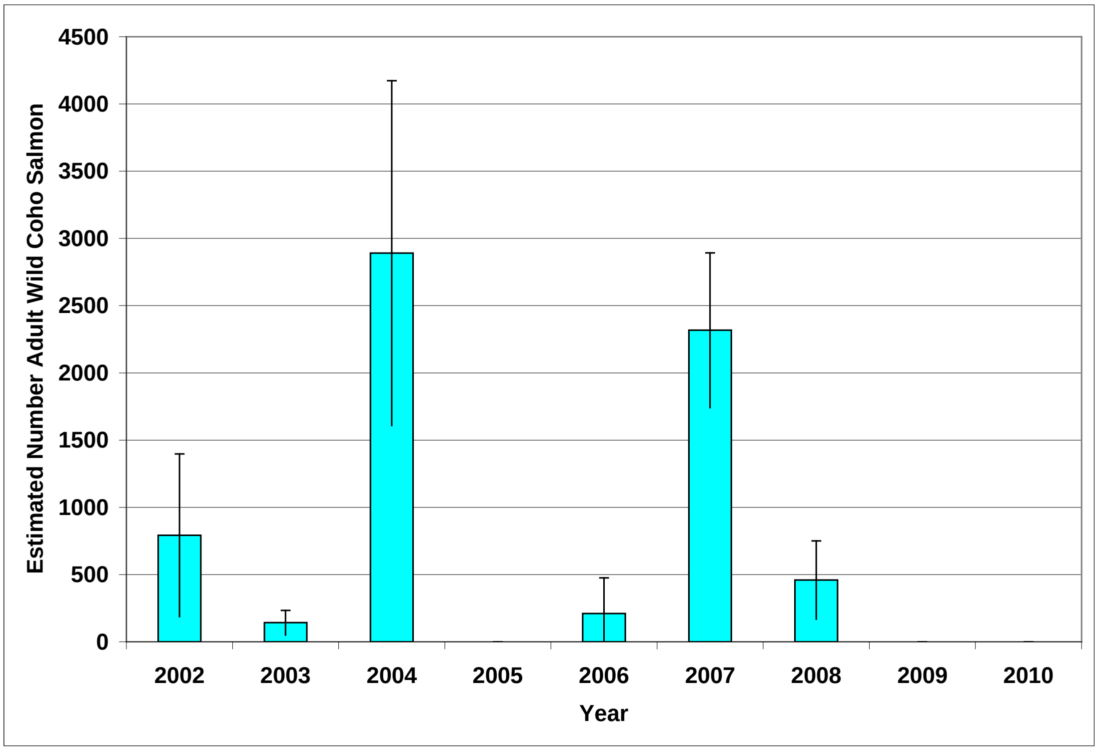

Figure 31-5. Estimated number of adult coho salmon in the Middle Rogue and Applegate rivers population, 2002 to 2010. No sampling occurred in 2005, 2009, or 2010 (ODFW 2011).

Huntley Park seine mark-recapture seine estimates occur in the lower Rogue River (river mile 8) and are the most robust and precise estimates of adult coho salmon abundance in the Rogue River (ODFW 2013b). It is impossible to determine, with existing information, how many of the estimated coho salmon at Huntley Park were returning to the Middle Rogue and Applegate rivers. If the trend in abundance is assumed to reflect trends in the Middle Rogue or Applegate rivers the data can inform whether the population is at high risk of extinction according to the population decline criterion (Williams et al. 2008). The number of adults estimated at Huntley Park has declined at an annual rate of 11% over the last 12 years (Figure 31-6), greater than the 10% decline associated with a high risk of extinction (Williams et al. 2008). Therefore, the population is at high risk of extinction due to its sharply declining productivity.

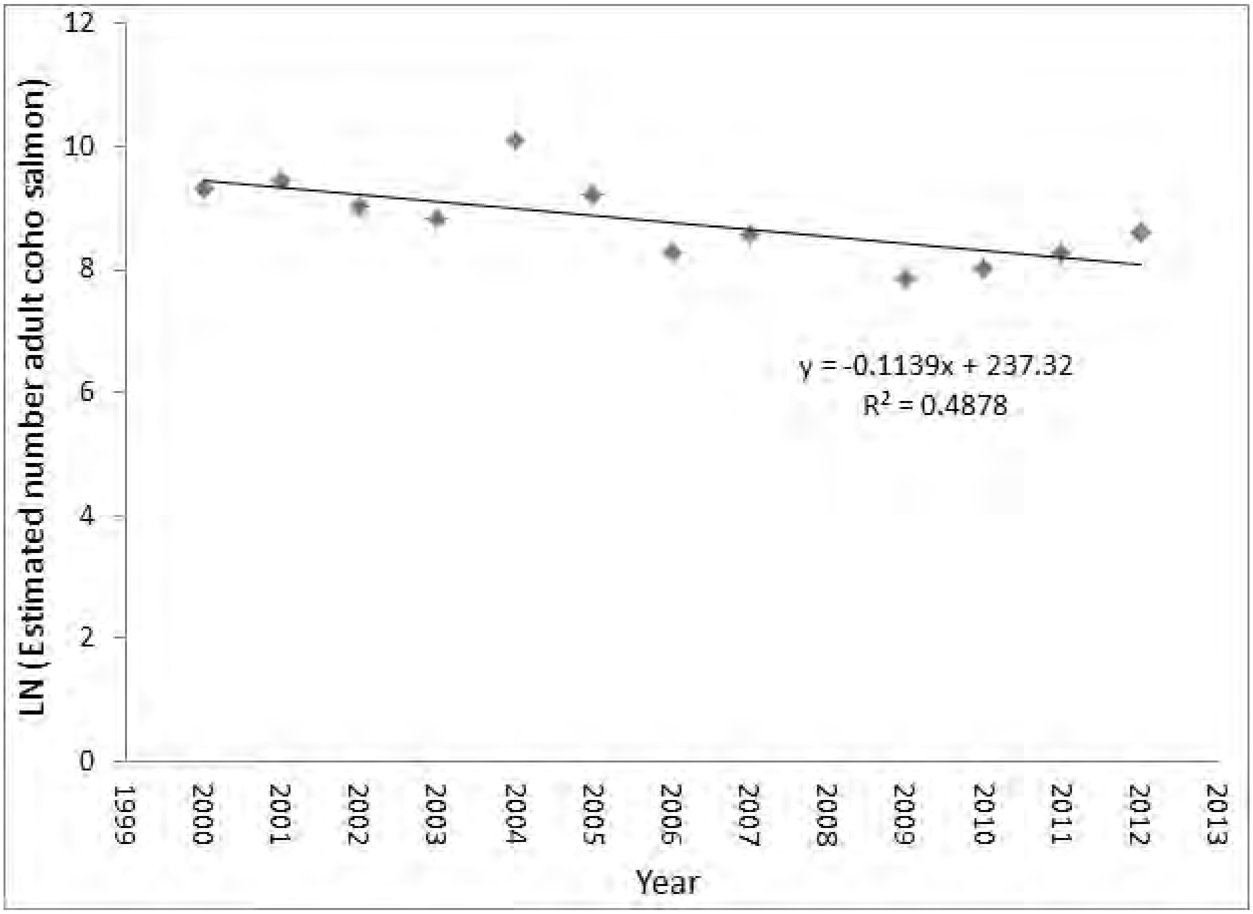

Figure 31-6. Rate of decline of estimated population abundance at Huntley Park, (data source: ODFW 2013b). Using seine mark-recapture data from Huntley Park, ODFW (2005c) calculated productivity for wild adult coho salmon in the Illinois, Middle, and Upper Rogue populations aggregated together for each year from 1980 to 2000. Recruits per spawner were less than replacement levels in eight of the years, indicating low productivity during those years (Figure 31-7).

Extinction Risk

The Middle Rogue-Applegate population is at high risk of extinction. The ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one; however, the population declined at a rate of ≥10% per year over the last two-to-four generations (both criterion described by Williams et al. (2008)). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria are related to population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

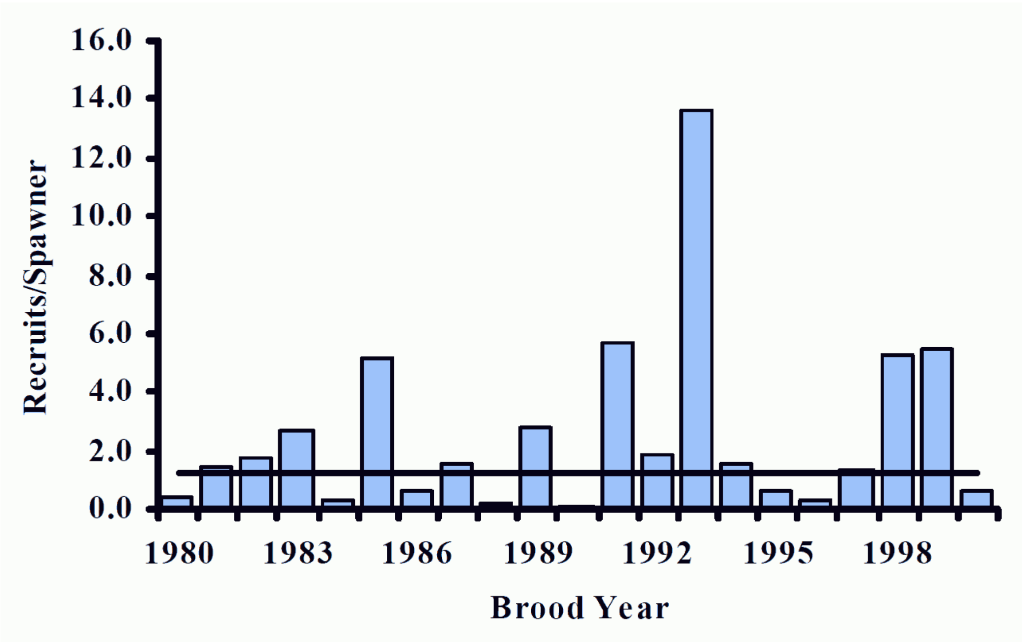

Figure 31-7. Recruit per spawner for brood years 1980 through 2000 for the Rogue River SMU (Species Management Unit), which includes the Middle Rogue, Upper Rogue, and Illinois River populations. Figure from ODFW 2005c.

Role in SONCC Coho Salmon ESU Viability

The Middle Rogue/Applegate River population is a non-core, Functionally Independent population within the Interior Rogue River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Middle Rogue/Applegate River non-core population needs to have at least 2,400 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Furthermore, the Middle Rogue/Applegate River population will contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to other populations in the Rogue River basin.

31.4 Plans and Assessments

State of Oregon

Expert Panel on Limiting Factors for Oregon's SONCC coho salmon populations

ODFW (2008b) convened a panel of fisheries and watershed science experts as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, the key concerns for Middle Rogue-Applegate sub-basin are as follows:

Key concerns were related to loss of over-winter tributary habitat complexity, floodplain connectivity, and access and over-summer water temperatures and habitat access. Over-winter tributary habitat and floodplain connectivity, especially in the lowlands, has been impacted by past and current agricultural practices and an interruption in the transport and presence of large wood. Access to habitat has been limited by road crossings. Summer habitat is limiting because high water temperatures have resulted from land management actions in the riparian zone and straightening of channels and water management actions for agricultural purposes. Water withdrawals and diversions and road crossings have also limited the amount of, and access to, summer habitat and thermal refuge.

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The state of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is a non-regulatory document that includes voluntary actions for all of the threats affecting coho salmon at that time in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary. The action plans, implementation, and annual reports can be found at their web site.

ODFW Coastal Salmonid Inventory Project

ODFW has monitored coho salmon in the Middle Rogue River as part of their Coastal Salmonid Inventory Project. From 1998 to 2004, ODFW carried out dives to detect juvenile coho salmon in both the Middle Rogue and Applegate rivers (ODFW 2005a). ODFW also estimated the abundance of adult coho salmon in the Middle Rogue-Applegate population from 2002 to 2004 and from 2006 to 2008 (ODFW 2011).

Southwest Oregon Salmon Restoration Initiative

The Restoration Initiative provides a regional framework for coho salmon recovery in southwest Oregon (Prevost et al. 1997) and has helped foster the formation of watershed councils. Core areas identified include Slate, Cheney and Williams Creek in the Applegate sub-basin, and Quartz Creek in the Middle Rogue.

Water Requirements of Rogue River Fish and Wildlife

ODFW (Thompson and Fortune 1970) conducted widespread surveys of the Rogue River basin to assess water flow and its effect on fish habitat and carrying capacity for salmonids. The study was designed to inform the Oregon Water Resources Board so that a “beneficial water use program” could be developed. Thompson and Fortune (1970) contains comprehensive flow tables for all major coho salmon producing tributaries in the Rogue River basin, including recommended minimum flows. It also provides a summary of the Rogue River basin fish community, including the Middle Rogue and Applegate Rivers. The report identified flow depletion as a major cause of stress, disease, and predation to Pacific salmonids.

Middle Rogue-Applegate Total Maximum Daily Load Reports

An Applegate River TMDL (Oregon Department of Environmental Quality (ODEQ) 2003) has been completed for temperature, and includes the Beaver Creek TMDL for temperature, sediment, and habitat impairment. A larger scale Rogue River TMDL (ODEQ 2008) covers all tributaries that are listed as impaired (ODEQ 2002a) but not covered by other TMDLs.

Middle Rogue River Watershed Council

Applegate Partnership and Watershed Council

Rogue River Watershed Health Factors Assessment

The Rogue Basin Coordination Council (RBCC 2006) produced the Rogue River Watershed Health Factors Assessment on behalf of all the watershed councils within the basin. The assessment rates aquatic health and watershed conditions, including wildfire risk. Key problems in different Rogue River sub-basins are described and potential solutions are proposed. Recognized problems in the Middle-Rogue are related to stream flows and summer water temperature.

31.5 Stresses

Table 31-2. Severity of stresses affecting each life stage of coho salmon in the Middle Rogue-Applegate rivers. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rate
1	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	Very High	Very High	Very High
2	Altered Hydrologic Function[1]	Medium	Very High	Very High[1]	Very High	High	Very High
3	Impaired Water Quality	Medium	Very High	Very High	High	Medium	Very High
4	Lack of Floodplain and Channel Structure	Medium	Very High	Very High	Medium	Medium	Very High
5	Impaired Estuary/Mainstem Conditions	-	High	High	Very High	High	Very High
6	Barriers	-	Medium	Very High	Low	Medium	High
7	Altered Sediment Supply	High	High	High	Medium	High	High
8	Disease/Predation/Competition	Medium	High	High	Medium	Low	High
9	Adverse Hatchery-related Effects	Medium	Medium	Medium	Medium	Medium	Medium
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low

[1]Key limiting stresses and limited life stage.

Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking. Juvenile summer rearing habitat is impaired by deficient floodplain and channel structure, high water temperatures resulting from degraded riparian conditions, and altered hydrologic function from water withdrawals. Furthermore, degraded riparian forests inhibit future potential input of large wood and cannot provide bank stability that assists in a stable and complex channel. Finally, barriers throughout the sub-basin limit access to rearing habitat. These findings are consistent with those of the Oregon Expert Panel (ODFW 2008b) (Section 31.4).

Degraded Riparian Forest Conditions

Many of the old growth conifers that historically lined the banks of the Middle Rogue-Applegate tributaries have been removed (USFS 1995b, 1999b, BLM 1998a, 1998b). Extensive ODFW riparian surveys found fewer than 75 conifers over 36 inches in diameter per 1000 feet of stream length, which rates as poor. These conditions were found in Grave and Jumpoff Joe creeks and their tributaries, and in almost all Applegate River tributaries. In headwater reaches of Mule, Howard, Galice, Pickett, upper Williams, upper Thompson, upper Grave, and Yale creeks, there were 75 to 125 conifers per 1000 feet, which rates as fair. More large conifers provide cooler ambient air temperatures near streams, providing a moderating influence on water temperature (Poole and Berman 2001). Large conifers are also a source of large wood recruitment that helps maintain habitat complexity.

Riparian vegetation along tributaries like Grave, Wolf, and Coyote creeks reflect 150 years of intensive land use; consequently, early seral species like alder and willow are dominant. The same is true of alluvial valley reaches of Applegate River tributaries on private land, such as Slate, Cheney, Williams, Thompson, and Yale creeks, and the Little Applegate River (USFS 1995b, BLM 1996a, ODEQ 2003). Riparian alteration and simplification are also widespread in the mainstem Applegate River (BLM 1998a) and a constraint on coho salmon recovery (Figure 31-8). The riparian condition stress score is consequently very high across all life history phases except egg.

Figure 31-8. Photo of convergence of Applegate and Middle Rogue rivers. Photo shows intensive land use in the floodplain, disconnected channels, and greatly simplified riparian habitat, all contributing to poor ecosystem function.

Altered Hydrologic Function

Altered hydrologic function is a very high stress for the Middle Rogue-Applegate coho salmon population due to several factors but is primarily the result of dewatering tributary streams (Thompson and Fortune 1970, BLM 1996a). Lack of instream flow limits water quality and salmonid production, including coho salmon (Prevost et al. 1997, RBCC 2006). Nearly all of the tributaries are over allocated to water users and do not meet ODFW minimum instream flows (RBCC 2006).

The Applegate Dam on the upper mainstem Applegate River reduces winter flood peaks and eliminates natural spring flow peaks that coho salmon downstream migrants adapted to. The reduced magnitude and frequency of peak flows may have detrimental effects on channel morphology. In the early period of operation of Lost Creek Dam, on the Upper Rogue River (RM 157), flows in the mainstem Middle Rogue were very low which affected Middle Rogue-Applegate River fish on their seaward migration. However, increased releases during the summer and fall from the reservoir have benefited coho salmon (ODFW 1989).

Impaired Water Quality

The state of Oregon (ODEQ 2002a, 2003, 2008) identified extensive water quality problems in the Middle Rogue-Applegate sub-basin that account for the high to very high stress scores for fry, juvenile, and smolt coho salmon life history phases. Only 21 percent of Middle Rogue and 44 percent of Applegate reaches surveyed by ODEQ met water quality standards (SO RC&D 2003). Elevated water temperature is the most pervasive water quality impairment, and is often caused by stream flow diversions (Thompson and Fortune 1970). Other water quality parameters listed as impaired include dissolved oxygen, fecal coliform (Middle Rogue River only in this population area), sedimentation (Beaver Creek only), and biological criteria (Beaver Creek only) (ODEQ 2003, 2008).

Water temperatures in the mainstem Middle Rogue River, Applegate River, and the larger tributaries are elevated during the summer months, likely approaching or exceeding coho salmon tolerance levels in most reaches (Appendix I); one exception is the tailwater below Applegate Dam. Elevated stream temperatures in coho salmon rearing streams decrease the survival and growth of fish and are a key limiting factor in this population area. Tributaries in the Wild Rogue Wilderness Area are cooler, as are headwater streams on public lands; however, most have stream gradients that are too high to provide high quality coho salmon rearing habitat. Water temperature in Forest Creek, Williams Creek below Rock Creek, and Thompson Creek above Nine Mile Creek met ODEQ standards and coho suitability (Applegate River Watershed Council [ARWC] 2007) (Figure 31-9).

It is unlikely that high fecal coliform bacterial levels in the Rogue River (ODEQ 2008) would directly harm coho salmon; however, the coliform levels might indicate livestock access to creeks or leaking septic systems. Dissolved oxygen impairment, which is apparent in the Applegate tributaries Williams, Thompson, Cheney, Forest and Slate creeks is likely related to both nutrient enrichment and decreased flows. Pesticides and herbicides have the potential to harm coho salmon (NMFS 2008), but data are lacking for the Middle Rogue/Applegate River sub-basin.

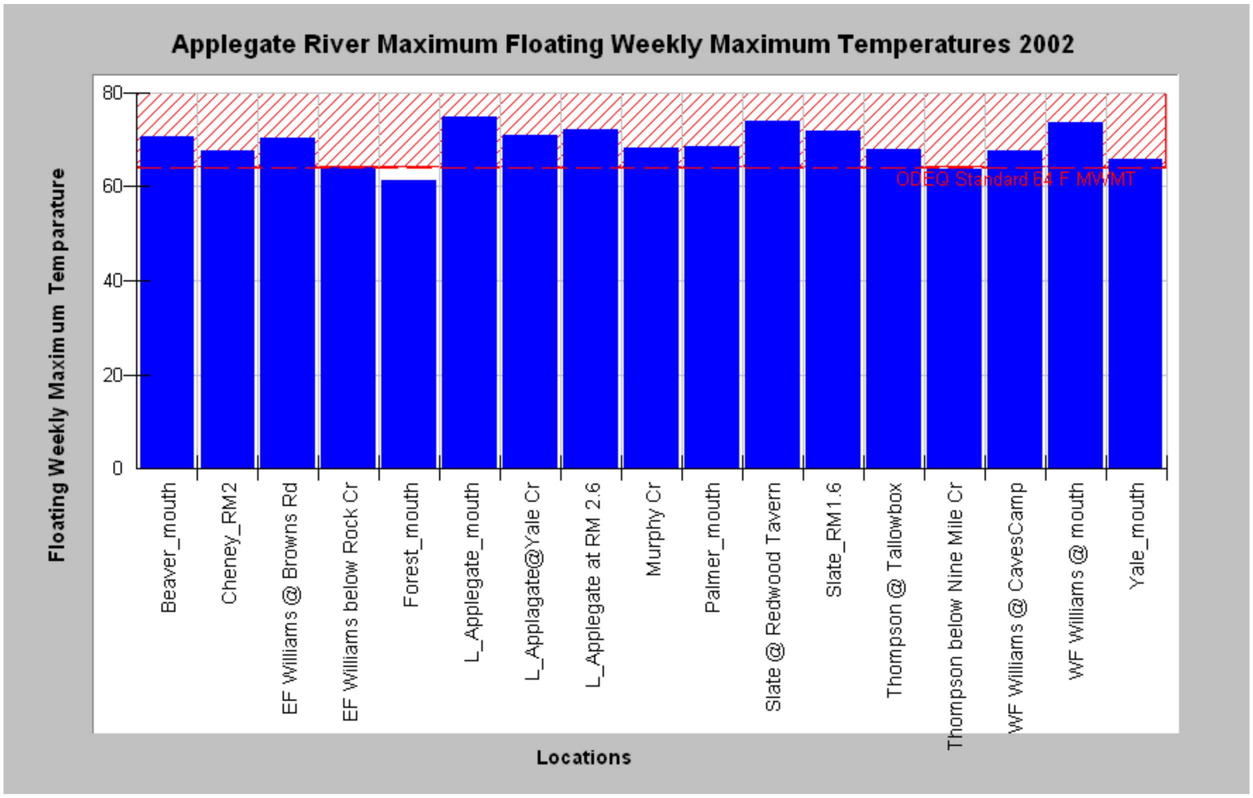

Figure 31-9. Floating weekly maximum temperature (MWMT) for several Applegate River tributaries. Temperatures in nearly all tributaries exceed Oregon Department of Environmental Quality (ODEQ) standards of 64° F (red line) (ARWC 2007).

Lack of Floodplain and Channel Structure

The straightening and simplification of streams has reduced the amount of slow, cool edgewater habitats where coho salmon fry and juveniles thrive (ODEQ 2008). Beaver have been greatly reduced along with the pools they create (ODFW 2005b). Although there are patches of functional coho salmon habitat, many river reaches and tributary channels do not support coho salmon (Prevost et al. 1997, ODFW 2008b). Channelization of the mainstem Rogue and Applegate rivers has disconnected them from much of their floodplain, reducing the physical processes that form coho salmon rearing and spawning habitat. These processes include side channel formation, accumulation of large wood jams, formation of slower water velocities, formation of pools, and lower shear stress. In the Applegate sub-basin, small tributaries on both the east and west sides of the river drain into irrigation canals; consequently, there is no connection of the tributary channel or riparian area to the mainstem (BLM 1998a). Although the hydrologic effects of Applegate Dam on downstream channel morphology have not been studied, research on other river systems with large dams by McBain and Trush (2002) has shown that lack of flushing flows causes channel confinement that increases velocities and diminishes the amount of slow, edgewater habitats favored by rearing juvenile coho salmon. Removal of large woody debris within the stream channels (USFS 1999b), timber harvest in riparian areas and associated road building have all contributed to reducing channel complexity and pool habitat, thus reducing juvenile coho salmon rearing capacity and survival.

Pool frequency and depth are important indicators of channel structure and both show impairment. Although some larger tributary mainstems have very good pool frequency (>35 percent of stream area), many have a rating of good (20 to 35 percent). Although some small headwater streams throughout the sub-basin have cool water temperatures, maximum average pool depths are less than 3 feet and are marginal or unsuitable for coho salmon rearing throughout the summer and winter. Shallow pool depths (<3 feet) also exist in alluvial valley tributaries like the Little Applegate, Thompson, Forest, Cheney, Slate, Murphy, Wolf, Coyote, and Williams creeks. Mainstems of large tributaries like Grave and Jumpoff Joe creeks score well on the 3-foot depth criteria, but since they are larger order streams they likely had much greater depths before disturbance. Some Lower Middle Rogue (Stair and Shasta Costa creeks), Wild Rogue (Mule, Big Windy, Bunker, Howard, and Whiskey creeks) and west-side tributaries that flow from public land (Galice Creek) have average maximum pool depths greater than 3 feet, indicating that their depth and carrying capacity for salmonids is increasing.

Spatial patterns from ODFW and USFS large wood surveys of Middle Rogue-Applegate stream channels are very similar to those observed in the riparian conifer surveys (Appendix B). Most mainstem reaches surveyed on private lands throughout the sub-basin, including most of Grave and Jumpoff Joe creeks, had less than one key piece of large wood per 100 meters, which rates as poor. Reaches in the Applegate River tributaries Thompson, Cheney, Slate, Beaver, and Williams creeks all have poor large wood scores. Upper reaches on private and public lands tend to have slightly better scores with many rated fair (1 to 2 key pieces/100 m), but only USFS and BLM headwater tributaries have good and very good large wood scores).

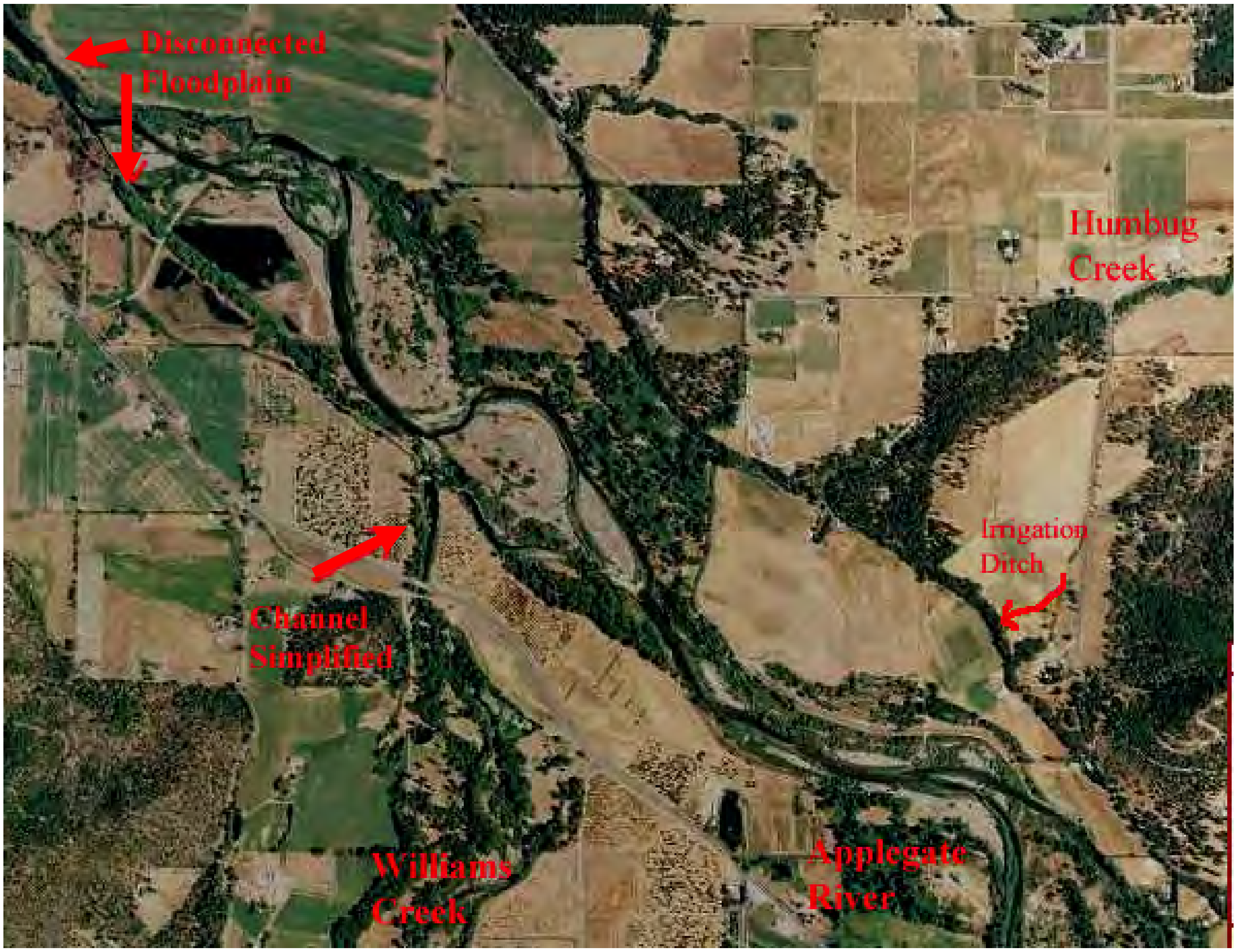

Figure 31-10. Aerial photo of convergence of Applegate River and Williams Creek. In this alluvial valley reach the river has a narrow riparian buffer zone as does Williams Creek at their point of convergence. The channel of Humbug Creek (right) appears to terminate in a diversion ditch.

Impaired Estuary/Mainstem Function

The Rogue River estuary is highly altered and has lost some of its historic function. Loss of rearing habitat in the estuary limits productive potential of the entire basin and is a moderate stress for juveniles in all Rogue basin populations. Insufficient refugia habitat for smolts and adults likely results in high rates of predation from birds and pinnipeds during migration to and from the ocean. These degraded conditions cause impaired estuarine function to be a very high stress for the population overall. A discussion of the causes of reduced estuarine function can be found in the Lower Rogue River population profile.

Barriers

Barriers pose a medium threat to the population overall, but a high stress to juveniles. Access to 19 miles of historic coho salmon habitat in the Applegate Sub-basin is blocked by Applegate Dam (ODFW 2005c, Figure 31-1). This blocked habitat is not essential to this population achieving its spawner target, so NMFS does not recommend removing the dam or providing passage. A substantial amount of historic habitat in the Middle Rogue-Applegate sub-basin may be inaccessible due to road-stream crossings associated with extensive road networks, and maps indicate barriers in Cheney and Slate creek watersheds (Bredensteiner et al. 2003). The Rogue Basin Fish Access Team (RBFAT) is developing a coordinated plan for assessment and removal of fish passage barriers in the Rogue River basin and nine of the top twenty targets are in the Middle Rogue sub-basin (Mosser and Graham 2004). Temporary gravel agricultural diversion dams, known as push up dams, may impede access in alluvial valley reaches of coho salmon tributaries (Prevost et al. 1997). The USFS (1995b) identified permanent agricultural diversion structures that impede both adult and juvenile salmonid migration. Savage Rapids Dam, which was previously recognized as an impediment to salmonid migration (RBCC 2006), was removed in 2009 (U.S Bureau of Reclamation 2009a).

Altered Sediment Supply

Sediment contribution from landslides and erosion occurs naturally in the Middle Rogue-Applegate River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. Excess fine sediment directly impacts egg viability and can reduce food for fry, juveniles and smolts. Beaver Creek's headwaters, in the Applegate sub-basin, intersect with a band of decomposed granitic soils that have little cohesion and contribute very large quantities of sand (ODEQ 2003). As a result, Beaver Creek is considered sediment impaired by ODEQ (2003). Poor pool frequency and depth throughout the Middle Rogue-Applegate River basin (USFS 1995b, BLM 1998a) are likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening.

Applegate Dam blocks coarse and fine sediment supply to the mainstem Applegate River (Reid Unpub.). Between 1980 and 2010, approximately 5,615 acre-feet of sediment was trapped by the reservoir (Reid Unpub.). Upper Applegate River has shown substantial reduction in the amount of gravel (7 mm – 90 mm) since construction of Applegate (Reid Unpub.). Substrate surveys of the first five miles below the dam revealed gravel was 10 times less abundant in 2009 than in 1972 prior to dam construction (Reid Unpub.).

Disease/Predation/Competition

Water temperatures in Middle Rogue and Applegate tributaries in recent years are above those recognized by McCullough (1999) as causing increased disease risk for juvenile coho salmon. Thompson and Fortune (1970) found that salmonids in the Rogue River basin, including the Upper Rogue River, had higher incidences of the fish diseases *furunculosis* and *columnaris* in reaches that were warm due to flow depletion. The ODFW has documented extensive losses of juvenile steelhead and salmon within the mainstem Rogue River near Grants Pass in 1947 (OSGC 1947), 1955 (OSGC 1955), 1960 (OSGC 1960), and 1977 (ODFW 2001). Starting in the 1955 report, OSGC cited infections of columnaris. These reports do not always indicate what species of salmon were found. While not explicitly documented, it is likely that SONCC coho salmon juveniles in the Rogue River also experienced injury and death during these times due to their similar biology and life history. Thompson and Fortune (1970) also noted that warm water conditions favored introduced species in the mainstem Rogue and Applegate rivers. Competition with and predation by non-native fishes is an ongoing problem, especially in the mainstem Applegate River (Wheeler 2009). In very temperature-impaired streams, such as portions of

Jumpoff Joe Creek, introduced species like redside shiners may predominate (BLM 1998b). Umpqua pikeminnow, an introduced and piscivorous species, is prevalent in the mainstem Rogue River, Jumpoff Joe Creek, Grave Creek, Vannoy Creek and many other low gradient streams within the Middle Rogue.

Adverse Hatchery Related Effects

Cole Rivers Hatchery is located upstream of the Middle Rogue/Applegate population area in the Upper Rogue River sub-basin, and produces approximately 200,000 coho salmon smolts annually in addition to millions of hatchery spring Chinook, winter steelhead, and summer steelhead (ODFW 2008d). Some coho salmon returning to the hatchery stray into the mainstem tributaries and to a lesser extent into the Applegate River. From 1996 to 1998, less than five percent of adults observed in spawner surveys in the Applegate River were of hatchery origin (Jacobs et al. 2002). Adverse hatchery-related effects pose a medium risk to all life stages, due to the presence of Cole Rivers Hatchery in the Rogue River basin (Appendix B).

Adverse Fishery-and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

31.6 Threats

Table 31-3. Severity of threats affecting each life stage of coho salmon in the Middle Rogue-Applegate rivers. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Dams/Diversions[1]	Low	Very High	Very High[1]	Very High	High	Very High
2	Urban/Residential/Industrial Dev.[1]	High	Very High	Very High[1]	High	Very High	Very High
3	Agricultural Practices	High	Very High	Very High	Very High	High	Very High
4	Roads	High	Very High	Very High	High	High	Very High
5	Channelization/Diking	High	Very High	Very High	High	High	Very High
6	Timber Harvest	High	High	High	High	Medium	High
7	Road-Stream Crossing Barriers	-	Medium	High	High	High	High
8	Mining/Gravel Extraction	Medium	High	High	Medium	Medium	High
9	High Severity Fire	Medium	Medium	Medium	Medium	Medium	Medium
10	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
11	Invasive Non-Native/Alien Species	-	Medium	Medium	Medium	Medium	Medium
12	Climate Change	Low	Low	Medium	Low	Low	Low
13	Fishing and Collecting	-	-	Low	Low	Medium	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect the recovery of the population by influencing stresses are dams/diversions and urban/residential/industrial development.

Dams/Diversions

Multiple diversions de-water most of the prime coho salmon rearing areas in the Middle Rogue-Applegate sub-basin (Thompson and Fortune 1970, Prevost et al. 1997, RBCC 2006, ODFW 2008b). ARWC (2007) noted that many streams in the Applegate watershed are over-allocated and irrigation withdrawals exacerbate low summer flows. Agricultural diversions diminish flows in alluvial reaches of Middle Rogue tributaries with high IP coho salmon habitat, including Grave, Pickett, Little Pickett, Limpy, Pass, and lower Taylor creeks (Thompson and Fortune

1970). Unscreened diversions may also cause significant loss of downstream migrating coho salmon juveniles (ODFW 2008b). In addition, approximately 19 miles of coho salmon habitat is blocked by Applegate Dam (ODFW 2005c).

Urban/Residential/Industrial Development

Urbanization and rural development pose a very high threat for Middle Rogue-Applegate coho salmon due to existing impacts to high IP habitat that are likely to continue in the future. Grants Pass, Merlin, the Applegate Valley, and Jumpoff Joe, Grave, Wolf, and Coyote creek watersheds contain high IP habitat and the vast majority of the human residences. Effects of urbanization increase with the total impervious area which causes increased peak flow, simplification of downstream channels, increased channel width to depth ratio, and toxic non-point source pollution (Booth and Jackson 1997, Booth et al. 2006). In urban centers such as Grants Pass, industrial development may add to non-point source pollution. Rural residential development is growing rapidly in Jackson County within the Middle Rogue-Applegate sub-basin (SO RC&D 2003), and septic system leakage or failure can lead to pollution. Backyard use of pesticides and fertilizers can also be significant in areas with concentrated development (Booth et al. 2006). Residential development outside cities and towns often relies on surface water from streams or groundwater wells that may deplete nearby surface flows. Rural residential developments are specifically noted as a concern in Jumpoff Joe Creek (BLM 1998b), Little Applegate (USFS 1995b), and Star Gulch (BLM 1998a) in the Applegate sub-basin.

Agricultural Practices

Agricultural impacts include flow depletion, elevated water temperature, channel simplification, riparian removal, and chemical application. The most intensive agricultural land use overlaps substantially with the highest IP coho salmon habitat. Agricultural impacts were assessed in part based on Landsat imagery (Homer et al. 2004). The lower mainstem Applegate, Little Applegate, Baum Slough, Yale, Williams, and East Fork Williams creeks all have high (5 to 10 percent of land area) or very high (>10 percent) agricultural land-use. Middle Rogue River tributaries that were rated high for agricultural land-use include Lathrop, Vannoy, Pass, Madams, Dutcher, Pickett, Little and Pickett, creeks. Significant grazing occurs routinely on private lands and by permit on Federally administered lands. Grazing may change soil infiltration rates and can cause deleterious channel changes (Spence et al. 1996). Riparian vegetation alteration occur with grazing as well. It is likely that pesticides known to harm salmonids (NMFS 2008, Laetz et al. 2009) are used in the region. However, information regarding pesticide and herbicide use in the Middle Rogue-Applegate sub-basin and the SONCC coho salmon ESU is generally unavailable (Riley, S. pers. comm. 2009). Herbicide use in the nearby Upper Rogue sub-basin has resulted in fish kills that included coho salmon (Ewing 1999).

Roads

Very high road densities, numerous road-stream crossings, and roads on steep slopes combine to pose a high to very high threat to all coho salmon life stages in the Middle Rogue-Applegate sub-basin. Road densities are very high (>3 mi/mi^2) in almost all areas of the sub-basin. The only Middle Rogue watersheds with low (0 to 1.6 mi/mi^2) road densities are Rogue Wilderness areas between Agness and Mule Creek, and the Howard Creek watershed. In the Applegate sub-basin, Palmer Creek is the only watershed below Applegate Dam with low road density. The aggregated Wild Rogue tributary watersheds near Whiskey Creek on BLM lands have high (2.5 to 3.0 mi/mi^2) road densities, as does Taylor Creek, a USFS Key Watershed.

The greatest road densities are in urban areas near Grants Pass, in some cases exceeding 7 mi/mi^2 (Bredensteiner et al. 2003). BLM (1998b) found road densities in the urbanized lower Jumpoff Joe watershed to be 8.29 mi/mi^2, but 4.63 mi/mi^2 on BLM land. Upper Grave Creek has nearly 6 mi/mi^2 due to a combination of urban, rural residential and timber management roads. Private forest lands, such as Cheney and Slate creeks in the lower Applegate sub-basin, have road densities of 4 to 5 mi/mi^2. Rural residential, forest, and agricultural roads combine to elevate the road density in Williams Creek in the Applegate sub-basin to near 5 mi/mi^2. There are far more un-surfaced than paved roads in the western Middle Rogue and Applegate watersheds. East-side tributaries in urban areas have mostly paved roads. While paved roads yield less fine sediment than dirt roads, they have greater hydrologic impacts (Booth and Jackson 1997) and can contribute toxic runoff (Booth et al. 2006).

Channelization and Diking

Channelization and diking threat is a high to very high threat across all Middle Rogue-Applegate coho life stages, and high overall, because of extensive channel changes related to historic mining, agriculture and urbanization (Prevost et al. 1997). Disruptions include key locations such as the convergence of the Applegate and Middle Rogue (Figure 31-8) and Williams Creek and the Applegate River (Figure 31-10). When a channel is disconnected from its floodplain, slow water habitats in the stream margins preferred by coho salmon are reduced or eliminated. Channelization of streams and disconnection from wetlands (Figure 31-11) has resulted in decreased water storage and disrupted surface water connections to cooler groundwater, causing loss of summer and fall rearing refugia (ODEQ 2008). This type of disruption is typical in the entire reach from Evans Creek downstream to the Applegate River. Applegate tributaries impacted by agriculture, such as Williams, Thompson, Slate, Cheney, and Yale creeks are channelized or confined, as is the Little Applegate River. Channelization in Jumpoff Joe Creek by agriculture, mining, and road construction has resulted in substantial negative impacts to coho salmon habitat (BLM 1998b).

Timber Harvest

Reeves et al. (1993) found that the rate of timber harvest in Oregon coastal watersheds should not exceed 25 percent of a watershed to minimize risks and disturbances to aquatic resources. The study covered a period of 30 years (Reeves, G., pers. comm. 2003) and watersheds exceeding that level of harvest did not maintain channel integrity or Pacific salmon species diversity. Middle Rogue-Applegate sub-basin timber harvest rates are typically greater than this threshold on private timber land; therefore, the threat from timber harvest on private land will likely remain high. This private land encompasses most of the high IP coho habitat. The greatest risk from timber harvest is on private industrial timberlands that are managed under the Oregon Forest Practices Act, such as in private in-holdings in upper Slate Creek, Cheney Creek, and the decomposed granitic soils of the upper Beaver Creek watershed. Timber harvest on public land is now largely restricted to selective harvests in previously logged areas in order to improve forest health.

Figure 31-11. The middle mainstem Rogue River is disconnected from its floodplain and wetlands. Red arrows point to disconnected portions. This eliminates stable side channels that provide coho salmon rearing habitat. June 2005.

Road-Stream Crossing Barriers

The high threat scores for fish passage at culverts and stream crossings is a result of high road densities in urban areas, industrial timber lands, and rural residential areas of the Middle Rogue-Applegate watershed. Bredensteiner et al. (2003) show particularly high road densities, road stream crossings, and associated potential barriers in watersheds of Mule, Grave, Wolf, Coyote, Jumpoff Joe, and Upper Middle Rogue tributaries (Grants Pass). In the Applegate sub-basin, road stream crossings are highest in the Cheney Creek and Slate Creek watersheds.

High Severity Fire

Fire risk is acknowledged as a regional concern (RBCC 2006, BLM 1998b). Early seral stage forests, which are common in this population's range, lead to dry site conditions and increased fire risk (SO RC&D 2003). Of all areas in the sub-basin, elevated fire risk poses the greatest threat to watershed recovery in the Wild Rogue tributaries between Mule and Grave creeks. Large areas of even-age plantations and areas converted from Douglas fir to hardwood or chaparral may have elevated fire risk.

Hatcheries

Hatcheries pose a medium threat to all life stages of coho salmon in the Middle Rogue/Applegate River. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Invasive Non-Native Species

Thompson and Fortune (1970) documented large populations of warm water fish in the lower Applegate River and in the mainstem Rogue River upstream of diversion dams such as Savage Rapids and Gold Ray dams. Non-native Umpqua pikeminnow, a coldwater predator, is present in the mainstem Rogue River and many tributaries. Removal of Gold Hill Diversion Dam in the Upper Rogue sub-basin in 2008 and Savage Rapids dam in the Middle Rogue sub-basin in 2009 are expected to have made this habitat less favorable for these invasive species. Agricultural and residential ponds provide a source of warm water game fish. Although the magnitude of competition and predation by introduced warm water species has not been assessed recently, NMFS believes it is a continuing problem in the lower Applegate River.

Mining/Gravel Extraction

Legacy effects from past gold mining may persist in some reaches (BLM 1999a) and there are still many active mining claims. Potential impacts of mining on salmonids include alteration of ecological integrity of the area (Bredensteiner et al. 2003). Significant occupied habitat in the Middle Rogue/Applegate River population occurs on federal lands (Figure 30-1), where mining access is permitted under the 1872 Mining Law. Gold mining on federal lands often occurs on those lower gradient stream reaches that are located just upstream of private lands. These reaches are very important to coho salmon and they represent the best low gradient habitat available. The location of such mining contributes to the severity of the threat to coho salmon in this population. The USFS alone has 64 active mining claims within one mile of SONCC coho salmon critical habitat (USFS 2013), the impacts of which will continue into the future for at least the next ten years.

BLM (1998b) notes that gravel extraction is widespread in the vicinity of the I-5 corridor and in urban areas of the Jumpoff Joe Creek watershed. The gravel operations adjacent to the mainstem Rogue River at the mouth of the Applegate occupy what was likely a wetland complex and salmonid refugia before disturbance. The ARWC (2007) expressed concern regarding gravel extraction because mainstem reaches are already depleted of coarse substrate due to Applegate Dam. One commercial operator removes approximately 500,000 cubic yards from the lower Applegate River annually, but much now comes from pits outside of the ordinary high water mark (Wheeler 2009). Pits excavated in the floodplain can capture juvenile coho salmon, coho salmon smolts, and adult coho salmon during high flow events. Most of these stranded fish perish if no outlet is available when flows recede.

Climate Change

Climate change scenarios for Middle Rogue-Applegate sub-basin (Independent Science Advisory Board (ISAB) 2007, Feely et al. 2008, Portner and Knust 2007) predict increasing air temperature for the years 2030 to 2050. Impacts of climate change in this region may affect all life history stages, but the greatest impact will likely be on juveniles. The projected increase in July air temperature ranges from 1.5 to 3.0 °C, and January temperatures are predicted to increase 1.0 to 1.5 °C at all elevations. This will likely result in less snow accumulation throughout most of the Middle Rogue-Applegate sub-basin, and the resulting decreased flow will directly diminish available habitat.

Van Kirk and Naman (2008) documented decreasing snow pack below 6,000 feet over the last 20 years in the Klamath Mountains just south of the Applegate sub-basin. Warming may increase rain-on-snow events, which result in increased runoff that can scour redds and eggs and can flatten channel profiles, resulting in loss of rearing habitat. Overall, the range and degree of variability in temperature and precipitation are likely to increase in all populations. Adults may be negatively impacted by ocean acidification and changes in ocean conditions and prey.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

31.7 Recovery Strategy

The most immediate need for habitat restoration and threat reduction in the Upper Rogue River is in those areas currently occupied by coho salmon. Particularly streams with good restoration potential and a high likelihood of success are Pickett, Shan, Limpy, Galice, Dutcher, Madams, and Taylor Creeks, including tributaries Minnow and Burnt Timber creeks. Unoccupied areas must also be restored to provide enough habitat for coho salmon recovery.

The degraded condition of the Middle Rogue-Applegate River habitat, combined with the depressed coho salmon population size and distribution, increases the risk of extinction of this important, inland coho salmon population. The most important factor limiting recovery of coho salmon in the Middle Rogue-Applegate River is a deficiency in the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by restoring flow, increasing habitat complexity within the channel, restoring off-channel rearing areas, and reducing threats to instream habitat. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 31-4 on the following page lists the recovery actions for the Middle Rogue/Applegate rivers population.

Table 31-4. Recovery action implementation schedule for the Middle Rogue/Applegate rivers population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.7.3.49	Riparian	No	Improve agricultural practices	Improve regulatory mechanisms	Population wide	1
SONCC-MRAR.7.3.49.1	*Determine the best way to revise the Agricultural Water Quality Management Act (AWQMAP) so that it does not limit recovery of SONCC coho salmon and recommend appropriate revisions*					
SONCC-MRAR.7.3.49.2	*Ensure basin rules are specific and linked to implementing AWQMAP recommendations, including developing specific standards for riparian buffers*					
SONCC-MRAR.7.3.49.3	*Ensure that AWQMA plans address both impaired areas and proactive prevention of water quality impairment*					
SONCC-MRAR.7.3.49.4	*Adopt interim buffers equal to the buffer standards NMFS is recommending in Washington state until the state establishes its own buffers*					
SONCC-MRAR.7.3.49.5	*Develop a process in the AWQMA Program that tracks and evaluates implementation*					
SONCC-MRAR.7.3.49.6	*Change the complaint-based compliance monitoring process to a focused compliance program*					
SONCC-MRAR.7.2.50	Riparian	No	Improve timber harvest practices	Improve regulatory mechanisms	Population wide	1
SONCC-MRAR.7.2.50.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-MRAR.7.2.50.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-MRAR.7.2.50.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-MRAR.7.2.50.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-MRAR.7.2.50.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams, increased shade on perennial streams, and protective buffers on intermittent streams.*					
SONCC-MRAR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2a
SONCC-MRAR.3.1.5.1	*Quantify groundwater withdrawal and ensure urban/residential/industrial development does not limit recovery of SONCC coho salmon*					
SONCC-MRAR.3.1.5.2	*Establish a comprehensive groundwater permit process*					
SONCC-MRAR.2.1.12	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve suction dredging practices	All streams where coho salmon would benefit immediately	2a
SONCC-MRAR.2.1.12.1	*Develop suction dredging regulations that minimize or prevent impacts to coho salmon. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-MRAR.2.1.71	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve suction dredging practices	Population wide	2b
SONCC-MRAR.2.1.71.1	*Develop suction dredging regulations that minimize or prevent impacts to coho salmon. Consider special closed areas, closed seasons, and restrictions on methods and operations*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MRAR.2.1.13	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately within private lands	2a
SONCC-MRAR.2.1.13.1		*Assess habitat to determine beneficial location and amount of instream structure needed*				
SONCC-MRAR.2.1.13.2		*Place instream structures, guided by assessment results*				
SONCC-MRAR.2.1.72	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-MRAR.2.1.72.1		*Assess habitat to determine beneficial location and amount of instream structure needed*				
SONCC-MRAR.2.1.72.2		*Place instream structures, guided by assessment results*				
SONCC-MRAR.2.2.10	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-MRAR.2.2.10.1		*Assess habitat to determine where potential exists for floodplain reconnection. Prioritize sites and determine best means for reconnection at each site using tools such as hydrologic analysis*				
SONCC-MRAR.2.2.10.2		*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*				
SONCC-MRAR.2.2.73	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-MRAR.2.2.73.1		*Assess habitat to determine where potential exists for floodplain reconnection. Prioritize sites and determine best means for reconnection at each site using tools such as hydrologic analysis*				
SONCC-MRAR.2.2.73.2		*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*				
SONCC-MRAR.2.2.11	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	All streams where coho salmon would benefit immediately	2a
SONCC-MRAR.2.2.11.1		*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*				
SONCC-MRAR.2.2.11.2		*Implement education and technical assistance programs for landowners, guided by the plan*				
SONCC-MRAR.2.2.11.3		*Reintroduce or relocate beaver if appropriate, guided by the plan*				
SONCC-MRAR.2.2.74	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2b
SONCC-MRAR.2.2.74.1		*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*				
SONCC-MRAR.2.2.74.2		*Implement education and technical assistance programs for landowners, guided by the plan*				
SONCC-MRAR.2.2.74.3		*Reintroduce or relocate beaver if appropriate, guided by the plan*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.2.2.47	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Mainstem Applegate River and major tributaries, Jumpoff Joe Creek, and all streams where coho salmon would benefit immediately	2a
SONCC-MRAR.2.2.47.1	*Develop a plan to remove levees and reconnect priority channelized stream reaches to historic side channels and wetlands*					
SONCC-MRAR.2.2.47.2	*Remove levees, guided by the plan*					
SONCC-MRAR.2.2.47.3	*Restore the historic side channels and wetlands, guided by the plan*					
SONCC-MRAR.2.2.75	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Population wide	2b
SONCC-MRAR.2.2.75.1	*Develop a plan to remove levees and reconnect priority channelized stream reaches to historic side channels and wetlands*					
SONCC-MRAR.2.2.75.2	*Remove levees, guided by the plan*					
SONCC-MRAR.2.2.75.3	*Restore the historic side channels and wetlands, guided by the plan*					
SONCC-MRAR.3.1.42	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams with ODFW water rights for fish and all streams where coho salmon would benefit immediately	2a
SONCC-MRAR.3.1.42.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-MRAR.3.1.66	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-MRAR.3.1.66.1	*Identify and cease unauthorized water diversions*					
SONCC-MRAR.3.1.78	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-MRAR.3.1.78.1	*Identify and cease unauthorized water diversions*					
SONCC-MRAR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-MRAR.3.1.4.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-MRAR.22.3.45	Urban, Residential, Industrial Development	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho salmon bearing	2b
SONCC-MRAR.22.3.45.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-MRAR.22.3.45.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.22.1.46	Urban, Residential, Industrial Development	Yes	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-MRAR.22.1.46.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-MRAR.22.1.46.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-MRAR.22.1.46.3	*Develop local regulatory mechanisms that limit development and reduce amount of total impervious area through incentives*					
SONCC-MRAR.2.3.39	Floodplain and Channel Structure	Yes	Reduce sediment mobilization and effects to channel morphology	Improve placer mining practices	All streams where coho salmon would benefit immediately, Moderate and high IP stream reaches on BLM and USFS lands in: Applegate River, Little Applegate River, Wolf Creek, Jumpoff Joe Creek, Quartz Creek, Taylor Creek	2b
SONCC-MRAR.2.3.39.1	*Assess the actual impacts of suction mining for gold*					
SONCC-MRAR.2.3.39.2	*Develop regulations that minimize or prevent impacts to coho salmon from placer mining. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-MRAR.2.3.39.3	*Educate miners regarding the ESA, coho salmon, and effects to habitat from proposed mining activities*					
SONCC-MRAR.2.3.39.4	*If impacts cannot be avoided, limit placer mining*					
SONCC-MRAR.2.3.77	Floodplain and Channel Structure	Yes	Reduce sediment mobilization and effects to channel morphology	Improve placer mining practices	Population wide	2c
SONCC-MRAR.2.3.77.1	*Assess the actual impacts of suction mining for gold*					
SONCC-MRAR.2.3.77.2	*Develop regulations that minimize or prevent impacts to coho salmon from placer mining. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-MRAR.2.3.77.3	*Educate miners regarding the ESA, coho salmon, and effects to habitat from proposed mining activities*					
SONCC-MRAR.2.3.77.4	*If impacts cannot be avoided, limit placer mining*					
SONCC-MRAR.3.1.68	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2b
SONCC-MRAR.3.1.68.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-MRAR.3.1.68.2	*Reduce diversions using a combination of incentives and enforcement measures*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.3.1.79	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2c
SONCC-MRAR.3.1.79.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-MRAR.3.1.79.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-MRAR.7.1.43	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands where coho salmon would benefit immediately	2b
SONCC-MRAR.7.1.43.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-MRAR.7.1.43.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MRAR.7.1.43.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-MRAR.7.1.81	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	2c
SONCC-MRAR.7.1.81.1	*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*					
SONCC-MRAR.7.1.81.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MRAR.7.1.81.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-MRAR.26.1.67	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-MRAR.26.1.67.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-MRAR.10.2.41	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	2b
SONCC-MRAR.10.2.41.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-MRAR.10.2.41.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					
SONCC-MRAR.10.2.29	Water Quality	No	Reduce pollutants	Set standard	Applegate River RM 0 to 32.4, tributaries to Applegate River	2b
SONCC-MRAR.10.2.29.1	*Develop TMDLs for water bodies listed under Clean Water Act Section 303(d)*					
SONCC-MRAR.2.1.2	Floodplain and Channel Structure	Yes	Increase channel complexity	Educate stakeholders	Population wide	2c
SONCC-MRAR.2.1.2.1	*Develop an educational program that promotes Salmon Safe methods for agricultural operations and Integrated Pest Management for rural residents*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MRAR.2.2.63	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2c
SONCC-MRAR.2.2.63.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-MRAR.7.1.44	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Federal lands	2d
SONCC-MRAR.7.1.44.1	*Monitor effects of livestock grazing on coho salmon habitat and adjust or discontinue grazing if effects of livestock grazing on salmon habitat are limiting coho recovery*					
SONCC-MRAR.7.1.9	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	2d
SONCC-MRAR.7.1.9.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-MRAR.7.1.9.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat*					
SONCC-MRAR.7.1.8	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Wild Rogue tributaries, Galice, Taylor, Pickett, Limpy, Williams, Thompson, Forest, and Beaver creeks, Little Applegate River, Federal forest lands	2d
SONCC-MRAR.7.1.8.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MRAR.7.1.8.3	*Plant conifers, guided by the plan*					
SONCC-MRAR.8.2.51	Sediment	No	Increase spawning gravel	Improve gravel availability	Upper Applegate River	3a
SONCC-MRAR.8.2.51.1	*Develop a gravel augmentation plan that removes gravel from upstream of the Applegate Dam and places is downstream*					
SONCC-MRAR.8.2.51.2	*Implement gravel augmentation project, guided by the plan*					
SONCC-MRAR.5.1.15	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately, except USFS lands	3b
SONCC-MRAR.5.1.15.1	*Assess and prioritize barriers using the ODFW fish passage barrier database*					
SONCC-MRAR.5.1.15.2	*Remove barriers, guided by the assessment*					
SONCC-MRAR.5.1.35	Passage	No	Improve access	Remove barriers	USFS lands	3b
SONCC-MRAR.5.1.35.1	*Evaluate and prioritize barriers for removal*					
SONCC-MRAR.5.1.35.2	*Remove barriers, based on evaluation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MRAR.5.1.80	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-MRAR.5.1.80.1	*Assess and prioritize barriers using the ODFW fish passage barrier database*					
SONCC-MRAR.5.1.80.2	*Remove barriers, guided by the assessment*					
SONCC-MRAR.8.1.6	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All basins with road densities greater than 3 miles/square mile	3b
SONCC-MRAR.8.1.6.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MRAR.8.1.6.2	*Decommission roads, guided by assessment*					
SONCC-MRAR.8.1.6.3	*Upgrade roads, guided by assessment*					
SONCC-MRAR.8.1.6.4	*Maintain roads, guided by assessment*					
SONCC-MRAR.8.1.82	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MRAR.8.1.82.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MRAR.8.1.82.2	*Decommission roads, guided by assessment*					
SONCC-MRAR.8.1.82.3	*Upgrade roads, guided by assessment*					
SONCC-MRAR.8.1.82.4	*Maintain roads, guided by assessment*					
SONCC-MRAR.10.2.37	Water Quality	No	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	3c
SONCC-MRAR.10.2.37.1	*Develop a pesticide management plan*					
SONCC-MRAR.10.2.37.2	*Implement pesticide management plan and technical assistance program*					
SONCC-MRAR.10.2.69	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-MRAR.10.2.69.1	*Develop a pesticide management plan*					
SONCC-MRAR.10.2.69.2	*Implement pesticide management plan and technical assistance program*					
SONCC-MRAR.10.7.65	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-MRAR.10.7.65.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MRAR.10.7.65.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MRAR.10.7.70	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MRAR.10.7.70.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MRAR.10.7.70.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.3.1.31	Hydrology	Yes	Improve flow timing or volume	Manage flows	Applegate Dam	3d
SONCC-MRAR.3.1.31.1	*Evaluate the effect of Applegate Dam flow releases on juvenile salmon rearing habitat*					
SONCC-MRAR.3.1.31.2	*Revise flow releases as necessary to minimize effects on coho salmon, based on the evaluation.*					
SONCC-MRAR.1.2.34	Estuary	No	Improve estuarine habitat	Improve estuary condition	Rogue River Estuary	3d
SONCC-MRAR.1.2.34.1	*Implement recovery actions for Lower Rogue River population that address the target "Estuary"*					
SONCC-MRAR.7.1.32	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	BLM lands	3d
SONCC-MRAR.7.1.32.1	*Manage timber harvest (and associated activities) on Federal lands in accordance with the Aquatic Conservation Strategy of the NWFP, or with the updated ACS guidance contained in newly revised Resource Management Plans or Land and Resource Management Plans, in order to achieve riparian and stream channel improvements for coho salmon.*					
SONCC-MRAR.16.1.16	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MRAR.16.1.16.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MRAR.16.1.16.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-MRAR.16.1.17	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MRAR.16.1.17.1	*Determine actual fishing impacts*					
SONCC-MRAR.16.1.17.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-MRAR.16.2.18	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MRAR.16.2.18.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-MRAR.16.2.18.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MRAR.16.2.19	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MRAR.16.2.19.1	*Determine actual impacts of scientific collection*					
SONCC-MRAR.16.2.19.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-MRAR.14.2.14	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of warm-water, non-native fish species	Population wide	3d
SONCC-MRAR.14.2.14.1	*Determine presence of warm water, non-native fish species and develop a plan for eradication or control*					
SONCC-MRAR.14.2.14.2	*Eradicate or suppress invasive fish species, guided by the plan*					

32. Upper Rogue River Population

Interior Rogue Stratum

Core, Functionally Independent Population

Moderate Extinction Risk

Population likely above depensation threshold

13,800 Spawners Required for ESU Viability

2,422 mi^2 watershed (52% Federal ownership)

689 IP-km (428 mi) (56% High)

Dominant Land Uses are Agriculture and Urban/Residential/Commercial Development

Key Limiting Stresses are ‘Altered Hydrologic Function’ and ‘Impaired Water Quality’

Key Limiting Threats are ‘Agricultural Practices’ and ‘Urban/Residential/Industrial Development’

Highest Priority Recovery Actions

• Improve timber harvest practices by revising Oregon Forest Practices Act • Improve agricultural practices • Improve suction dredging practices	• Increase regulatory oversight to reduce pollutants • Increase instream flows • Increase large woody debris (LWD), boulders, or other instream structure

32.1 History of Habitat and Land Use

From 1780 to 1840, trappers swept Oregon coastal rivers, including the Rogue River basin, reducing the robust beaver population to remnant levels (Oregon Department of Fish and Wildlife (ODFW) 2005b). Beaver ponds provide excellent rearing habitat for coho salmon, and thus beaver trapping was likely the first negative effect of European settlers on coho salmon. In the mid- to late 1800s, proliferation of gold mining in the Rogue Valley further decreased coho salmon rearing, spawning, and migratory habitat. After the 1850s, settlers began reclaiming and development of the flat, alluvial valley bottoms and wetlands, and increased agricultural production. Many Rogue River streams were straightened and disconnected from their floodplains, wetlands and meanders were filled, flows were diverted and riparian shade was reduced. Due to habitat alteration and flow depletion, summer air temperatures (which often exceed 100° F) in the Upper Rogue River sub-basin are now more likely to cause higher stream temperatures than in the past, thereby reducing the quality and quantity of summer rearing habitat, and decreasing juvenile coho salmon survival.

The Upper Rogue River headwaters, primarily managed by the U.S. Forest Service (USFS), are located along the crest of the Cascade Range. Public and private lands in the Upper Rogue River sub-basin were extensively logged after World War II, when there were few restrictions on harvesting near streams or using stream beds to skid logs. Channel damage from the 1964 flood was widespread in areas downstream of timber harvest activity (Thompson and Fortune 1970, USFS 1997a).

The USFS adopted more conservation-based management in 1994 when the Record of Decision for the Northwest Forest Plan was signed, but most National Forest lands in the sub-basin are above the current range of coho salmon. The USFS manages an appreciable amount of coho salmon habitat within Elk Creek and Little Butte Creek watersheds. Lands managed by the BLM are extensive in the watersheds of Evans, Trail, Big and Little Butte, and upper Bear creeks but alternate with private land in a checker board pattern. The BLM manages substantial lands in Elk Creek where ownership is fairly contiguous. Urban development is extensive in Lower Bear Creek and the Upper Rogue Valley, where most land is privately owned. In addition, there has been substantial residential development in many parts of the sub-basin, accompanied by surface water and groundwater extraction.

The completion of Lost Creek Dam (later renamed William L. Jess Dam) in 1977 created Lost Creek Reservoir, altering the natural hydrograph of the mainstem Rogue River, and the associated Cole Rivers Hatchery mitigation program annually produces 200,000 coho salmon smolts. The notching of the Elk Creek Dam on Elk Creek, an important tributary that joins the Rogue River five miles downstream of Lost Creek Reservoir, in 2008 provided coho salmon with unrestricted access to that watershed after nearly 20 years of trapping and hauling coho salmon upstream (USACE 2014). Other recent major fish passage improvements include the removal of three diversion dams on the mainstem Rogue River: Savage Rapids Dam in 2009 in the Middle Rogue sub-basin (U.S. Bureau of Reclamation 2009a) and Gold Hill Dam in 2008 (Oregon Water Watch 2008) and Gold Ray Dam in 2010 (Freeman 2010) in the Upper Rogue sub-basin.

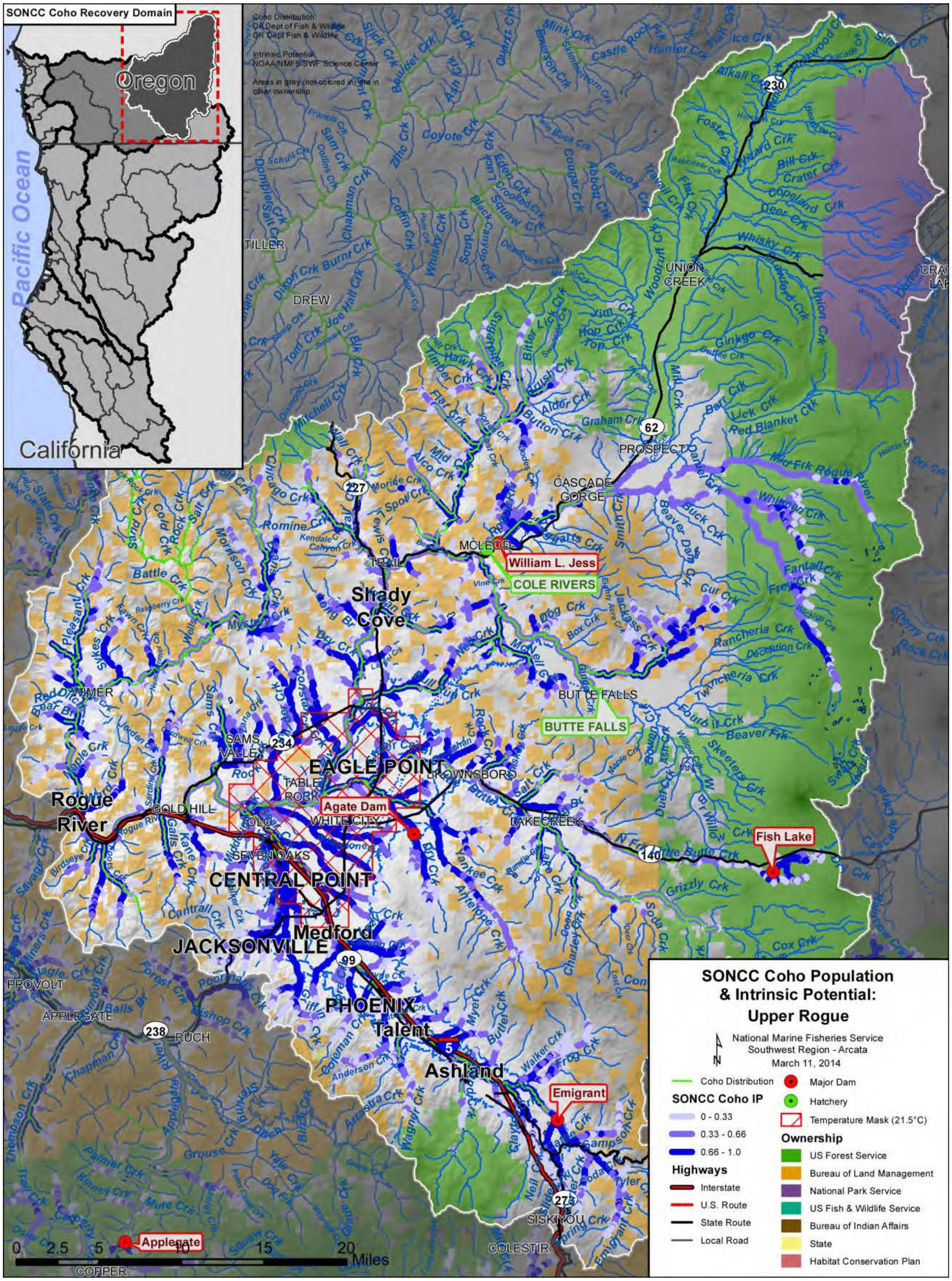

Figure 32-1. The geographic boundaries of the Upper Rogue River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Rogue River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

32.2 Historic Fish Distribution and Abundance

The 1977 construction of William L. Jess Dam (Figure 32-2) at river mile (RM) 157 in the Upper Rogue River sub-basin reduced mainstem coho salmon distribution by only 12 miles (ODFW 2005c) because geologic barriers near Prospect above the dam naturally prevented anadromous fish migration to the uppermost reaches of the mainstem Rogue River (USFS 1998d); however, some additional habitat in the South and Middle forks of the Rogue River is also blocked by the dam (ODFW 2013c). Major tributaries below the dam include Evans, Trail, Elk, Bear, Big Butte, and Little Butte creeks; however, some high coho salmon IP habitat is blocked by dams within these watersheds. Dams impounding Emigrant Reservoir in the Bear Creek watershed, Agate and Fish Lake Reservoirs in the Little Butte Creek watershed, and Willow Lake Reservoir on Big Butte Creek are the most significant barriers.

A cannery operated at the mouth of the Rogue River beginning in 1876. Records from the cannery were used to estimate an annual run size of approximately 114,000 adult coho salmon in the late 1800s (Meengs and Lackey 2005). There is no way to know how many of these fish were returning to the sub-basin, rather than elsewhere in the 5,600 square mile Rogue River basin. The sub-basin contains 39 percent of the basin-wide IP kilometers of habitat (Williams et al. 2008), suggesting possible returns of 45,000 fish during the time of cannery operation, if fish were produced in proportion to IP kilometers.

Figure 32-2. William L. Jess Dam. The dam blocks anadromous fish access upstream, but provides a perennially cold mainstem Rogue River flows below the dam (at center left). Aerial photo from June 2005.

32.3 Status of Upper Rogue River Coho Salmon

Spatial Structure and Diversity

Coho salmon juvenile surveys performed in the Upper Rogue River sub-basin (ODFW 2005a) confirmed presence and varying levels of abundance in Little Butte, Big Butte, Evans, Trail, Elk, and Antelope creeks (Figure 32-3). Most high density rearing occurs in the upper watersheds and often immediately below public land that supplies cool water. Potential coho salmon habitat periodically lacks sufficient flow (Rogue Basin Coordinating Council (RBCC) 2006), and Trail Creek seasonally has no flow (Nawa 1999).

Densities of juvenile coho salmon throughout the Upper Rogue River population vary by location (Figure 32-3). Most of the juvenile coho salmon observed recently were in the headwater areas of Little and Big Butte creeks, Elk Creek, Trail Creek, and Evans Creek. Historically, Bear Creek had more than 25 miles of estimated high IP habitat (Figure 32-1); however, no juvenile coho salmon were observed during summer sampling (Figure 32-3), likely due to high water temperatures and habitat degradation in this highly urbanized watershed. Coho salmon juveniles died in Bear Creek during an herbicide-related fish kill on May 6, 1996 (Ewing 1999), indicating some juveniles are present in this watershed at least during times of year with lower temperatures. Juvenile coho salmon were documented in Larson Creek (VanDyke 2006a) and Military Slough (VanDyke 2006b), both in the Bear Creek watershed, during sampling with hoop traps from November 2005 to March 2006. No juvenile coho salmon were observed during sampling on Sand Creek during that same period (VanDyke 2006c).

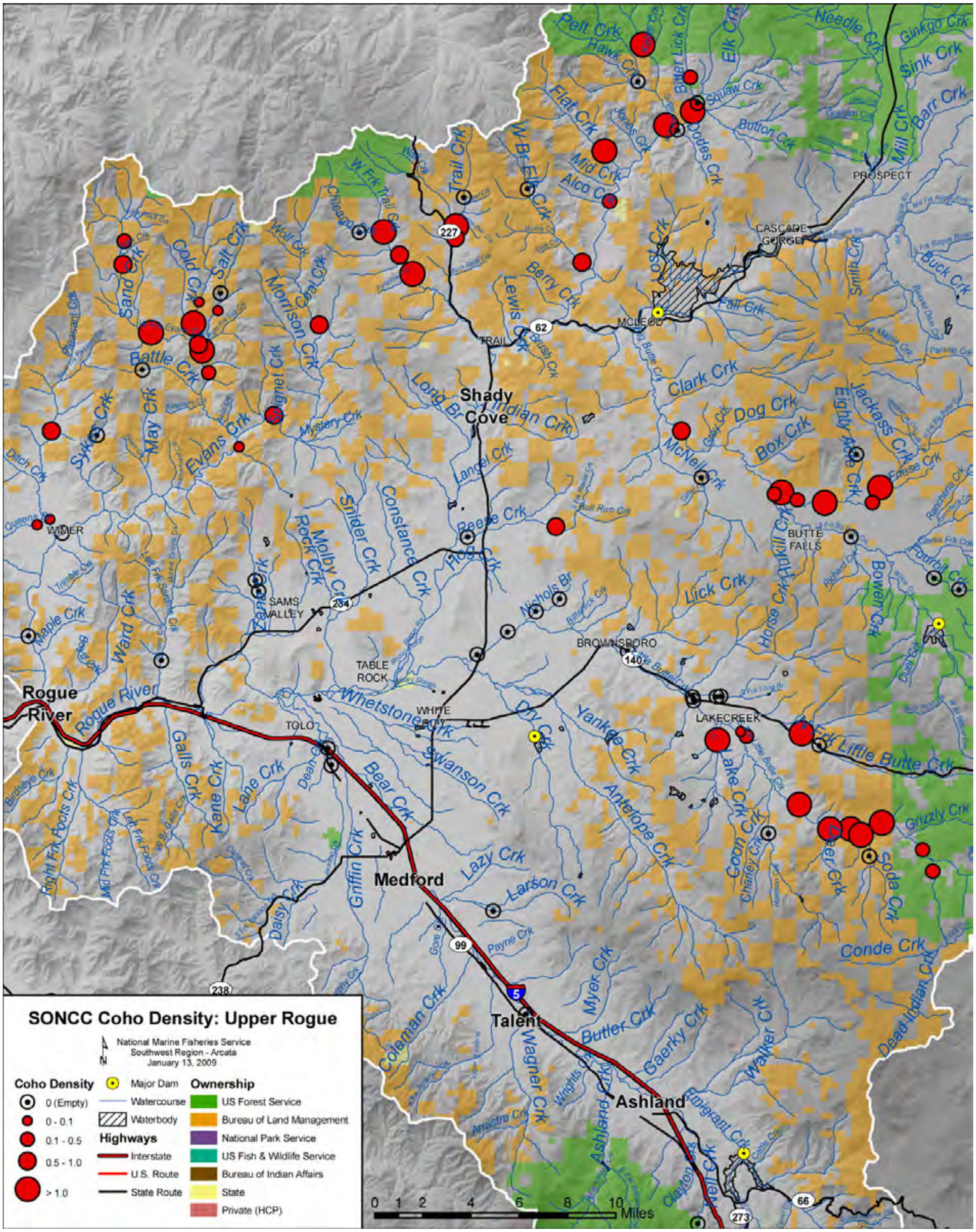

Figure 32-3. Upper Rogue River juvenile coho salmon survey results from 1998 to 2004. Map shows density of fish per square meter. The highest densities were located in upper watershed areas, and coho salmon were absent in lower reaches of all tributaries and at all stations in Bear Creek ODFW (2005a).

During the 2004 to 2008 run years, on average about 17 percent of surveyed sites were occupied by wild adult coho salmon with an estimated average of 6 spawners per mile in the Upper Rogue sub-basin (hatchery or wild origin unstated) (Lewis et al. 2009).

Williams et al. (2008) expressed concern about potential loss of genetic diversity of Rogue River coho salmon due to very low returns from 1966 to 1990 and the high contribution of hatchery coho salmon to the overall number of returning adults. Overall, Williams et al. (2008) rated the threat of hatchery fish on population diversity as moderate, because although many hatchery fish were observed in surveys of adult coho salmon, few were observed on the spawning grounds.

Population Size and Productivity

ODFW used spawning surveys to estimate the abundance of wild adult coho salmon from 2002 to 2008 in the Upper Rogue River (Figure 32-4). Budget restraints have eliminated surveys since 2009. The lack of data makes it difficult to track the strength of year classes. From 2002 to 2004, estimates of wild adult coho salmon were above the depensation threshold of 805, but from 2006 to 2008 estimates of wild adult coho salmon returns were low (Figure 32-4). However, interpretation of these data is problematic because the number of miles surveyed in each of the first three years (average 19 miles) was considerably greater than in the second three years (average 8 years; ODFW 2011).

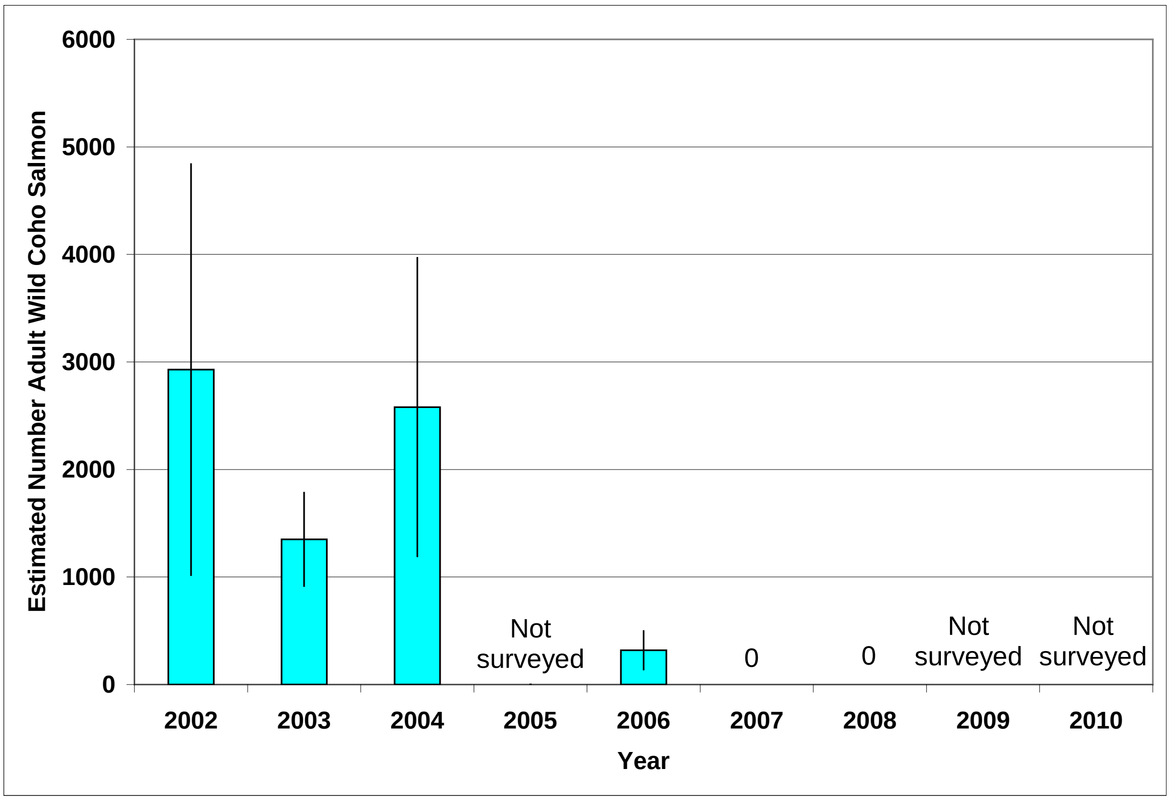

Figure 32-4. Estimated number of wild adult coho salmon in the Upper Rogue River, from ODFW spawning surveys. Error bars indicate the 95% confidence interval. Data from ODFW (2011b).

ODFW also monitored returning adult coho salmon at Gold Ray Dam until it was removed in 2010. This data set presents a rare opportunity to evaluate long-term trends within the Upper Rogue River coho salmon population (Figure 32-5). Between 1942 and the early 1980s, the number of adult coho salmon returns suggested a downward trend. While the average number of adult coho salmon returning (including jacks) to the entire Rogue River from 1942 to 1950 was 3936 adults, populations averaged only 750 adults between 1951 and 1979 (ODFW 2009b). For 15 out of 16 years from 1964 to 1979 fewer than 500 adults returned to the Rogue River (ODFW 2009b). Returns reached their lowest level during the 1976 drought, when only 44 coho salmon were counted at Gold Ray Dam. Hatchery coho salmon began returning to the Upper Rogue River in the late 1970s following the initiation of the hatchery mitigation program associated with the construction of Lost Creek Dam (later renamed William L. Jess Dam). The number of wild and hatchery coho salmon adults peaked in 2000 and 2002, respectively. Thereafter, a declining trend in both wild and hatchery coho salmon escapement has been observed (Figure 32-5). In 2007, approximately 4,500 wild coho salmon returned to Gold Ray Dam. Coho salmon returns declined in the Rogue River basin in 2008, and remained low in 2009 (Oregon State University 2009, ODFW 2009b). In 2008 and 2009, total adult coho salmon returns to Gold Ray Dam including both hatchery and wild fish were about 2,500 per year. If we assume the current returns of adult coho salmon contain the approximate proportion of hatchery fish as observed from 1996 to 2007, then 60 percent of these fish, or about 1,500 spawners, were wild fish.

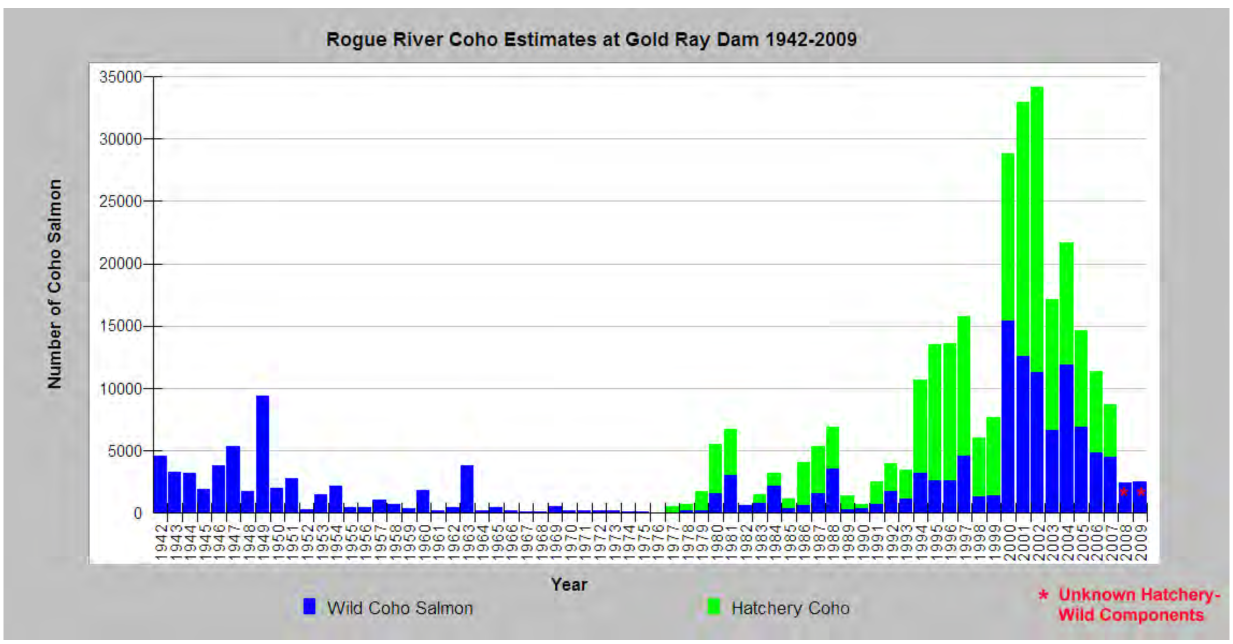

Figure 32-5. Coho salmon returns at Gold Ray Dam, including jacks (ODFW 2010a and 2010b). Hatchery fish are not distinguished from wild fish in 2008 and 2009 because estimates are preliminary.

The trend in adult abundance over the last four generations (1998-20010) has been negative, but less than a 10 percent decline (Figure 32-6).

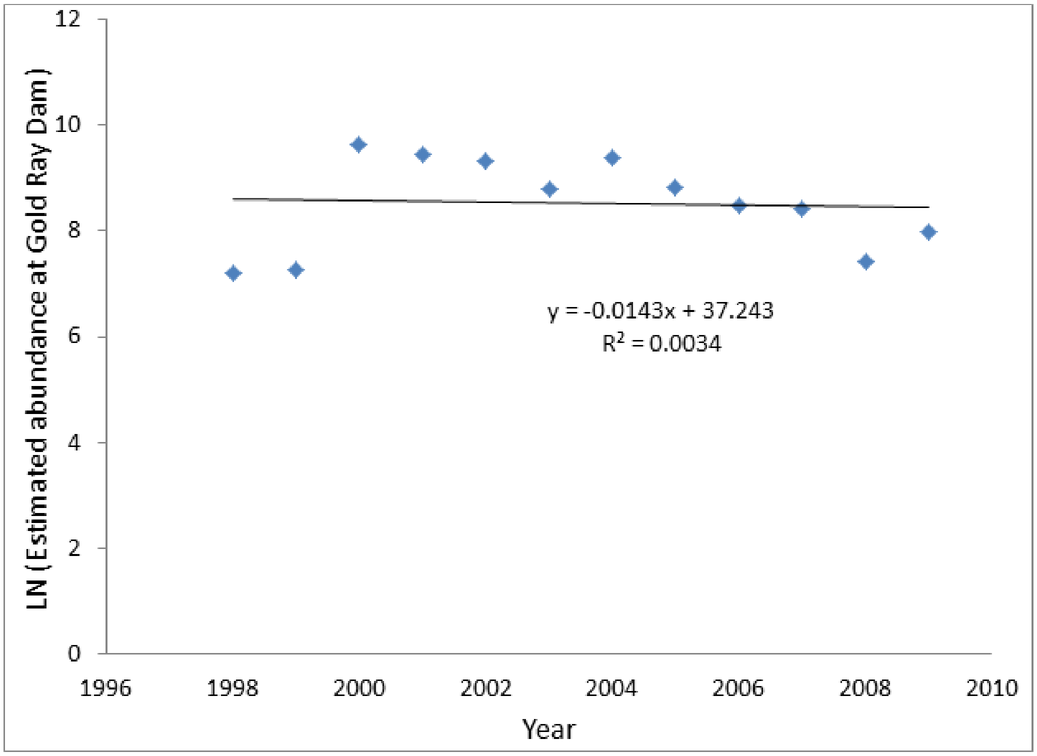

Figure 32-6. Rate of decline of estimated population abundance at Gold Ray Dam. (Data source: ODFW 2010a and 2010b).

Extinction Risk

The Upper Rogue River population is at moderate risk of extinction because the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one, but the ratio is less than the minimum required spawner density (both criteria described in Williams et al. 2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Upper Rogue River population is a core, Functionally Independent population within the Interior Rogue River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Upper Rogue River core population needs to have at least 13,800 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Upper Rogue population would serve as a source of spawner strays for other Rogue River populations.

32.4 Plans and Assessments

U.S. Forest Service, Rogue River-Siskiyou National Forest and U.S. Bureau of Land Management (Medford District)

Sufficiency Assessment: Forest Service and Bureau of Land Management Programs in Support of SONCC Coho Salmon Recovery (USFS and BLM 2011)

The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, Sugarpine Creek, a tributary of Elk Creek, was identified as a high priority 6th field sub-watershed in the Rogue-Siskiyou National Forest (USFS and BLM 2011).

U.S. Bureau of Reclamation

Rogue River Basin Project Coho Salmon Instream Flow Assessment

The U.S. Bureau of Reclamation modeled stream flow needs of SONCC coho salmon in two drainages in southern Oregon in order to assess the effects of the U.S. Bureau of Reclamation's Rogue River Basin Project on the species (Sutton et al. 2007). The Rogue River Basin Project (RRBP) is a series of reservoirs and diversions designed to provide water to 35,000 acres of irrigated cropland in Oregon (U.S. Bureau of Reclamation 2009b). For the most part water is diverted and stored during the winter, then delivered for irrigation in the summer. Sutton et al. (2007) was relied upon when analyzing and describing the future effects of the RRBP on SONCC coho salmon and other listed species (U.S. Bureau of Reclamation 2009b). On April 12, 2012, NMFS completed a biological opinion finding continued operation of the RRBP is likely to adversely affect SONCC coho salmon and their critical habitat, but is not likely to jeopardize the continued existence of SONCC coho salmon or result in the destruction or adverse modification of designated critical habitat for SONCC coho salmon. The greatest effects of the project are on juveniles from flow management.

State of Oregon

Expert Panel on Limiting Factors for Oregon's SONCC coho salmon populations

ODFW (2008b) convened a panel of fisheries and watershed scientists as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on perceived limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the concerns for the Upper Rogue River as follows:

Key concerns were related to loss of over-winter tributary habitat complexity, floodplain connectivity, and access and oversummer water temperatures and habitat access. Over-winter tributary habitat and floodplain connectivity, especially in the lowlands, has been impacted by past and current agricultural, urban, rural residential, and forestry development and practices and an interruption in the transport and presence of large wood. Access to habitat has been limited by road crossings. Summer habitat is limiting because high water temperatures have resulted from land management actions in the riparian zone and straightening of channels and water management actions for agricultural purposes. Water withdrawals and diversions and road crossings have also limited the amount of, and access to, summer habitat and thermal refuge.

Secondary concerns spanned a number of life history stages and locations. Unscreened diversions and non-criteria screens at diversions affect fry, summer parr, and out-migrating smolts. Summer juvenile habitat has been impacted by a loss of tributary habitat complexity, especially in the lowlands, caused by past and current agricultural, urban, rural residential, and forestry development and practices and an interruption in the transport and presence of large wood. Non-native vegetation is a secondary factor contributing to higher water temperatures affecting summer parr by limiting native riparian vegetation. Runoff from urban and agricultural areas impacts summer parr through poor water quality and the presence of toxins. Access to spawning habitat by returning adults is limited by road crossings and diversion structures. Spawners are affected by both a lack of gravel due to alteration of large wood processes (i.e., some tributaries have bedrock) and sedimentation of existing gravel. Finally, reduced estuarine habitat for smolts due to past and current forestry practices and rural residential development is another impact.

Oregon Plan for Salmon and Watersheds
http://www.oregon.gov/OPSW/about_us.shtml

The State of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is comprehensive, and includes voluntary actions for all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. ODFW implemented fishery harvest and hatchery program reforms in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary. The action plans, implementation, and annual reports can be found on the above web site.

ODFW Coastal Salmonid Inventory Project

ODFW has monitored coho salmon in the Upper Rogue River as part of their Coastal Salmonid Inventory Project. From 1998 to 2004, ODFW conducted dives in the Upper Rogue River sub-basin to detect juvenile coho salmon (ODFW 2005a) (Figure 32-3). ODFW also estimated the abundance of adult coho salmon in the Upper Rogue River from 2002 to 2004 and from 2006 to 2008.

Southwest Oregon Salmon Restoration Initiative

The Southwest Oregon Salmon Restoration Initiative (Prevost et al. 1997) was created to help fulfill a memorandum of understanding between ODFW and NMFS (Northwest Region) to recover coho salmon. The initiative provides the framework for recovery in southwest Oregon and helped foster formation of watershed councils. Prevost et al. (1997) designated upper South Fork Little Butte Creek, West Fork Trail Creek, Sugarpine Creek (Elk Creek), West Branch Elk Creek, and West Fork Evans Creek as “core areas” in the Upper Rogue River watershed that are defined as 'reaches or watersheds that are judged to be of critical importance to the maintenance of salmon populations that inhabit those basins.'

Water Requirements of Rogue River Fish and Wildlife

ODFW fisheries biologists (Thompson and Fortune 1970) conducted widespread surveys of the Rogue River basin to assess water flow and its effect on fish habitat and carrying capacity for salmonids. The study was designed to inform the Oregon Water Resources Board so that a “beneficial water use program” could be developed. The document contains comprehensive flow tables for all major coho-salmon-producing tributaries in the Rogue River basin, including recommended minimum flows. Thompson and Fortune (1970) also provides a summary of the Rogue River basin fish community, including the Upper Rogue River. The report identified flow depletion as a major cause of stress, disease, and predation to Pacific salmonids.

Upper Rogue River Total Maximum Daily Load Reports

A large-scale Rogue River TMDL (ODEQ 2008) covers all perennial and intermittent streams, rivers, and lakes within the Rogue River basin in Oregon with the exception of those areas where TMDLs have previously been developed: Bear Creek Watershed, Applegate Sub-basin, Lobster Creek Watershed, and Sucker Creek Watershed.

Bear Creek Watershed TMDL

The Bear Creek Watershed TMDL (ODEQ 2007) addresses the listed parameters of temperature, bacteria (fecal coliform and *E. coli*) and sedimentation. The TMDL includes shade targets for the Bear Creek watershed and a water quality management plan.

Rogue River Watershed Health Factors Assessment

The Rogue Basin Coordination Council (RBCC 2006) produced the Rogue River Watershed Health Factors Assessment on behalf of the watershed councils within the basin. The assessment rates aquatic health and watershed conditions, including wildfire risk. Key problems in different Rogue River watersheds are described and potential solutions proposed.

Bear Creek Habitat and Temperature Study 1990-1991

Dambacher et al. (1992) investigated the temperature and habitat in Bear Creek and its tributaries during the summers of 1990 and 1991, and made recommendations for rehabilitation of the watershed. Temperatures in lower Bear Creek and in tributaries approached and exceeded, respectively, 80 °F. Temperature in Bear Creek increased downstream, was strongly influenced by solar input, and reached a maximum in late July. High water temperature was found to be the greatest factor limiting production of salmonids. Redside shiners were found in Bear Creek, and the authors were concerned that they were outcompeting and displacing salmonids.

Upper Rogue Watershed Association

Upper Rogue Watershed Assessment

The assessment (URWA 2006) describes various aspects of the Upper Rogue River sub-basin, including hydrology, water quality, fish populations, fish habitat, riparian conditions, and wetland conditions. The assessment also identifies the issues and restoration opportunities within each of five sub-watersheds of the Upper Rogue watershed.

Bear Creek Watershed Council (BCWC)

Ashland Watershed Management & Action Plan (BCWC 2007)

The watershed management and action plan (BCWC 2007) considers the Ashland Creek and Neil Creek drainages in the Bear Creek watershed, and includes an assessment of hydrology and water use, riparian and wetlands, sediment sources, channel modifications, water quality, and fish and aquatic wildlife. A number of projects are suggested to restore habitat, manage stormwater, address fish passage barriers, and inform and educate the public. The plan focuses on voluntary activities on private and municipal land.

32.5 Stresses

Table 32-1. Severity of stresses affecting each life stage of coho salmon in the Upper Rogue River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rate
1	Altered Hydrologic Function[1]	High	Very High	Very High[1]	Very High	High	Very High
2	Impaired Water Quality[1]	High	Very High	Very High[1]	High	High	Very High
3	Degraded Riparian Forest Conditions	-	Very High	Very High	Very High	Very High	Very high
4	Lack of Floodplain and Channel Structure	Medium	Very High	Very High	High	High	Very High
5	Altered Sediment Supply		Medium	Medium	Medium	Very High	Very High
6	Barriers	-	Medium	High[1]	High	High	High
7	Impaired Estuary/Mainstem Conditions	-	High	High	Very High	High	Very High
8	Increased Disease/Predation/Competition	Medium	High	High	Medium	Low	High
9	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low

[1]Key limiting stresses and limited life stage.

Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking. Juvenile summer rearing habitat is impaired by deficient floodplain and channel structure, high water temperature resulting from degraded riparian conditions, and altered hydrologic function from water withdrawals. Furthermore, the degraded nature of the riparian forests inhibits future input of large wood and cannot provide bank stability that assists in a stable and complex channel. Finally, barriers throughout the basin limit access to rearing habitat. These findings are consistent with those of the Oregon Expert Panel (ODFW 2008b) (Section 32.4).

Altered Hydrologic Function

The Rogue River Basin Project (RRBP) is a series of reservoirs and other facilities used to collect, impound, and divert water from tributaries to the Rogue River for delivery to irrigated cropland (U.S. Bureau of Reclamation 2009b). The RRBP adversely affects coho salmon in the Bear Creek and Little Butte Creek watersheds of the Upper Rogue River sub-basin. Forty-seven percent of the high-IP habitat in the Upper Rogue River sub-basin is located in these watersheds. Another major source of hydrologic alteration affecting the Upper Rogue River coho salmon population is flow depletion due to groundwater extraction. Many types of groundwater uses do not require a water right, including stock watering, lawn or noncommercial garden watering of up to 0.5 acres, and domestic use of up to 15,000 gallons per day (Bureau of Land Management [BLM] 1998c). Data are lacking regarding groundwater use, its interaction with surface flow, and potential impacts to coho salmon (ODEQ 2008). However, due to the presumed large number of wells, groundwater pumping is likely contributing to inadequate stream flows and reduced groundwater inflow to many streams in the Upper Rogue River sub-basin. Streams sometimes lose flow entirely (Thompson and Fortune 1970). The overall stress rating for Upper Rogue River coho salmon from this factor is very high.

Impaired Water Quality

Thirty-three percent of the 137 sampled reaches in the Upper Rogue River sub-basin met water quality standards (Southwest Oregon Resource Conservation and Development Council (SO RC&D) 2003). The most pervasive problem affecting coho salmon is water temperature. Very few reaches in the Upper Rogue River Sub-basin meet ODEQ (2008) water standards compatible with coho salmon recovery. Few locations other than the tailwater of William L. Jess Dam contain both cold water temperatures (<64.4 °F) and pools deep enough to harbor coho salmon (>3 feet). The urbanized Bear Creek watershed is listed as temperature impaired (ODEQ 2007), with summer water temperatures in lower Bear Creek and its tributaries approaching 80 °F in 1990 and 1991 (Dambacher et al. 1992). However, in August 2007, detailed surveys detected 13 coldwater springs, seeps, and tributaries in the Bear Creek watershed (Sutton 2007), suggesting that there are some localized areas with temperatures suitable for summer rearing. Most potential thermal refugia were located in the upper half of Bear Creek watershed, with the majority being tributary inflows originating in the southwest portion of Bear Creek watershed.

Flow depletion reduces water volume and slows water velocity, thus promoting warming, stagnation, and depressed dissolved oxygen (D.O.) (Thompson and Fortune 1970). Nawa (1999) documented loss of coho salmon juveniles in Trail Creek due to flow depletion and low D.O. Little Butte Creek is similar to Trail Creek and has both low flow and D.O. problems. Growth of free-floating and attached algae may indicate nutrient enrichment, and algal photosynthetic activity may cause daily fluctuations in pH and D.O. (ODEQ 2007). The Larson and Lazy Creek watersheds are considered impaired due to high pH. It is unlikely that high fecal coliform bacterial levels in the Upper Rogue would directly harm coho salmon; however, the coliform levels might indicate livestock access to creeks or leaking septic systems.

Degraded Riparian Forest Conditions

Riparian zones on the mainstem and in tributaries exhibit impacts from 150 years of land use leading to a very high level of stress rating for coho salmon. In forested reaches conifers have been removed (ODEQ 2007, 2008) and early seral species like alder and willows are dominant in the Upper Rogue River. ODFW found low numbers of large conifers in Upper Rogue River riparian surveys, with almost all reaches having fewer than 75 conifers over 36" in diameter per 1,000 feet of stream surveyed. Streams surveyed include Evans, Little Butte, Big Butte, Elk and Trail creeks.

On valley floors where there may have previously been cottonwood gallery forests, marshes, and beaver ponds, the straightening of channels and draining of wetlands has altered the most productive coho salmon habitat (ODEQ 2008). The resulting disruption of surface and groundwater connections has led to stream warming (ODEQ 2008). Downcutting due to channel confinement is widespread in the Rogue River basin. Regional studies (Spence et al. 1996) found that downcutting may change near-stream soil moisture, which can inhibit recovery of riparian forest species. The most degraded streams in the Upper Rogue are channelized urban streams that are nearly devoid of riparian vegetation.

Lack of Floodplain and Channel Structure

The straightening and simplification of streams has reduced the amount of slow, cool edgewater habitats where coho salmon fry and juveniles thrive (ODEQ 2008). Beaver have been greatly reduced along with the pools they create (ODFW 2005b). Although there are patches of functional coho salmon habitat, juvenile surveys indicate that many lower elevation Upper Rogue tributary channels are too altered to support them (Figure 32-7). Channelization of the Upper Rogue River has disconnected it from much of its floodplain, reducing the physical processes that form coho salmon rearing and spawning habitat. These processes include side channel formation, accumulation of large wood jams, formation of slower water velocities, formation of pools, and lower shear stress. Extensive ODFW habitat surveys of Evans, Elk, Trail, Little and Big Butte creeks indicated poor wood levels (< 1 key piece per 100m), except in headwaters at a few locations, usually on or below USFS and BLM lands. All these factors lead to a high stress ranking for Upper Rogue River coho salmon.

Figure 32-7. The Upper Rogue River running through Shady Cove. This 2005 aerial photo shows channelization, lack of a functional riparian vegetation, and potential risk of non-point source pollution.

Altered Sediment Supply

Sediment contribution from landslides and erosion occurs naturally in the Upper Rogue River basin; however, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. The majority of stream reaches measured for surface fine sediment in Upper Rogue River habitat surveys rated poor (>17 percent surface fines), with only Little Butte above the confluence with Antelope Creek rated as very good (<12 percent surface fines). Lower Evans Creek has particular problems with sand-sized sediment pollution because its watershed has extensive areas of decomposed granite (BLM 1995b). Other than a short reach of Big Butte Creek, most other tributaries with low levels of fine sediment are steeper, confined channels often on BLM or USFS lands. Poor pool frequency and depth throughout the Upper Rogue River basin (URWA 2006) are likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening.

Barriers

The high level of stress caused by barriers to migration in the Upper Rogue River sub-basin is a result of high numbers of road stream crossings (i.e., shown in Bredensteiner et al. 2003 maps), small temporary agricultural dams (Prevost et al. 1997), large diversion dams, and seasonal complete loss of stream flow in tributaries such as Trail Creek (RBCC 2006, Nawa 1999).

William L. Jess Dam was constructed in 1977 at river mile 157 in the Upper Rogue basin and blocks passage into the Rogue River headwaters. NMFS believes recovery of the Upper Rogue population of SONCC coho salmon can occur without access to habitat above this dam. Several dams in the Middle and Upper Rogue Sub-basin have been evaluated for removal or fish passage improvement (Mosser and Graham 2004). The top three dams (Savage Rapids, Gold Ray, and Gold Hill Irrigation dams) have all been removed. Five of the top ten dams targeted are on Evans Creek, including Feilder (RM 3.0) and Wimer (RM 9.0) which impede passage to nearly the entire Evans Creek watershed.

Impaired Estuary/Mainstem Function

The Rogue River estuary is highly altered and retains little of its historic function. Studies of other rivers in the region have shown that some portion of coho salmon fry and juveniles migrate out of their stream of origin in search of viable habitat patches, and these fish opportunistically use estuarine and slough habitats (Koski 2009, Miller and Sadro 2003). The lack of rearing habitat in the estuary limits the productive potential of the entire Rogue River basin and impaired estuary/mainstem function is rated as an overall very high stress for coho salmon. A discussion of the causes of reduced estuarine function can be found in the Lower Rogue River population profile.

Adverse Hatchery Related Effects

Cole Rivers Hatchery is located in the Upper Rogue River sub-basin, and produces approximately 200,000 coho salmon smolts annually in addition to millions of hatchery spring Chinook, winter steelhead, and summer steelhead (ODFW 2008d). Adult coho salmon were counted at Gold Ray Dam until its removal in 2010. From 1977, when hatchery production started, to 2007 (last year for which hatchery proportion was available), the proportion of hatchery adults that passed Gold Ray Dam nearly always exceeded 50 percent. However, these data are not a good indicator of the proportion of spawning adults of hatchery origin in the population. Fish that passed Gold Ray Dam were on their way to Cole Rivers Hatchery. Up until 2008, a trap was maintained at Elk Creek, about 5 miles below Cole Rivers Hatchery. This trap was an ideal location to estimate stray rates, because it was at the terminal end of the current anadromous distribution of coho salmon in the Rogue River basin. From 1995 to 2008, on average 10 percent of adult coho salmon trapped at Elk Creek were of hatchery origin. Adverse hatchery-related effects pose a medium threat to all life stages because greater than or equal to 5 percent and less than or equal to 10 percent of observed adults are of hatchery origin and there is a hatchery in the basin (Appendix B).

Increased Disease/Competition/Predation

Thompson and Fortune (1970) found that salmonids in the Rogue River basin, including the Upper Rogue River, had higher incidences of the fish diseases *furunculosis* and *columnaris* in reaches that were warm due to flow depletion. They also noted that warm water conditions favored introduced species in the mainstem Rogue River. Warm water and low flows are still pervasive in the Upper Rogue River sub-basin; therefore, problems related to disease, competition and predation likely persist for coho salmon. These warm water conditions favor introduced fish species such as Umpqua pikeminnow and centrarchids which are prevalent throughout the population. Competition with and predation on coho salmon is likely more prevalent now than historically. Port Orford Cedar root-rot is a disease which is negatively impacting this important riparian species region-wide (Frissell 1992).

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

32.6 Threats

Table 32-2. Severity of threats affecting each life stage of coho salmon in the Upper Rogue River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Agricultural Practices[1]	High	Very High	Very High[1]	Very High	Very High	Very High
2	Roads	Very High	Very High	Very High	Very High	Very High	Very High
3	Urban/Residential/Industrial Dev.[1]	Medium	Very High	Very High[1]	Very High	Very High	Very High
4	Timber Harvest	Very High	Very High	Very High	Very High	Medium	Very High
5	Dams/Diversion	Medium	Medium	Very High	High	Medium	High
6	Channelization/Diking	Medium	High	High	High	High	High
7	Climate Change	Low	High	High	Medium	Medium	High
8	Mining/Gravel Extraction	Low	Medium	Medium	Medium	Medium	Medium
9	Invasive Non-Native/Alien Species	Medium	Medium	Medium	Medium	Medium	Medium
10	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
11	Road-Stream Crossing Barriers	-	Medium	Medium	Medium	Medium	Medium
12	High Severity Fire	Medium	Medium	Medium	Medium	Medium	Medium
13	Fishing and Collecting	-	-	Low	Low	Medium	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are agricultural practices and urban/residential/industrial development.

Agricultural Practices

Although the extent of agriculture in the Upper Rogue River sub-basin is not large, these lands substantially overlap high IP (>0.66) coho salmon habitat. Much of the water withdrawals causing insufficient flow are used for agriculture. Other agricultural impacts include grazing, wetland filling, channelization and diking, riparian removal, channel simplification, and chemical application. Significant grazing occurs on private lands and by permit on Federally administered lands. Grazing may change soil infiltration rates and can cause deleterious channel changes (Spence et al. 1996). Riparian vegetation alteration occurs with grazing as well. Herbicide use has resulted in fish kills in the Rogue River basin, including juvenile coho salmon in Bear Creek in 1996 (Ewing 1999). Risk to coho salmon resulting from agriculture chemical use has been identified as a concern throughout the Pacific Northwest (Laetz et al. 2009), and it is likely that pesticides known to harm salmonids (NMFS 2008) are used in the region.

Roads

Upper Rogue River sub-basin road density associated with timber harvest, residential and urban development, and major highway systems are high (Bredensteiner et al. 2003). For example, the lower Big Butte watershed (BLM 1999b) has approximately 4.6 miles of road per square mile of watershed (mi. /sq. mi.). The Bear Creek watershed in the Upper Rogue likely has similar values. NMFS (1995) recommended a road density limit of 2 mi./sq. mi. to protect anadromous salmonids in interior Columbia River basins to limit sediment and damaging cumulative watershed effects. Streamside roads, known to yield chronic fine sediment and elevate the probability of landslides, are common in Upper Rogue watersheds with timber harvest activities (BLM and USFS 1997, BLM 1999b) (Figure 32-9).

Urban/Residential/Industrial Development

The city of Medford and surrounding areas have grown substantially over the last several decades and future projections suggest that Rogue Valley urban and rural development will continue to increase. Maps of impervious areas (Homer et al. 2004) indicate extensive urbanization occurred in the Upper Rogue River sub-basin. For example, total impervious area (TIA) in the lower Bear Creek watershed is greater than 10 percent, a level which studies in other river systems found caused increased peak flows, decreased base flows, simplified channel conditions, increased non-point source storm water pollution, and resulted in loss of aquatic system function (Booth and Jackson 1997). An acute regional example of this phenomenon is that toxic storm water runoff is leading to high pre-spawn mortality of adult coho salmon in tributaries to Washington's Puget Sound (Booth et al. 2006). Urbanization and commercial development are expected to continue in the Interstate 5 corridor along Bear Creek.

Streams, such as Big Butte Creek and Little Butte Creek, supply water for urban areas and agriculture (RBCC 2006), and new residents add to growing water demand. Rural residential development also uses water and presents potential for pollution from septic systems (SO RC&D 2003). The threat to coho salmon from urban/residential and industrial development in the Upper Rogue River is very high.

Figure 32-8. Jackson Creek with channel altered by agricultural and urban land uses. Bear Creek is at right along the I-5 corridor in the city of Medford. Photo from 2005.

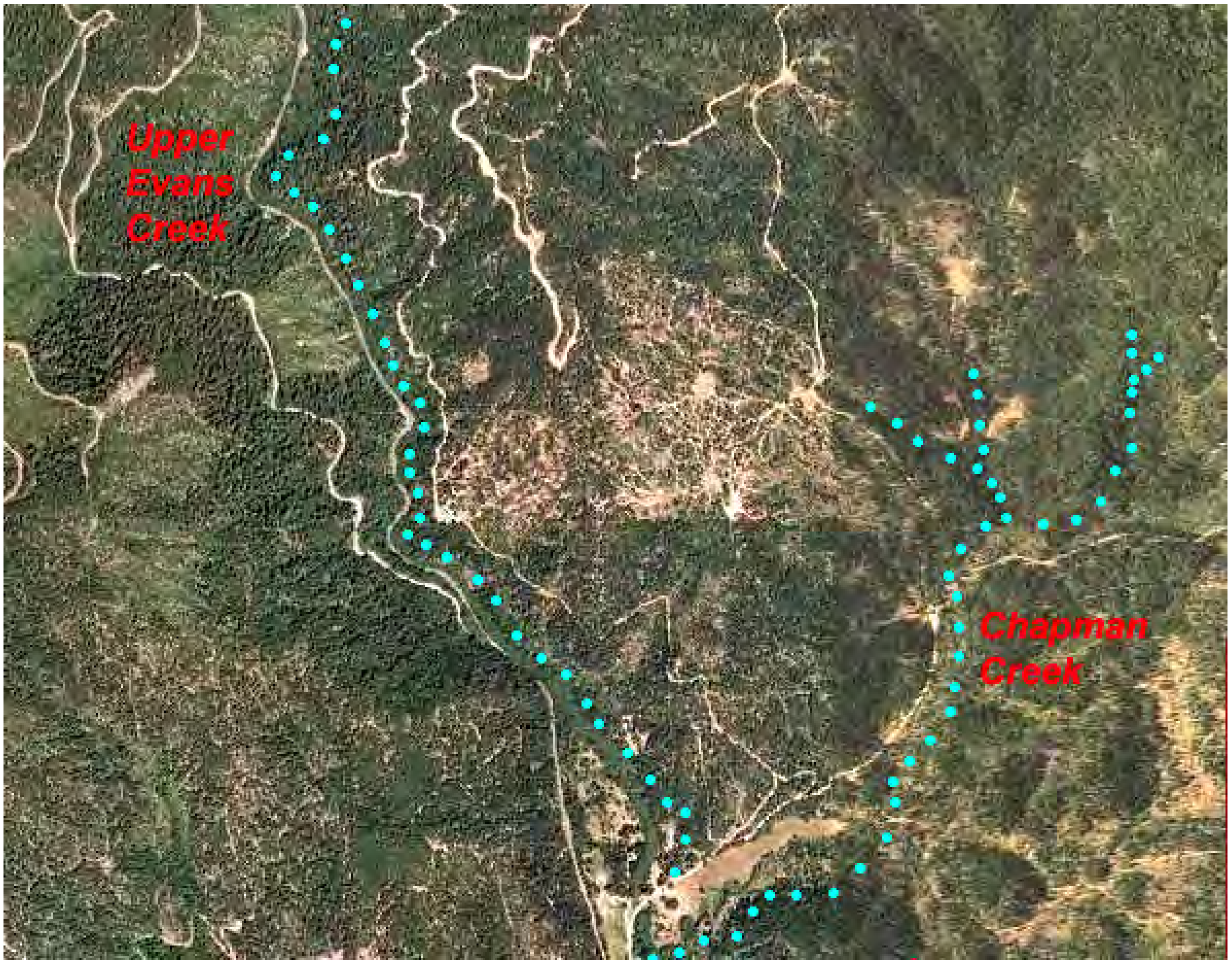

Figure 32-9. Upper Evans Creek and tributary Chapman Creek shown with dots. Timber management roads are immediately next to the channel and there is an extensive network of skid trails that can alter watershed hydrology and sediment yield. Stream courses are based on the USGS (1989) topographic map. June 2005.

Timber Harvest

Studies in coastal basins of Oregon found that when timber harvest exceeds approximately 25 percent of a watershed (Reeves et al. 1993) in 30 years (Reeves, G., pers. comm. 2003), aquatic habitat becomes degraded and simplified and Pacific salmon species diversity diminished. The extent of early- to mid-seral-stage forests on private land in the Upper Rogue River sub-basin (BLM 1999b) indicates that harvest rates on those lands were typically greater than this threshold. Aerial photos show that harvest rotations on private lands may be as short as 30 to 50 years, with very early seral stand conditions and high road densities near stream areas. Studies in other areas of the region have shown that timber harvest in unstable headwater areas increases sediment yield substantially (PWA 1998), depleting the supply of large wood delivered to streams during natural landsliding (May and Greswell 2003). In addition, the Independent Multidisciplinary Science Team (IMST 1999) concluded that the Oregon Forest Practice Rules for riparian protection, large wood management, sedimentation, and fish passage are not adequate to recover depressed stocks of wild salmonids. The primary timber harvest areas within this population are Evans Creek, Trail Creek, Elk Creek, and some parts of Little Butte Creek.

Dams/Diversions

The high number of dams and diversion systems in the Upper Rogue River sub-basin resulted in a high threat score. Agricultural diversions on major low gradient tributaries can impede upstream adult passage or strand downstream-migrating juveniles, if fish screens are not in place. Major diversions by the City of Medford and large agricultural districts are particularly problematic with regard to reduced stream flows (RBCC 2006).

Channelization/Diking

Channelization and confinement of mainstem and tributary reaches of the Upper Rogue River is common and shown in Figure 32-9 and Figure 32-8. Disconnecting high IP coho salmon streams from their floodplains and constricting their channels into straight, narrow stream courses greatly diminishes their summer and winter habitat carrying capacity (BLM 1997). These activities also tend to reduce surface-groundwater connections that help maintain cool stream temperatures (ODEQ 2008).

Climate Change

The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for the climate change stress assessment methods). Average temperature could increase by over 2.8 ^{o}C in the summer and 1 ^{o}C in the winter. Annual precipitation in this area is predicted to stay within the natural range of current variability; however, seasonal patterns in precipitation may change (Mote and Salathe 2010). Juvenile and smolt rearing and migratory habitat are most at risk from climate change. Rising sea level may reduce the quality and extent of wetland rearing habitat. Adult Upper Rogue River coho salmon will likely be negatively affected by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Mining/Gravel Extraction

Large scale gravel operations along the Upper Rogue River have resulted in the river abandoning its channel and forming a new one, and degrading formerly productive coho salmon rearing areas. Off channel ponds formed by pits excavated in the floodplain can capture juvenile coho salmon, coho salmon smolts, and adult coho salmon during high flow. Gravel extraction reduces overall habitat complexity and reduces the quality and quantity of available pool habitat. Given the sensitivity of the channel to disturbance (i.e., due to the current lack of floodplain and channel structure, and low levels of instream wood), and the use of the gravel extraction reach by coho salmon juveniles for summer rearing, gravel extraction is a significant threat to rearing juveniles. However, gravel mining has not occurred within stream channels for many years and no proposals to do so are known.

Invasive Non-Native/Alien Species

Thompson and Fortune (1970) noted that warm water favored introduced species in the mainstem Rogue River, with largemouth bass, black crappie, bluegill, pumpkin seed, and brown bullhead present at fishable levels in the mainstem near Shady Cove prior to dam construction. In the Gold Ray Dam pool, carp were previously abundant (Thompson and Fortune 1970), but this dam has now been removed. In the nearby Middle Rogue, BLM (1999b) noted that private farm ponds related to agriculture and rural residential development have been stocked with introduced warm water species such as largemouth bass and sunfish. Umpqua pikeminnow, introduced in the Rogue River, have become established and likely represent the greatest threat to coho salmon of all the non-native species present. The threat of non-native fish species predominately occurs in the mainstem Rogue River. The risk of non-native fish species to the recovery of Upper Rogue River coho salmon is medium.

Hatcheries

Cole Rivers Hatchery releases 200,000 smolts annually, in addition to millions of hatchery spring-run Chinook salmon, winter-run steelhead, and summer-run steelhead (ODFW 2008d). Consequently, Upper Rogue River coho salmon are exposed to risks posed by hatcheries. The greatest hatchery-related concerns for this population are spawning between hatchery coho salmon and wild coho salmon in the wild, and predation by and competition with hatchery fish. The management goal for this population is to have less than 10 percent of the spawning coho salmon be hatchery-origin (ODFW 2008d). There is some uncertainty on whether this goal is being attained because randomized sampling of spawning sites has been sporadic. Available information suggests that the incidence of hatchery fish spawning in the wild is likely in the range of 5 to 15 percent.

Road-Stream Crossing Barriers

Road densities in portions of the Upper Rogue River sub-basin are very high and stream side roads are common. Culverts may block upstream migration for adults or passage for juveniles during low flow periods. Watersheds with particularly high road densities, road stream crossings, and associated barriers are Bear Creek, Evans Creek and lower Little Butte Creek. Stream crossings have been, and continue to be, improved on federal lands in the sub-basin.

High Severity Fire

Fire risk is acknowledged as a regional concern (RBCC 2006, BLM 1998b). Early seral stage forests, which are common in the Upper Rogue River sub-basin, lead to dry site conditions and increased fire risk (SO RC&D 2003). There have been recent occurrences where fire occurred within/along coho salmon occupied stream segments within the Upper Rogue (i.e., Timbered Rock Fire in Elk Creek watershed 2002). Overall, high severity fire is a medium threat to Upper Rogue River coho salmon.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

32.7 Recovery Strategy

The most immediate need for habitat restoration and threat reduction in the Upper Rogue River is in those areas currently occupied by coho salmon in the headwaters of Evans, Trail, Elk, Big Butte, and Little Butte Creeks. Unoccupied areas must also be restored to provide enough habitat for coho salmon to achieve recovery.

The degraded conditions of the Upper Rogue River habitat, combined with the depressed coho salmon population size and distribution, increases the risk of extinction of this inland coho salmon population, which is critical to recovery of the Interior Rogue River diversity stratum. The greatest factor limiting recovery of coho salmon in the Upper Rogue River is the lack of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by restoring flow, increasing habitat complexity within the channel, restoring off-channel rearing areas, and reducing threats to instream habitat. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 32-3 on the following page lists the recovery actions for the Upper Rogue River population.

Table 32-3. Recovery action implementation schedule for the Upper Rogue River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.12.1.50	Agricultural Practices	Yes	Improve agricultural practices	Improve regulatory mechanisms	Population wide	1
SONCC-URR.12.1.50.1	*Determine the best way to revise the Agricultural Water Quality Management Act (AWQMAP) so that it does not limit recovery of SONCC coho salmon and recommend appropriate revisions.*					
SONCC-URR.12.1.50.2	*Ensure basin rules are specific and linked to implementing AWQMAP recommendations, including developing specific standards for riparian buffers*					
SONCC-URR.12.1.50.3	*Ensure that AWQMA plans address both impaired areas and proactive prevention of water quality impairment*					
SONCC-URR.12.1.50.4	*Adopt interim buffers equal to the buffer standards NMFS is recommending in Washington state until the state establishes its own buffers*					
SONCC-URR.12.1.50.5	*Develop a process in the AWQMA Program that tracks and evaluates implementation*					
SONCC-URR.12.1.50.6	*Change the complaint-based compliance monitoring process to a focused compliance program*					
SONCC-URR.10.5.14	Water Quality	No	Improve timber harvest practices	Improve regulatory mechanisms	Privately held timberlands	1
SONCC-URR.10.5.14.1	*Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions*					
SONCC-URR.10.5.14.2	*Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat*					
SONCC-URR.10.5.14.3	*Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat*					
SONCC-URR.10.5.14.4	*Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat*					
SONCC-URR.10.5.14.5	*Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams.*					
SONCC-URR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	2c
SONCC-URR.3.1.7.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-URR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2c
SONCC-URR.3.1.4.1	*Quantify groundwater withdrawal and determine maximum amount available for use without significantly reducing instream flows*					
SONCC-URR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2c
SONCC-URR.3.1.5.1	*Quantify groundwater withdrawal and ensure urban/residential/industrial development does not limit recovery of SONCC coho salmon*					
SONCC-URR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2c
SONCC-URR.3.1.6.1	*Establish a comprehensive groundwater permit process*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.22.3.47	Urban, Residential, Industrial Development	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	All coho salmon bearing streams	2c
SONCC-URR.22.3.47.1	*Strengthen city and county ordinances to limit development within the 100 year channel migration zone*					
SONCC-URR.22.3.47.2	*Strengthen city and county ordinances to limit development within the 50 year flood elevation*					
SONCC-URR.2.1.11	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve suction dredging practices	All streams where coho salmon would benefit immediately	2c
SONCC-URR.2.1.11.1	*Develop suction dredging regulations that minimize or prevent impacts to coho salmon. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-URR.2.1.70	Floodplain and Channel Structure	Yes	Increase channel complexity	Improve suction dredging practices	Population wide	2d
SONCC-URR.2.1.70.1	*Develop suction dredging regulations that minimize or prevent impacts to coho salmon. Consider special closed areas, closed seasons, and restrictions on methods and operations*					
SONCC-URR.2.1.49	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2c
SONCC-URR.2.1.49.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-URR.2.1.49.2	*Place instream structures, guided by assessment results*					
SONCC-URR.2.1.71	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-URR.2.1.71.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-URR.2.1.71.2	*Place instream structures, guided by assessment results*					
SONCC-URR.2.2.9	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2c
SONCC-URR.2.2.9.1	*Assess habitat to determine where potential exists for floodplain reconnection. Prioritize sites and determine best means for reconnection at each site using tools such as hydrologic analysis*					
SONCC-URR.2.2.9.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.2.2.73	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-URR.2.2.73.1	*Assess habitat to determine where potential exists for floodplain reconnection. Prioritize sites and determine best means for reconnection at each site using tools such as hydrologic analysis*					
SONCC-URR.2.2.73.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-URR.2.2.10	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	All streams where coho salmon would benefit immediately	2c
SONCC-URR.2.2.10.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-URR.2.2.10.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-URR.2.2.10.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-URR.2.2.72	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2d
SONCC-URR.2.2.72.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-URR.2.2.72.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-URR.2.2.72.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-URR.3.1.44	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams with ODFW water rights for fish and all streams where coho salmon would benefit immediately	2c
SONCC-URR.3.1.44.1	*Secure adequate instream flows to fulfill ODFW water rights for fish*					
SONCC-URR.3.1.65	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2c
SONCC-URR.3.1.65.1	*Identify and cease unauthorized water diversions*					
SONCC-URR.3.1.67	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2c
SONCC-URR.3.1.67.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-URR.3.1.67.2	*Reduce diversions using a combination of incentives and enforcement measures*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.3.1.74	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-URR.3.1.74.1	*Identify and cease unauthorized water diversions*					
SONCC-URR.3.1.75	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-URR.3.1.75.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-URR.3.1.75.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-URR.26.1.66	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2c
SONCC-URR.26.1.66.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-URR.10.2.43	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	2c
SONCC-URR.10.2.43.1	*Increase application of Low Impact Development (LID) techniques through education and incentives*					
SONCC-URR.10.2.43.2	*Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge*					
SONCC-URR.10.2.48	Water Quality	No	Reduce pollutants	Increase regulatory oversight	Population wide	2c
SONCC-URR.10.2.48.1	*Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards*					
SONCC-URR.10.2.48.2	*Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced*					
SONCC-URR.10.2.48.3	*Develop local regulatory mechanisms that limits development and reduces amount of total impervious area through incentives*					
SONCC-URR.10.1.12	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Improve long-range planning	Population wide	2c
SONCC-URR.10.1.12.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-URR.10.1.12.2	*Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat*					
SONCC-URR.10.1.13	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase conifer riparian vegetation	Federal forest lands	2c
SONCC-URR.10.1.13.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-URR.10.1.13.3	*Plant conifers, guided by the plan*					
SONCC-URR.2.2.61	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	2d
SONCC-URR.2.2.61.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-URR.5.1.20	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	3c
SONCC-URR.5.1.20.1		*Assess and prioritize barriers using the ODFW fish passage barrier database*				
SONCC-URR.5.1.20.2		*Remove barriers, based on evaluation*				
SONCC-URR.5.1.76	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-URR.5.1.76.1		*Assess and prioritize barriers using the ODFW fish passage barrier database*				
SONCC-URR.5.1.76.2		*Remove barriers, based on evaluation*				
SONCC-URR.10.5.37	Water Quality	No	Improve timber harvest practices	Improve timber harvest practices	BLM lands	3c
SONCC-URR.10.5.37.1		*Manage timber harvest (and associated activities) on Federal lands in accordance with the Aquatic Conservation Strategy of the NWFP, or with the updated ACS guidance contained in newly revised Resource Management Plans or Land and Resource Management Plans, in order to achieve riparian and stream channel improvements for coho salmon.*				
SONCC-URR.7.1.45	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands where coho salmon would benefit immediately	3c
SONCC-URR.7.1.45.1		*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*				
SONCC-URR.7.1.45.2		*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*				
SONCC-URR.7.1.45.3		*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*				
SONCC-URR.7.1.77	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-URR.7.1.77.1		*Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions*				
SONCC-URR.7.1.77.2		*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*				
SONCC-URR.7.1.77.3		*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*				
SONCC-URR.8.1.2	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3c
SONCC-URR.8.1.2.1		*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-URR.8.1.1	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All basins with road densities greater than 3 miles/square mile	3c
SONCC-URR.8.1.1.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-URR.8.1.1.2		*Decommission roads, guided by assessment*				
SONCC-URR.8.1.1.3		*Upgrade roads, guided by assessment*				
SONCC-URR.8.1.1.4		*Maintain roads, guided by assessment*				
SONCC-URR.10.2.42	Water Quality	No	Reduce pollutants	Reduce pesticides	All streams where coho salmon would benefit immediately	3c
SONCC-URR.10.2.42.1		*Develop a pesticide management plan*				
SONCC-URR.10.2.42.2		*Implement pesticide management plan and technical assistance program*				
SONCC-URR.10.2.68	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-URR.10.2.68.1		*Develop a pesticide management plan*				
SONCC-URR.10.2.68.2		*Implement pesticide management plan and technical assistance program*				
SONCC-URR.10.7.64	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-URR.10.7.64.1		*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*				
SONCC-URR.10.7.64.2		*Supply marine-derived nutrients to streams guided by the plan*				
SONCC-URR.10.7.69	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-URR.10.7.69.1		*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*				
SONCC-URR.10.7.69.2		*Supply marine-derived nutrients to streams guided by the plan*				
SONCC-URR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Manage flow	William L. Jess Dam	3d
SONCC-URR.3.1.8.1		*Review dam management practices to ensure operations benefit the survival of all life stages of coho salmon*				
SONCC-URR.3.1.8.2		*Modify dam management, if needed*				
SONCC-URR.1.2.39	Estuary	No	Improve estuarine habitat	Improve estuary condition	Rogue River Estuary	3d
SONCC-URR.1.2.39.1		*Implement recovery actions for Lower Rogue River population that address the target "Estuary"*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.7.1.46	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Federal lands	3d
SONCC-URR.7.1.46.1	*Monitor effects of livestock grazing on coho salmon habitat and adjust or discontinue grazing if effects of livestock grazing on salmon habitat are limiting coho recovery*					
SONCC-URR.16.1.21	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-URR.16.1.21.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-URR.16.1.21.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-URR.16.1.22	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-URR.16.1.22.1	*Determine actual fishing impacts*					
SONCC-URR.16.1.22.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-URR.16.2.23	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-URR.16.2.23.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-URR.16.2.23.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-URR.16.2.24	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-URR.16.2.24.1	*Determine actual impacts of scientific collection*					
SONCC-URR.16.2.24.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-URR.10.2.15	Water Quality	No	Reduce pollutants	Educate stakeholders	Population wide	3d
SONCC-URR.10.2.15.1	*Develop an educational program that promotes Salmon Safe methods for agricultural operations and Integrated Pest Management for rural residents*					
SONCC-URR.14.2.19	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of warm-water, non-native fish species	Population wide	3d
SONCC-URR.14.2.19.1	*Determine presence and absence of warm water, non-native fish species and develop a plan for eradication or control*					
SONCC-URR.14.2.19.2	*Eradicate or suppress invasive fish species, guided by the plan*					
SONCC-URR.10.7.63	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-URR.10.7.63.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-URR.10.7.63.2	*Supply marine-derived nutrients to streams guided by the plan*					

33. Middle Klamath River Population

Interior Klamath River Diversity Stratum

Non-Core 1, Potentially Independent Population

Moderate Extinction Risk

Population likely above depensation threshold

450 Spawners Required for ESU Viability

1038 mi^2 watershed (98% Federal ownership)

113 IP-km (70 IP-mi) (4% High)

Dominant Land Use is Forest Service Public Land

Key Limiting Stresses are ‘Impaired Water Quality’ and ‘Lack of Floodplain and Channel Structure’

Key Limiting Threats are ‘High Severity Fire’ and ‘Dams/Diversions’

Highest Priority Recovery Actions

• Construct off channel ponds, alcoves, backwater habitats, and old stream oxbows • Re-connect channel to existing off-channel ponds, wetlands, and side channels • Improve estuary condition	• Remove, setback, or reconfigure levees and dikes • Increase large woody debris (LWD), boulders, or other instream structure • Protect existing or potential cold water refugia

33.1 History of Habitat and Land Use

Historical mining, excessive timber harvest, and road building activities have contributed to environmental degradation in the Middle Klamath River sub-basin. Throughout the 1850s, hydraulic and placer mining removed gravel and filtered out gold in sections of the mainstem Klamath River. Piles of gravel tailings remain along the mainstem river and tributaries as remnants of these historic practices, continuing to create stress and alter channel structure throughout the watershed. Timber harvest was prevalent in the late 1940s to the 1990s, but has since declined largely due to recent Forest Service policy on maintaining ecosystem health. Today, most timber management projects on Six Rivers and Klamath National Forest include hazard tree removal, fuel reductions, salvage timber harvest, and promoting the development and maintenance of diverse stand structures and species composition. Existing roads used for past timber harvest remain in the watershed and many continue to contribute sediment to tributary and mainstem channels.

Since the early 1900s, water has been diverted from the Klamath River for the U.S. Bureau of Reclamation’s Klamath Project. This diversion has altered the historic hydrologic regime of the mainstem Klamath River, as well as reduced the total volume of water available for instream flows; this reduction contributes to water quality degradation and directly affects critical periods of the life history of SONCC coho salmon (NMFS and USFWS 2013). Although unquantified, substantial volumes of water are also diverted for municipal use and to non-Project irrigators from many tributaries in the Klamath River Basin, further reducing cold water inputs into the mainstem. Hydropower dams, constructed upstream of the Middle Klamath River in the early to mid-1900s, also contribute to the alteration of mainstem flows. Although there are no notable dams in the Middle Klamath, the operations of Iron Gate, Copco 1 and 2, JC Boyle and Keno dams in the upper Klamath River block fish passage above Iron Gate Dam, alter sediment transport processes, and contribute to the reduction of flow variability, which create instream conditions that favor disease proliferation and facilitate increased fish infection rates (*Ceratonova shasta*, *Icthyopthirius multifilis* [Ich], *Flavobacterium columnare* [columnaris], Aeromonid bacteria, *Nanophyetus salmonicola*, *Parvicapsula minibicornis*) (Stocking and Bartholomew 2007, NMFS and USFWS 2013). Upper basin agricultural practices contribute to high nutrient levels, low dissolved oxygen levels, and altered water temperature regimes in the Klamath River; these water quality issues are also influenced by the upstream dams (NMFS and USFWS 2013). More information on how agricultural practices and hydropower dams impact water quality and actions being taken to reduce these impacts can be found in the Upper Klamath population profile (Chapter 34) and PacifiCorp’s habitat conservation plan (HCP) for coho salmon (NMFS 2012, PacifiCorp 2012).

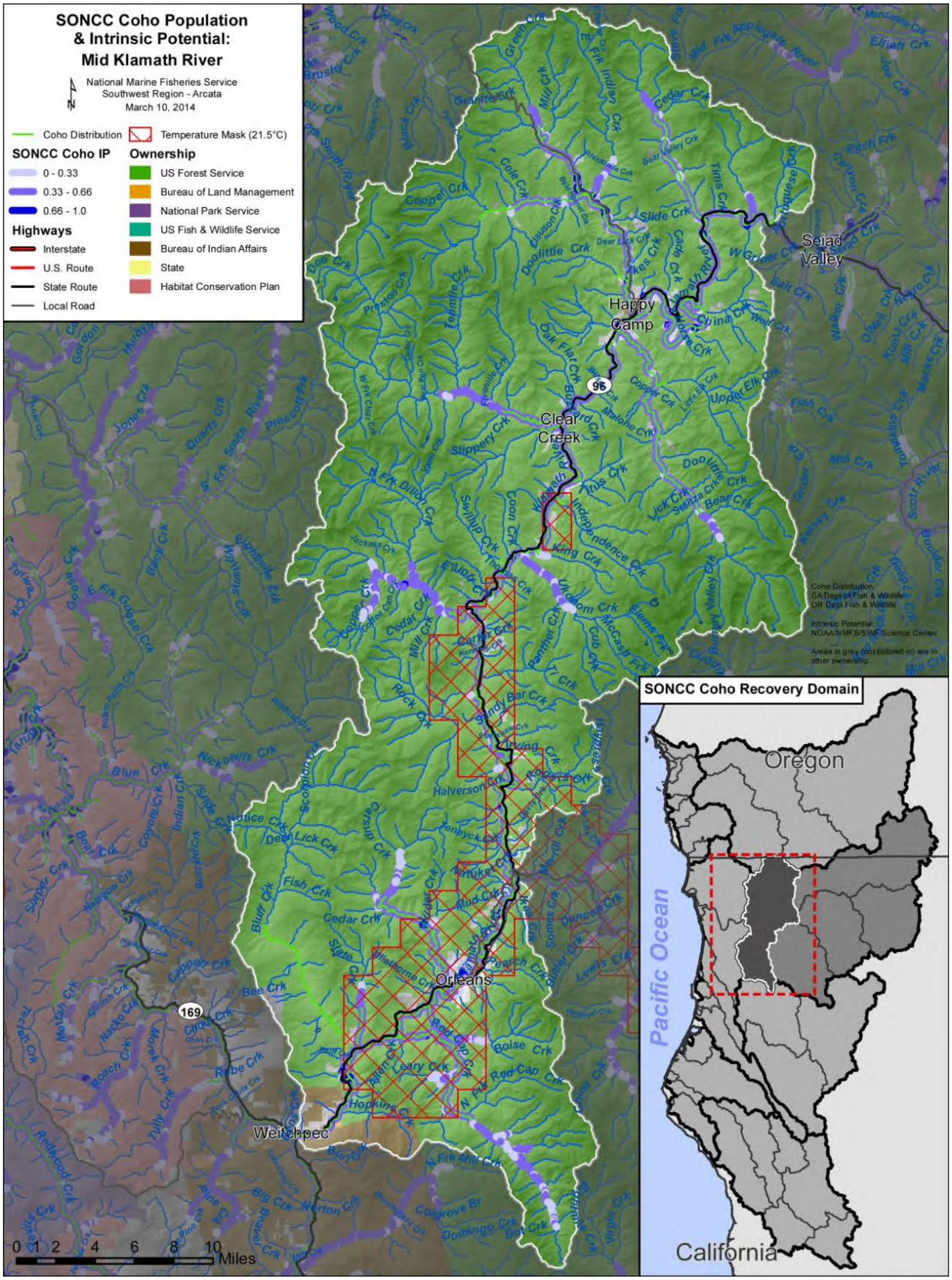

Figure 33-1. The geographic boundaries of the Middle Klamath River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Klamath River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

33.2 Historic Fish Distribution and Abundance

Very little historic data exist on coho salmon in the Middle Klamath population area. Within the larger Klamath River basin, early gill net catches were on the order of 11,000 for coho salmon in 1919 (Snyder 1931). Large declines in the basin were thought to occur between 1940 and 1960 due to large-scale timber harvest, mining, and associated habitat loss (Weitkamp et al. 1995). By the 1980s, the annual escapement of coho salmon in the basin was down to around 15,000 to 20,000 fish, and this estimate included a large portion of hatchery fish (Leidy and Leidy 1984). Some have concluded that salmon runs across the ESU declined by over 90 percent between the 1940s and 1980s (Weitkamp et al. 1995, California Department of Fish and Game [CDFG] 2004b). Since many tributaries in the Middle Klamath were affected by land use activities over this same time period, the Middle Klamath River population was likely part of this decline. Historic runs in this population were likely never as large as in some tributaries, such as the Scott or Shasta River populations. The IP model shows that there are approximately 113 IP-km of suitable juvenile rearing habitat spread throughout the mainstem Klamath River and tributaries in the Middle Klamath region. Most of this habitat has moderate IP value (0.33 to 0.66) with a few very isolated patches of high IP value (>0.66). Historic use of Middle Klamath River tributaries by coho salmon has been documented in Aikens, Bluff, Slate, Red Cap, Boise, Camp, Irving, Stanshaw, Sandy Bar, Rock, Ti, Dillon, Swillup, Ukonom, Independence Clear, Oak Flat, Elk, Little Grider, Indian, China, Thompson, Fort Goff, and Portuguese creeks (Brownell et al. 1999). Many other tributaries also likely supported natal and non-natal coho salmon spawning and rearing historically, as evidenced by current juvenile presence in most tributaries of the Middle Klamath River.

33.3 Status of Middle Klamath River Coho Salmon

Spatial Structure and Diversity

There are several monitoring efforts in the Middle Klamath River, including: 1) fish populations, 2) stream flow, 3) water quality, 4) physical habitat, and 5) restoration sites. Monitoring is conducted by a number of entities, including the Karuk Tribe, the U.S. Forest Service (USFS), the U.S Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (formerly CDFG), the North Coast Regional Water Quality Control Board (NCRWQCB), the U.S. Geological Survey (USGS), and the Mid Klamath Watershed Council (MKWC). These efforts have taken place in many tributaries of the Klamath River since 1986, and have provided information on coho salmon distribution and abundance as well as habitat condition and restoration effectiveness.

Juvenile coho salmon surveys have been conducted over the past several decades by various parties including the Karuk Tribe, MKWC, and USFS. These surveys have found coho salmon juveniles rearing in Hopkins, Aikens, Bluff, Slate, Red Cap, Boise, Camp, Pearch, Whitmore, Irving, Stanshaw, Sandy Bar, Rock, Dillon, Swillup, Coon, Kings, Independence, Titus, Clear, Elk, Grider, Little Grider, Cade, Tom Martin, China, Thompson, Fort Goff, Seiad, Horse, Beaver, and Portuguese creeks (Soto et al. 2008a, Karuk Tribe 2012). Lower Middle Klamath surveys conducted between 2002 and 2009 indicate that juvenile coho salmon are most abundant in Aikens, Bluff, Boise, Camp, Red Cap, Sandy Bar, Slate, and Stanshaw Creeks (Karuk Tribe 2012). Most of the observations are of juveniles using the lower parts of the tributaries and it is likely that many of these fish are non-natal rearing in these refugia areas. Natal rearing is likely confined to those tributaries where spawning is occurring and where sufficient rearing habitat exists (Boise, Aikens, Bluff, Slate, Thompson, Red Cap, Elk, Indian, Independence, Titus, Seiad, Horse, China, Beaver, Clear, and Camp creeks).

Only limited coho salmon spawning surveys have occurred in the Middle Klamath River. Spawning adult coho salmon have been documented in Bluff, Slate, Red Cap, Camp, Boise, Elk South Fork Clear, and Indian creeks (Soto et al. 2008a). The Karuk Tribe surveyed 28 streams in 2011 and found evidence of coho salmon spawning in 13 streams including Aikens, Beaver, Camp, China, East Fork Elk, Grider, Horse, Independence, Seiad, Slate, Titus, and South Fork Clear creeks, as well as the Klamath River at Barkhouse side channel (Corum 2012). Outmigrant trapping between 2002 and 2008 on Red Cap and Camp creeks found juveniles less than 40 mm, indicating that there was likely natal rearing occurring (USFS 2009a, Cyr 2010). In addition, coho salmon have been observed spawning in side channels, tributary mouths, and shoreline margins of the mainstem Klamath River between Beaver Creek (RM 161) and Independence Creek (RM 94) (Magneson and Gough 2006).

Williams et al. (2008) determined that at least 34 coho salmon per-IP-km of habitat are needed (3,900 spawners total) for the Middle Klamath coho salmon population to be at low risk of extinction. Adults and juveniles appear to be well distributed throughout the Middle Klamath; however, use of some spawning and rearing areas is restricted by water quality, flow, access, and sediment issues. Little is known about the genetic and life history diversity of the population, but diversity is expected to be limited because of the depressed population size. The Middle Klamath River coho salmon population spatial distribution appears to be good, but since many of the Middle Klamath tributaries are used for non-natal rearing too little is known for its natal spatial structure and diversity to be evaluated.

Population Size and Productivity

Little data exist on the Middle Klamath coho salmon population, but runs are thought to be extremely reduced compared to historic levels. Regional biologists estimate that the total population size is around 1,000-1,500 in strong run years and 0-500 in weaker run years (Ackerman et al. 2006). A few tributaries in the Middle Klamath (e.g., Slate, Boise, Red Cap, Clear, Camp, and Indian Creeks) support significant returns of coho salmon; however total spawner abundance and population productivity is unknown. The Karuk Tribe found at least 64 coho salmon redds and 22 adult coho salmon in Middle Klamath tributaries in the 2013-2014 spawning season (Corum 2014). Tributaries with observed coho salmon spawners or redds in 2013-2014 included Aikens, Camp, China, East Fork Elk, Elk, Independence, Indian, Mill (tributary to Indian), South Fork Clear, and Titus creeks (Corum 2014).

Juvenile counts indicate that productivity is relatively low, with less than 12,000 juvenile coho salmon found between 2002 and 2009 during surveys of Middle Klamath tributaries (USFS 2009a). Outmigrant trapping on Red Cap and Camp Creeks by the USFS exhibited consistent use of these Middle Klamath River tributaries by young-of-the-year (YOY) and age-1 coho salmon. In every year sampled (2002 to 2003 and 2007 to 2009), USFS found YOY and age-1 outmigration from these streams during the late spring and early summer, although the number of outmigrating age-1 smolts was generally less than 100 during most years (USFS 2009a).

Based on adult returns to other Klamath River populations, the 2004/2007/2010 brood year is likely a relatively stronger year class than the other two (i.e., 2003/2006/2009 and 2002/2005/2008) (Ackerman et al. 2006). Generally the returns are more consistent between years in Middle Klamath tributaries than in other populations such as the Scott or Shasta rivers, which have very weak year classes most years (Chesney and Knechtle 2008).

Williams et al. (2008) determined at least 113 coho salmon must spawn in the Middle Klamath each year to avoid the effects of extremely low population sizes. Based on the available data, the Middle Klamath River coho salmon population likely has an average spawner abundance of 200-600 individuals, and is at moderate risk of extinction given the low population size and negative population growth rate (Ackerman et al. 2006). Based on current estimates, the population is likely above depensation, but well below the low-risk threshold of 3,900 spawners.

Extinction Risk

The Middle Klamath River population is at moderate risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one, but the ratio is less than the minimum required spawner density (both criteria described in Williams et al. 2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Middle Klamath River population is a non-core, Potentially Independent population within the Interior Klamath River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, but strongly influenced by immigration from other populations such that they did not exhibit independent dynamics (Williams et al. 2006). The Middle Klamath River population is strongly influenced by upstream populations. Adult strays from these populations spawn and interact with coho salmon in the Middle Klamath River. To contribute to stratum and ESU viability, the Middle Klamath River non-core population needs to have at least 450 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and to continue to represent critical components of the evolutionary legacy of the ESU. Furthermore, the Middle Klamath River population will contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to other populations in the Klamath River basin.

33.4 Plans and Assessments

Mid Klamath Watershed Council

Since 2001, the Mid Klamath Watershed Council (MKWC) has been engaged in habitat restoration work along the Klamath River corridor, including the upper Klamath River area.

Reports related to fisheries and aquatic resources, available via MKWC's homepage (http://www.mkwc.org), include the following:

Middle Klamath Restoration Implementation Plan, Instream Working Group (2013 draft)

The Instream Working Group's Instream Candidate Actions Table (CAT; Grunbaum et al. 2013) includes recovery actions that specifically address constraints to recovery in 35 tributary watersheds within the Mid Klamath Basin, and in 31 tributary watersheds within the Upper Klamath Basin. Though these tributaries are not all mentioned by name in the SONCC coho salmon ESU recovery plan, the recommended candidate actions in the CAT for each tributary watershed are incorporated into the SONCC recovery plan's recovery actions.

Middle Klamath Sub-basin Fisheries Resource Recovery Plan, December 1, 2008

Off-Channel Coho Salmon Rearing Pond Projects: Seiad Creek and Grider Creek (2012 update)

2008 DFG Klamath Tributary Fish Passage Improvement Results

Restoring Coho Salmon in the Klamath River, One Beaver At A Time

The Effect of the Klamath Hydroelectric Project on Traditional Resource Uses and Cultural Patterns of the Karuk People within the Klamath River Corridor (Salter 2003)

Karuk Tribal Fisheries Department and Restoration Division

Mid Klamath Sub-basin Fisheries Resource Recovery Plan
http://mkwc.org/publications/index.html#Sub-Basin

In 2003, the Karuk Tribe developed a fisheries resource recovery plan (Soto and Hentz 2003) to identify core variables pertaining to ecological function in the sub-basin, and to provide management priorities and objectives to guide efforts to improve conditions in the sub-basin. The plan was updated in December 2008 by the Karuk Tribe and MKWC (Soto et al. 2008). The Tribe will administer the long-range plan, in cooperation with federal and state management agencies, private landowners, and local communities. The resource plan focuses on active restoration of those processes most degraded by historic and current land uses, and passive restoration for protection of currently functioning sub-basin processes.

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004 (CDFG 2004b) and is a guide for recovering coho salmon on the north and central coasts of California, including the Middle Klamath River. The Recovery Strategy emphasizes cooperation and collaboration at many levels, and recognizes the need for funding, public and private support for restorative actions, and maintaining a balance between regulatory and voluntary efforts.

Klamath River TMDL

The purpose of the Klamath River TMDLs (NCRWQCB 2010) are to estimate the assimilative capacity of the system with respect to the total loads of nutrients and organic matter that can be delivered to the Klamath River without causing an exceedance of the water quality objectives for nutrients and dissolved oxygen. The TMDLs also establish the amount of protection from solar radiation and cold water withdrawals necessary to meet water quality objectives for water temperature. The current TMDLs for the Klamath River in California address temperature, dissolved oxygen, nutrient, and *microcystin* water quality impairments for the Klamath River Hydrologic Unit, Middle HA (Oregon to Trinity River) and Lower HA, Klamath Glen HSA (Trinity River to Pacific Ocean).

U.S. Forest Service

Watershed Condition Framework

The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, Bluff Creek was identified as a high priority 6th field sub-watershed in the Six Rivers National Forest (USFS and BLM 2011).

The Klamath (KNF) and Six Rivers National Forests have also conducted various other watershed assessments for National Forest lands within the Middle Klamath region.

33.5 Stresses

Table 33-1. Severity of stresses affecting each life stage of coho salmon in the Middle Klamath River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Sediment Supply	High	High	Very High	High	High	Very High
2	Impaired Water Quality[1]	Low	Medium	Very High[1]	High	Medium	High
3	Lack of Floodplain and Channel Structure[1]	Low	High	High[1]	High	Medium	High
4	Barriers	-	High	High	High	High	High
5	Increased Disease/Predation/Competition	Low	Medium	High	High	Medium	High
6	Altered Hydrologic Function	Low	Low	High	High	Medium	High
7	Impaired Estuary/Mainstem Function	-	Low	High	High	Low	High
8	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
9	Degraded Riparian Forest Conditions	-	Medium	Medium	Medium	Medium	Medium
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are impaired water quality and lack of floodplain and channel structure, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. There are also other stresses that limit the function of habitat for certain life stages in the Middle Klamath and therefore limit productivity of this population (Table 33-1). The lack of quality summer and winter rearing habitat that is protected from warm temperatures and high winter flows, respectively, is one of the most likely factors limiting productivity (Soto et al. 2008a). Summer rearing occurs in cold-water tributaries and other thermal refugia along the mainstem. This type of rearing habitat is limited in terms of its quality, quantity and connectivity within the Middle Klamath River. In the summer, water diversion leads to poor hydrologic function, disconnection and diminishment of thermal refugia, and poor water quality. Accretion of sediment at creek mouths also limits access to important thermal refugia and summer rearing habitat. Winter rearing occurs primarily in mainstem, confluence, and tributary habitats where backwaters, alcoves, off-channel ponds and wetlands have formed. Winter rearing habitat has been primarily impacted by past mining activities and construction of flood control levees in the mainstem and in many tributaries, which has led to the loss and degradation of floodplain and channel structure. The majority of winter habitat that does exist is small, has poor quality, and is poorly connected. In addition to juvenile rearing habitat, mainstem disease issues may be limiting the productivity of the population during certain years.

Looking at the overall productivity of the population, the juvenile life stage is most limited due to the degradation of summer and winter rearing habitat and the issues associated with disease and water quality that affect survival and growth in the mainstem river during migration. In order to improve the viability of this population, addressing these limiting stresses and improving habitat and conditions for the juvenile life stage will be imperative. Addressing other stresses and threats and improving habitat for all life stages and life history strategies will also be an important component of recovery for this population.

Thermal refugia are one of the most important habitat types in the Middle Klamath River due to their role in coho salmon rearing and migration in the Klamath River. USFS biologists in the Orleans and Happy Camp Ranger Districts have been monitoring Klamath mainstem and tributary stream temperatures since 1996 (Cyr 2010). Results from these data and other studies along the Middle Klamath River have shown that once water temperatures in the mainstem become warm they typically remain warm, except for stream reaches receiving significant groundwater inflow. Cool water from these tributaries plays a vital role in reducing salmonid thermal stress and mortality, and cool water from smaller tributaries is as critical as larger tributaries in maintaining water quality in the Klamath River and providing thermal refugia for coho salmon.

The Yurok Tribe and MKWC have collected temperature data in tributaries and the mainstem Middle Klamath River (MKWC 2006) and surveyed potential refugia areas that are available to juvenile coho salmon. Many tributaries serve as thermal refugia because of their cooler water temperatures relative to the warm mainstem Klamath River (MKWC 2006) (Table 33-2). Table 33-2 may not be a complete list of all thermal refugia in the Middle Klamath because tributary confluences change regularly, thereby increasing or decreasing availability and usefulness to coho salmon. Any tributary with water temperatures cooler than the mainstem Klamath River can be considered thermal refugia due to its role in maintaining water quality in the mainstem Klamath River. The presence of juveniles in these tributaries, especially when water temperatures in the mainstem Klamath River are high, supports the conclusion that they are used as refugia areas. Other important tributaries for juvenile rearing include Sandy Bar, Stanshaw, China, Little Horse, Pearch, and Boise creeks (Harling 2009). Intact, high quality rearing and spawning tributary habitat is also vital to the recovery of this population. Habitat in Indian, Elk, Camp, Boise, Red Cap, Clear, Thompson, Dillon, Slate, and Bluff creeks provide the highest quality spawning and rearing habitat for coho salmon in the Middle Klamath (Mid Klamath Restoration Partnership 2010).

Table 33-2. Thermal refugia areas in the Middle Klamath River. (MKWC 2006, NCRWQCB 2010).

Stream Name	Stream Name	Stream Name
Aikens Creek	Rock Creek	Oak Flat Creek
Bluff Creek	Ti Creek	Elk Creek
Slate Creek	Dillon Creek	Little Grider Creek
Red Cap Creek	Aubrey Creek	Indian Creek
Boise Creek	Elliot Creek	Cade Creek

Camp Creek	Swillup Creek	Little Horse Creek
Pearch Creek	Ukonom Creek	China Creek
Rodgers Creek	King Creek	Thompson Creek
Irving Creek	Independence Creek	Ft. Goff Creek
Stanshaw Creek	Titus Creek	Portuguese Creek
Sandy Bar Creek	Clear Creek	

Altered Sediment Supply

Altered sediment supply poses a high or very high stress to all of the life stages of coho salmon. Access to tributary rearing habitat and refugia during some parts of the summer is blocked at times by alluvial barriers. The hydrologic and connectivity issues associated with excess sediment increase the risk of infections from *C. shasta* and *P. minibicornis*. Soils in this area are highly erodible, and in combination with the steep terrain, recent intense fires, and a legacy of past timber harvest and road-building, fine sediment loading has contributed to impaired conditions throughout the Middle Klamath. Excessive fine sedimentation reduces habitat diversity, embeds spawning gravel, and reduces channel stability. Changes in the natural structure of the river and in water flow cause alluvial sills to form at many tributary confluences, which can either physically block fish or force flows subsurface, thereby limiting or eliminating access to important refugia and spawning/rearing habitat. Habitat complexity in many tributaries has been reduced by fine sediment filling of pools, off-channel ponds and wetlands.

Impaired Water Quality

Coho salmon in the Middle Klamath River sub-basin have numerous interacting stresses. High water temperatures, exacerbated by water diversions and seasonal low flows, restrict juvenile rearing in the mainstem Klamath River and lessen the quality of tributary rearing habitat. Water quality issues are a primary concern due to issues of elevated water temperatures, low dissolved oxygen, and high nutrient levels. Water quality conditions in the Middle Klamath are impaired by seasonal high temperature, low DO, and high pH (NMFS 2012). Seasonal decreases in water quality can be a very high stress for juveniles and a high stress for smolts due to poor rearing and migratory conditions. In general, mainstem habitat in the Klamath River is not suitable for productive summer or winter rearing, making tributary habitats highly valuable for growth and survival of coho salmon (NMFS and USFWS 2013). Benthic macroinvertebrate indicators of water quality (via the IBI and EPT metrics) are good for the watershed. However, other water quality parameters including pH and temperature (>17 ºC MWAT) are poor in the mainstem Klamath River, although several key tributaries were found to have fair water temperatures (16.1 to 17 ºC; NCRWQCB 2010). Grider, Indian, Elk, Sandy Bar, and Whitmore creeks all have had water temperatures above the 17º MWAT recommended as suitable for juvenile fish (MKWC 2006). Dissolved oxygen (DO) levels are fair (6 to 6.75 mg/l 7 DA-min) in the upper Middle Klamath, while DO levels in the lower Middle Klamath are good (6.75- 7 mg/l) to very good (>7 mg/l) (NCRWQCB 2010). Overall, the water quality in the Klamath River is impaired and is on the 303(d) Clean Water Act list due to temperature.

Use of mainstem habitat is most limited by water quality during the summer months (June through September) when water temperatures are high throughout the day. Juveniles must utilize tributaries and other off-channel areas where cooler water can be found. Juvenile foraging and rearing during early summer is most affected by poor mainstem conditions, which force individuals into cold water tributaries (NMFS 2012, NMFS and USFWS 2013); in some years adult migration in the fall may be impacted as well. Dissolved oxygen is also impaired in areas during this same time period and can reach as low as 5.5 mg/L in the mainstem (NCRWQCB 2010). Highly fluctuating DO concentrations are common throughout the mainstem and pH tends to rise throughout the summer, peaking in late August and fluctuating widely between day and night (NMFS 2007b). This fluctuating condition likely further limits use of mainstem areas for juveniles and restricts rearing to tributary and confluence habitat where water quality is better. Disease prevalence and impacts may also be affected by water quality, with recent documented incidences of sub-lethal and lethal effects on juveniles, smolts, and adults associated with elevated temperatures (Bartholomew and Courter 2007). MKWC (2006) documented mainstem and tributary temperatures in the summer of 2006 and showed that while mainstem temperatures are often higher than the range of coho salmon suitability, most tributary temperatures were suitable for coho salmon (Figure 33-2).

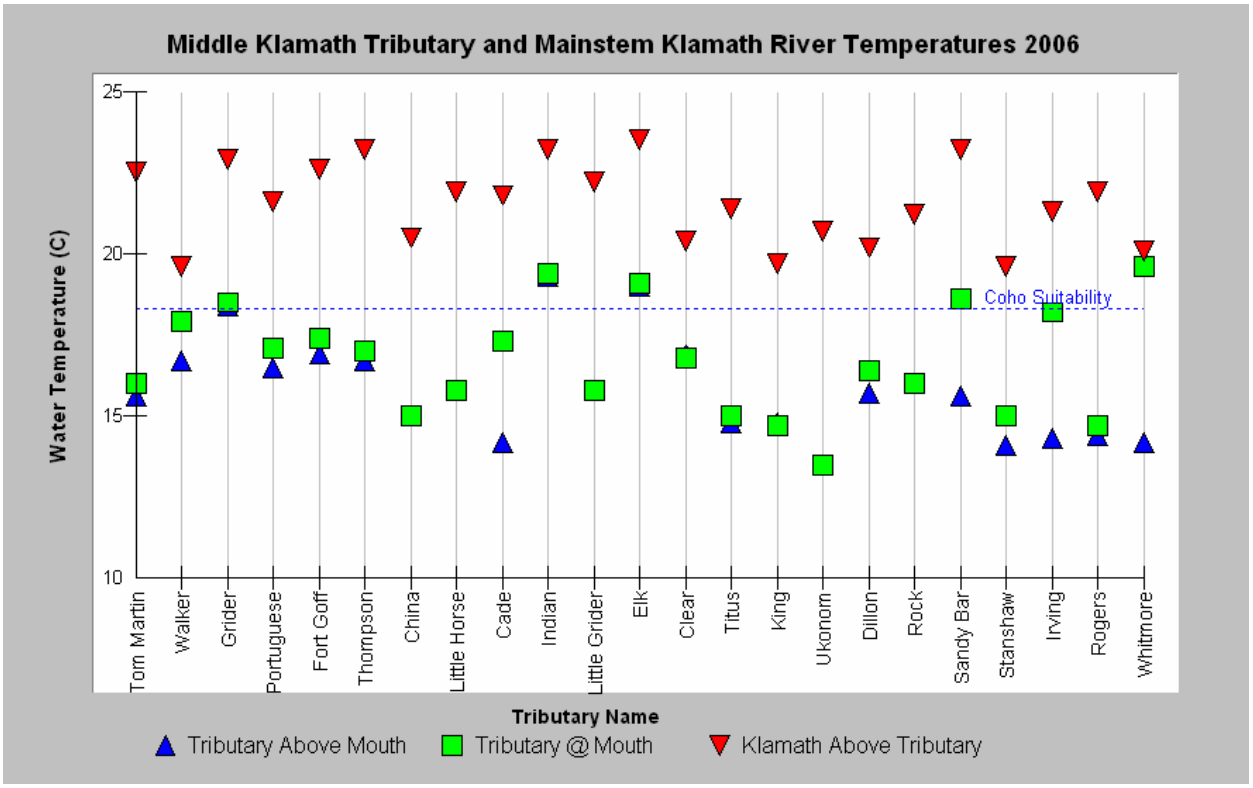

Figure 33-2. Temperature data collected during 2006 surveys (mid-June through mid-October). The data show that most tributaries were cool enough at the time of survey to support coho salmon, while mainstem Klamath River water temperatures were in the highly stressful range (MKWC 2006).

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure is also a high stress because juvenile coho salmon need to rear in tributaries, using thermal refugia during summer and velocity refugia during winter. Habitat complexity in the form of pools, LWD cover, and off-channel floodplains is essential for juvenile rearing to optimize prey availability, avoid predation, and access these thermal and velocity refugia. The Middle Klamath River sub-basin generally lacks habitat complexity. The lack of floodplain and channel structure is a high stress for most life stages in this population. Fry, juveniles and smolts frequently use floodplains, side channels, and slow water habitats where available, especially in winter when high flows inhibit use of mainstem channel habitat. Generally, floodplain structure is not available in many Middle Klamath tributaries due to the steeper gradient and channel confinement in these areas, as well as the remnant dredge tailings on the floodplain in many areas. Floodplain connectivity is poor in the Indian Creek sub-watershed and the area between Dillon Creek and the Salmon River confluence. NMFS (2007b) noted that wood was inadequate in many Middle Klamath tributaries, which contributes stress to certain life stages that use more complex habitats. Sediment loading in some tributaries has affected the quality and availability of off-channel habitat as well. Lack of balanced sediment inputs along with the absence of adequate transport flows have filled many off-channel ponds and wetlands and prevent the creation and maintenance of side and off-channel habitat. Adults are impacted through the lack of suitable spawning habitat as a result of poor gravel recruitment and retention.

Barriers

Alluvial dams, low flow conditions, road-crossings, and diversions cause many seasonal and permanent barriers in the Middle Klamath. Of these, alluvial dams at the mouths of many tributaries present the greatest number of barriers. In total, there are almost 50 known seasonal or permanent barriers in the Middle Klamath blocking or impairing access to over 170 miles of coho salmon habitat (Mid Klamath Restoration Partnership 2010). Hwy 96 has several poorly designed culverts that block upstream and downstream migration in key watersheds (Portuguese, Fort Goff, and Cade creeks) and unscreened diversions in streams are problematic. Overall, barriers pose a high stress for fry, juveniles, smolts, and adults due to the numerous barriers that exist throughout the tributaries of the Klamath. Barriers throughout the Middle Klamath are especially detrimental because they may block access for juvenile coho salmon to summer and winter refugia and rearing areas, as well as blocking spawning grounds for returning adults.

Increased Disease/Predation/Competition

Disease, predation, and competition are a moderate to high stress for the population. Of these three stresses, disease is the most significant. Pathogens that cause diseases in juveniles and adults include *C. shasta*, *Ichthyopthirius multifilis* (Ich), *Flavobacterium columnare* (columnaris), Aeromonid bacteria, *Nanophyetus salmonicola*, and the kidney myxosporean *P. minibicornis* (Federal Regulatory Energy Commission [FERC] 2007, National Research Council [NRC] 2004). Disease occurs when conditions for the pathogen are favorable and when fish are susceptible. Ich and columnaris were responsible for the die-off event in the Lower Klamath River in the summer of 2002. Infection by *P. minibicornis* may occur at a prevalence of greater than 50 percent of juvenile coho salmon. It is unknown how often *P. minibicornis* causes direct mortality (Bartholomew and Courter 2007). Juvenile mortality rates from short term and longer term exposures at various locations in the Klamath River vary by location and time of year, but are consistently higher at Beaver Creek (Upper Klamath) and Seiad Valley. Between 2008 and 2010, mortality has been less than 10 percent at the Orleans site (Bartholomew 2012). With respect to predation and competition, the presence and abundance of exotic fish species have both increased in the Klamath River since the mid-20th century, creating an additional stress to coho salmon. Exotic fish have changed the ecology of the Klamath River; adverse interactions between exotic fish and coho salmon are poorly understood but may include competition for food/habitat, predation of coho salmon, and disease introduction. The threat of non-native/alien fish species is discussed further in Section 33.6 under Threats.

Altered Hydrologic Function

Altered hydrologic function poses an overall high stress for the population. The timing, magnitude and volume of flows in the mainstem Klamath River have been altered compared to historical unimpaired conditions. The high stress rank for juveniles and smolts is due to the altered flow regime in the mainstem and human-induced seasonal low flows in many Middle Klamath tributaries. The altered hydrology in the mainstem has led to decreased water quality and reductions in thermal refugia due to lack of access to tributaries and other suitable rearing habitat. Alteration of the natural hydrograph is primarily due to diversions and water withdrawals in the Upper Klamath Basin and in upstream tributaries, as well as the managed flow from Iron Gate Dam. Although the impacts of the agricultural projects and hydropower decrease with distance downstream from Iron Gate Dam, adverse effects can be detected in the Middle Klamath mainstem hydrograph. Generally, spring and summer flows are lower than historically unimpaired flows, and tend to peak approximately a month earlier, subsiding to summer baseflow approximately two months earlier during most years. As a result, important life history strategies/traits (e.g., smolt outmigration timing, spring juvenile/fry redistribution) have now been either modified or lost entirely due to the hydrologic shift. The earlier onset of low baseflows also precipitates poor water conditions that now coincide with a greater proportion of the smolt outmigration through the mainstem reach.

Many of the flow impairments in tributary streams are due to the diversion of water for private and municipal use. Diversions cause some tributaries to go subsurface intermittently during the summer and may eliminate or reduce thermal refugia in tributaries or tributary outlets at other times of the year. Also detrimental are the high sediment loads that have caused some reaches to flow subsurface intermittently during the summer. Refugia and off-channel rearing habitat are often cut off from mainstem and tributary streams during low flow conditions in the summer. Summer water diversions can contribute to degraded habitat and/or fish passage issues in tributaries including Indian, Stanshaw, Red Cap, Boise, Camp, Cade, Elk Creek, and Fort Goff creeks during low water years (MKWC 2006).

Impaired Estuary/Mainstem Function

All anadromous fish natal to Middle Klamath River tributaries must migrate through the Lower Klamath River and estuary to complete its life cycle. The Klamath River estuary plays an important role in providing holding habitat, foraging and refuge opportunities for juvenile coho salmon and smolts from the Middle Klamath. Although the estuary is short and small compared to the large size of the watershed, it does provide complex habitat as well as rearing opportunities for juvenile coho salmon. The degraded conditions that exist throughout the Klamath Basin today may mean that the estuary must play an even greater role for all Klamath populations by providing rare opportunities for juvenile and smolt growth and refugia prior to entering the ocean. The Klamath River estuary suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain (Hiner 2006). Additionally, diking and development on the floodplain along the

Lower Klamath has led to the loss and degradation of riparian vegetation and side channel habitat in the estuary. More information about the Klamath River estuary can be found in the Lower Klamath River population profile.

Disease, limited access to and availability of thermal refugia and off-channel habitat, and lack of connectivity between tributaries and the mainstem are all issues that impact the quality of migratory and rearing habitat downstream of the Middle Klamath. Juveniles, smolts, and adults transitioning through estuarine and mainstem habitats are stressed by the degraded conditions in these migratory habitats and suffer from the lost opportunity for increased growth, and consequently, may have a lower survival rate. The loss and degradation of estuarine and mainstem habitat is considered a moderate to high stress for the population, with the most affected life stages being juveniles and smolts due to the degradation of rearing and juvenile migratory habitat.

Adverse Hatchery-Related Effects

No hatcheries or artificial propagation occur in the Middle Klamath population area, but there are two hatcheries in the Klamath River Basin. Iron Gate Hatchery is upstream on the Klamath River, and Trinity River Hatchery is on the Trinity River, which flows into the Klamath River near the Middle Klamath population area. The proportion of spawning adults of hatchery origin in the Middle Klamath River is unknown. Adverse hatchery-related effects pose a medium risk to all life stages, due to the presence of Iron Gate Hatchery and Trinity River Hatchery in the Klamath Basin.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions pose a medium stress for all life stages. Aerial photos show that while there are areas of disturbance, the majority of riparian areas surrounding tributaries and high quality refugia contain abundant riparian vegetation and have adequate structure and diversity. The medium rating is due to areas of degraded riparian condition resulting from high severity fires, mining, major floods (such as the 1964 flood), and past timber harvests. These disturbances create localized, short term reductions in riparian vegetation that can have major impacts depending on the degree and extent of coho salmon use of the area. Many riparian areas along the Middle Klamath remain partially barren as a result of historic placer and hydraulic mining activities, as well as lower hillslope road construction. Mining and roads have had a prolonged impact on geologic stability, soil, nutrients, cover, temperature, and riparian plant and animal communities. These barren areas are still apparent in the landscape today. Areas such as Elk Creek, where wildfire has recently denuded riparian vegetation, will experience higher water temperatures and higher sediment loads over the short term, but will slowly recover their riparian function in the long term.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

33.6 Threats

Table 33-3. Severity of threats affecting each life stage of coho salmon in the Middle Klamath. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	High Severity Fire[1]	High	High	High[1]	High	High	High
2	Dams/Diversions[1]	Low	Medium	High[1]	High	Medium	High
3	Climate Change	Medium	Medium	High	High	Medium	High
4	Roads	Medium	Medium	High	Medium	Medium	Medium
5	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
6	Road-Stream Crossing Barriers	-	Low	Medium	Medium	Medium	Medium
7	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
8	Fishing and Collecting	-	-	Low	Low	Low	Low
9	Channelization/Diking	Low	Low	Low	Low	Low	Low
10	Agricultural Practices	Low	Low	Low	Low	Low	Low
11	Timber Harvest	Low	Low	Low	Low	Low	Low
12	Invasive Non-Native/Alien Species	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.
[2] Urban/Residential/Industrial Development is not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are high severity fire and dams/diversions.

High Severity Fire

High severity fire is a high threat to all life stages in the Middle Klamath. Because of past timber harvest practices and fire-suppression efforts, understory forest fuel loads have become excessive. High severity fires result from excessive forest fuel loads and are seen regularly throughout the area (e.g., Dillon, Pony, Swillup, Stanza, Titus, and Panther creeks). Large, high severity fires can cause chronic sediment transport from upslope sources to stream channels, particularly when coupled with salvage and other timber harvest activities. Landscapes scorched by severe fire loosen soil integrity as plant and tree roots degrade, triggering landslides that introduce large quantities of sediment into creeks and rivers. Areas that are prone to future fire events (based on fuel loading) include important coho salmon habitat in Red Cap, Boise, Bluff, Slate, Camp, Indian, Elk, Goff, Portuguese, Clear, Dillon, and Thompson creeks.

Dams/Diversions

Dam construction on the mainstem Klamath River has contributed to the degraded instream and floodplain conditions and unnatural sediment loads in the watershed. PacifiCorp's HCP for the operations of the Klamath hydroelectric project includes measures to augment gravel and LWD to enhance habitat conditions below Iron Gate Dam (NMFS 2012, PacifiCorp 2012). Dams and diversions are a high threat to juveniles and smolts, and a medium threat to fry and adults. The threat from dams and diversions primarily stems from agricultural diversions in the Upper Basin and from Middle Klamath tributaries, as well as the influence of upstream dams on mainstem habitat, water quality, fish passage, tributary access, and refugia. Water diversions from tributaries are largely undocumented and are expected to continue to degrade habitat and refugia. Within the Middle Klamath River, there are approximately 170 documented diversions (CalFish 2009). Diversion of water from tributaries diminishes summer base flows, decreases the potential for summer rearing, limits access to thermal refugia, and exacerbates water quality issues. Unscreened, undocumented diversions throughout the Middle Klamath River likely act as fish passage barriers, preventing migration of juveniles.

Marijuana cultivation has become common in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the water diversion required to support these plants places a high demand on a limited supply of water (Bauer 2013). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Upstream dams, including Iron Gate, Copco 2 and 1, JC Boyle, and Keno dams, contribute to the water quality and hydrology issues in the Middle Klamath River. These water quality issues facilitate increased infection rates and disease occurrence, and are reflected in low dissolved oxygen levels, altered water temperature regimes, and increased nutrient levels. The operation of these dams affects the hydrologic regime by altering the timing and magnitude of peak flows (when the reservoirs are not at full capacity), as well as curtailing downstream transport of upstream sediment sources. Fish passage or dam removal above Iron Gate Dam is expected to occur in the next 10 years as part of the Klamath Hydroelectric Settlement Agreement, which will reduce the threat posed by the hydroelectric project over the long term. In the interim, efforts will be made to avoid, minimize, or mitigate the impacts from the dams through the PacifiCorp HCP.

Upstream diversions by the Klamath Project in the Upper Klamath River Basin and in the Scott and Shasta rivers decrease flows required to maintain adequate water temperatures in the mainstem Klamath River, and increase the occurrence and severity of alluvial barriers at many tributary mouths. Upstream dams and diversions adversely affects all life stages of coho salmon through their impacts on habitat quality and availability, water quality and quantity, altered sediment supply and transport, and disease/infection rates.

Climate Change

Climate change has emerged as a high threat to coho salmon in the Middle Klamath River due to predicted changes in fire regimes, snow pack, ambient temperatures, and precipitation. Climate change in this region will likely have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm, and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for modeling methods). Average ambient temperature could increase by up to 3 ^{o}C in the summer and by 1 ^{o}C in the winter, while annual precipitation in this area is predicted to trend downward over the next century. Additionally, snowpack in upper elevations of the Klamath Basin is predicted to decrease in response to changes in temperature and precipitation (California Natural Resources Agency 2009). Rearing and migratory habitat are most at risk to climate change. Increasing water temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008). Overall, the range and degree of variability in ambient temperature and precipitation are likely to increase in this population, creating long term threats to the persistence of coho salmon in this area.

Roads

Historic timber harvest, road building, and wildfires in the Middle Klamath River have contributed to degraded instream and floodplain conditions and unnatural sediment loads in the watershed. Roads are a high threat to juveniles and a medium threat to eggs, fry, smolts and adults. Road density is high (≥2.5 to 3 mi/sq. mi) or very high (>3 mi/sq. mi) throughout half of the watershed, including areas where limited high IP reaches and high quality refugia areas are located. The majority of these roads are located on U.S. Forest Service land and are being prioritized for treatment and treated as resources allow through upgrading, storm-proofing, and decommissioning). The Klamath and Six Rivers National Forests have developed a Forest Road Analysis and a Motorized Travel Management Plan, which prioritizes road work that will result in benefits to natural resources. Since 1995, approximately 18.5 percent of Forest roads have been decommissioned and 11.5 percent upgraded within key anadromous fisheries' watersheds on the Orleans Ranger District of the Six Rivers National Forest within the Middle Klamath (Cyr 2011). However, because road decommissioning and road improvements are costly, many high priority roads still remain untreated. Currently, the areas with the greatest remaining road densities and greatest risk for slope failure include the China, Cade, Dillon, Rock, Reynolds, and Slate Creek watersheds. The high density of roads is expected to continue to contribute to sedimentation in the Middle Klamath River over the next several decades. Excessive sedimentation leads to simplification of streams, embeds spawning gravel, decreases pool depth for rearing juveniles and reduces channel stability. Such habitat changes hinder successful spawning and emergence, limit access to rearing habitats, increase competition and predation, and affect macro-invertebrate densities.

Hatcheries

Hatcheries pose a medium threat to other life stages in the Middle Klamath River Basin. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Road-stream Crossing Barriers

Road-related barriers pose a medium threat and primarily affect juveniles, smolts, and adults in this population and juveniles and smolts from upstream populations that utilize rearing and refugia habitat in the Middle Klamath. Over the past decade, the Klamath and Six Rivers National Forests have removed most of the critical anadromous fish passage barriers on Forest Service roads. However, there are still a number of passage problems associated with Highway 96 (Table 33-4). Road-stream crossings are important because they block access to tributary habitat and refugia, and because they may impact the hydrologic function of tributaries and lead to increased road failures. Some of the remaining road-stream crossing barriers have been prioritized for removal (Fort Goff Creek) and the remaining barriers are being evaluated for removal.

Table 33-4. List of important road-stream crossing barriers in the Middle Klamath River area.

Barrier Treatment Ranking	Stream Name	Road Name	USFS District	County	Miles of upstream habitat*
2	Portuguese Creek	Hwy 96	Happy Camp	Siskiyou	0.4
2	Fort Goff Creek	Hwy 96	Happy Camp	Siskiyou	0.9
2	Cade Creek	Hwy 96	Happy Camp	Siskiyou	0.5
2	Negro Creek	Private	Happy Camp	Siskiyou	unknown
1	Crawford Creek	Hwy 96	Orleans	Humboldt	0.6
1	Stanshaw Creek	Hwy 96	Orleans	Siskiyou	0.2
1	Sandy Bar Creek	Hwy 96	Orleans	Siskiyou	0.4

*Miles of habitat and ranking is estimated by the Mid Klamath Restoration Partnership (2010). Ranking is on a scale from 0 to 3 with 3 being the highest priority for removal.

Mining/Gravel Extraction

Suction dredging mostly affects juveniles and has a number of detrimental effects. Degradation of the channel bed can deplete the entire depth of gravel, exposing other substrates that may underlie the gravel, which would reduce the amount of usable anadromous spawning habitat (Collins and Dunne 1990, Kondolf, 1994, Oregon Water Resources Research Institute 1995). Gravel removal not only impacts the extraction site, but may reduce gravel delivery to downstream spawning areas (Pauley et al. 1989). Other adverse effects of mining include increasing turbidity, modifying spawning channels, decreasing emergent macro-invertebrate prey, and disturbing and displacing juveniles and smolts from refugia. Past mining activities have also left heavy metal contamination (i.e., mercury, copper, arsenic, etc.) at sites on Indian and Copper creeks (a tributary of Dillon Creek). The California Department of Fish and Wildlife is currently prohibited by statute from issuing suction dredge permits, making it unlawful to use any vacuum or suction dredge equipment in any river, stream, or lake in California (see http://www.dfg.ca.gov/suctiondredge).

The Forest Service recently capped the mill tailings with fill at the Siskon Mine superfund site, and plans are underway to revegetate the mill tailing pond and mill site area, and stormproof and stabilize the mine road. No details of the Luther Gulch superfund site near Indian Creek are available. Overall, mining and gravel extraction is considered a low threat for coho salmon in the Middle Klamath River.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Channelization/Diking

Channelization and diking is not a major threat in the Middle Klamath River coho salmon population. There is little residential and agricultural development in the Middle Klamath, and therefore only small-scale channelization and diking of tributaries, except for Indian Creek.

Agricultural Practices

Because of the small number of existing ranches and farms in this watershed, agricultural practices are a low threat to this population and are not thought to cause significant decreases in water quality, are not significantly altering streambanks or floodplains, and are not decreasing riparian habitat in the Middle Klamath sub-basin. However, effects from water withdrawals are seen in these areas, and act cumulatively with withdrawals occurring upstream. These water withdrawals are considered in the threat ranking for Dams/Diversions. Grazing occurs in the Marble Mountain Wilderness and in the Upper Bluff Creek watershed, but, the extent of grazing impacts to these watersheds is not significant. Upstream agricultural practices in the Upper Basin and the Scott and Shasta valleys are affecting water quality and flow volumes in the Middle Klamath River mainstem (See appropriate profiles for more information). In particular, upstream agricultural practices may be contributing to extended summer low flow conditions, reduction in available rearing habitats, and overall increased stress to juveniles.

Timber Harvest

Timber harvest is not a threat to coho salmon in this area due to the protective measures in place on National Forest timberlands. Timber harvesting has been low throughout this watershed the past few decades, and is not expected to increase in the near future. Under current management practices and the financial, administrative and legal restrictions on timber harvest, the USFS is unlikely to implement large timber sales. Additionally, timber practices are governed by the rigorous protective measures for water quality required under the Northwest Forest Plan.

Invasive Non-Native/Alien Species

The presence and abundance of invasive non-native/alien fish species have increased in the Klamath River since the mid-20th century. Some of these introduced fish species are: American shad (*Alosa sapidissima*), golden shiner (*Notemigonus crysoleucas*), brown bullhead (*Ameirus nebulosus*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), brook stickleback (*Culaea inconstans*), black crappie (*Pomoxis nigromaculatus*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), catfish (*Ictalurus sp.*), spotted bass (*Micropterus punctulatus*), yellow perch (*Perca flavescens*), and wakasagi (*Hypomesus nipponensis*) (Mount and Moyle 2003, Israel 2003). These exotic fish have changed the ecology of the Klamath River, creating an additional "unknown" threat to coho salmon. These species are hardy and tend to adapt well to warm Klamath River summer water temperatures. Adverse interactions between these exotic fish species and coho salmon are poorly understood, but may include: competition for food and/or space, habitat interference, disease and parasites introduction, and predation of coho salmon.

33.7 Recovery Strategy

The potential for coho salmon recovery in the Middle Klamath is very high. However, the population abundance is currently depressed and habitat is degraded in many areas. The quality of summer and winter rearing habitat is poor in many areas, and this habitat type is limited in its extent and connectivity. Mainstem conditions during the summer prohibit migration and rearing. Recovery activities in the watershed should focus on improving water quality and increasing floodplain and channel structure for juveniles. Restoration should also include the ongoing long term reduction in sediment through road decommissioning where necessary, timber harvest management, and reduction in high severity fire risks through fuels reduction on private and public lands.

The removal of four mainstem dams in the Upper Klamath River as provided in the Klamath Hydroelectric Settlement Agreement will be important to the improvement of hydrologic function, water quality, and disease conditions in the mainstem Klamath River. The immediate restoration and maintenance of tributary water quality, hydrologic function, and floodplain and channel structure for spawning and rearing will help increase productivity, abundance, and distribution of the population. Recovery actions should focus on protecting and restoring those tributaries that have been identified as being important to natal and non-natal coho salmon. Specific goals for restoration are listed below and in the table of recovery actions that follows.

The highest potential for restoring summer migratory and rearing habitat is in the mainstem Middle Klamath River and in Boise, Slate, Elk, and Indian creeks (Mid Klamath Restoration Partnership 2010). Reducing stream temperatures, maintaining and improving thermal refugia, improving hydrologic function, and removing barriers will all help to increase the opportunity and capacity for summer rearing and migration in the Middle Klamath River. These actions will benefit both the natal population as well as the other populations in the Klamath River basin.

The highest potential for restoring winter rearing habitat is in the mainstem Klamath River and in Elk and Indian creeks (Mid Klamath Restoration Partnership 2010). Improving channel and floodplain complexity and connectivity and reducing sediment supply to tributaries will help to increase the opportunity and capacity for winter rearing. These actions will benefit both the natal population as well as the other Klamath populations in the stratum.

Table 33-5 on the following page lists the recovery actions for the Middle Klamath River population.

Table 33-5. Recovery action implementation schedule for the Middle Klamath River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MKR.10.3.1	Water Quality	Yes	Protect cold water	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	1
SONCC-MKR.10.3.1.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MKR.10.3.1.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MKR.2.2.4	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	All areas that will immediately benefit coho salmon	1
SONCC-MKR.2.2.4.1	*Assess instream flow conditions and side channel connectivity and develop a plan to obtain adequate flows for channel connectivity*					
SONCC-MKR.2.2.4.2	*Mechanically alter side channels, off channel ponds and wetlands to achieve connectivity*					
SONCC-MKR.1.2.43	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary, including tributaries and off-channel habitats in or near estuary	1
SONCC-MKR.1.2.43.1	*Implement recovery actions for Lower Klamath River population that address the target "Estuary", including the creation/restoration of off-channel rearing habitat throughout the lower Klamath River*					
SONCC-MKR.2.1.6	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All areas that will immediately benefit coho salmon	2c
SONCC-MKR.2.1.6.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MKR.2.1.6.2	*Place instream structures, guided by assessment results*					
SONCC-MKR.2.1.64	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-MKR.2.1.64.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MKR.2.1.64.2	*Place instream structures, guided by assessment results*					
SONCC-MKR.10.3.10	Water Quality	Yes	Protect cold water	Protect existing or potential cold water refugia	All areas that will immediately benefit coho salmon	2c
SONCC-MKR.10.3.10.1	*Develop emergency plan and implement measures to protect thermal refugia during warm periods*					
SONCC-MKR.10.3.10.2	*Develop program that identifies, designs, and constructs projects that reduce warm tailwater input*					
SONCC-MKR.10.3.10.3	*Implement tailwater reduction program*					
SONCC-MKR.10.3.10.4	*Protect cold water refugia through water conservation efforts (e.g. California Water Code Section 1707, storage, forbearance, etc.)*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MKR.10.3.61	Water Quality	Yes	Protect cold water	Protect existing or potential cold water refugia	Population wide	2d
SONCC-MKR.10.3.61.1	*Develop emergency plan and implement measures to protect thermal refugia during warm periods*					
SONCC-MKR.10.3.61.2	*Develop program that identifies, designs, and constructs projects that reduce warm tailwater input*					
SONCC-MKR.10.3.61.3	*Implement tailwater reduction program*					
SONCC-MKR.10.3.61.4	*Protect cold water refugia through water conservation efforts (e.g. California Water Code Section 1707, storage, forbearance, etc.)*					
SONCC-MKR.2.2.5	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Leveed streams that will immediately benefit coho salmon (e.g. Indian Creek, etc.)	2c
SONCC-MKR.2.2.5.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-MKR.2.2.5.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-MKR.10.2.13	Water Quality	Yes	Reduce pollutants	Remove pollutants	Luther and Baker gulches, Deer Lick Creek in Indian Creek watershed, Copper Creek in Dillon Creek watershed, and other areas that will benefit coho salmon immediately	2c
SONCC-MKR.10.2.13.1	*Assess contamination from tailing piles and develop mining activities remediation plan*					
SONCC-MKR.10.2.13.2	*Take necessary actions to ensure responsible parties remediate mine tailing piles, guided by the plan*					
SONCC-MKR.10.2.60	Water Quality	Yes	Reduce pollutants	Remove pollutants	Population wide	2d
SONCC-MKR.10.2.60.1	*Assess contamination from tailing piles and develop mining activities remediation plan*					
SONCC-MKR.10.2.60.2	*Take necessary actions to ensure responsible parties remediate mine tailing piles, guided by the plan*					
SONCC-MKR.5.1.22	Passage	No	Improve access	Reduce sediment barriers	All areas that will immediately benefit coho salmon	2c
SONCC-MKR.5.1.22.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-MKR.5.1.22.2	*Construct low flow channels, and reduce stream gradient to provide fish passage over alluvial deposits for all life stages*					
SONCC-MKR.5.1.69	Passage	No	Improve access	Reduce sediment barriers	Population wide	2d
SONCC-MKR.5.1.69.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-MKR.5.1.69.2	*Construct low flow channels, and reduce stream gradient to provide fish passage over alluvial deposits for all life stages*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MKR.3.1.15	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon will benefit immediately	2c
SONCC-MKR.3.1.15.1	*Assess diversion impact and develop a program to increase flow during low flow periods*					
SONCC-MKR.3.1.15.2	*Increase flows during low flow periods, as described in the program*					
SONCC-MKR.3.1.56	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2c
SONCC-MKR.3.1.56.1	*Identify and cease unauthorized water diversions*					
SONCC-MKR.3.1.58	Hydrology	No	Improve flow timing or volume	Increase instream flows	All areas that will immediately benefit coho salmon	2c
SONCC-MKR.3.1.58.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-MKR.3.1.58.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-MKR.3.1.66	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-MKR.3.1.66.1	*Assess diversion impact and develop a program to increase flow during low flow periods*					
SONCC-MKR.3.1.66.2	*Increase flows during low flow periods, as described in the program*					
SONCC-MKR.3.1.68	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-MKR.3.1.68.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-MKR.3.1.68.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-MKR.10.3.24	Water Quality	No	Protect cold water	Remove structural barriers	All areas that will immediately benefit coho salmon	2c
SONCC-MKR.10.3.24.1	*Assess barriers and prioritize for removal*					
SONCC-MKR.10.3.24.2	*Remove barriers, based on evaluation*					
SONCC-MKR.10.3.62	Water Quality	No	Protect cold water	Remove structural barriers	Population wide	2d
SONCC-MKR.10.3.62.1	*Assess barriers and prioritize for removal*					
SONCC-MKR.10.3.62.2	*Remove barriers, based on evaluation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MKR.7.1.8	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	2d
SONCC-MKR.7.1.8.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MKR.7.1.8.2	*Thin, or release conifers, guided by the plan*					
SONCC-MKR.7.1.8.3	*Plant conifers, guided by the plan*					
SONCC-MKR.7.1.9	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce fire hazard	Population wide	2d
SONCC-MKR.7.1.9.1	*Develop fire hazard reduction educational materials for landowners*					
SONCC-MKR.7.1.9.2	*Develop a plan for fire break stewardship and defensible space*					
SONCC-MKR.7.1.9.3	*Implement fire-safe community action plans in identified areas*					
SONCC-MKR.7.1.9.4	*Reduce stand densities through prescribed burning and thinning to reduce high severity fire*					
SONCC-MKR.26.1.57	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2d
SONCC-MKR.26.1.57.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-MKR.10.3.12	Water Quality	Yes	Protect cold water	Improve regulatory mechanisms	Population wide	3c
SONCC-MKR.10.3.12.1	*Develop regulatory mechanisms that protect critical cold water refugia*					
SONCC-MKR.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	All areas that will immediately benefit coho salmon	3c
SONCC-MKR.2.2.2.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-MKR.2.2.2.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-MKR.2.2.2.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-MKR.2.2.65	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	3d
SONCC-MKR.2.2.65.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-MKR.2.2.65.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-MKR.2.2.65.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MKR.5.2.27	Passage	No	Decrease mortality	Screen all diversions	All areas that will immediately benefit coho salmon	3c
SONCC-MKR.5.2.27.1		*Assess diversions and develop a screening program*				
SONCC-MKR.5.2.27.2		*Screen all diversions*				
SONCC-MKR.5.2.72	Passage	No	Decrease mortality	Screen all diversions	Population wide	3d
SONCC-MKR.5.2.72.1		*Assess diversions and develop a screening program*				
SONCC-MKR.5.2.72.2		*Screen all diversions*				
SONCC-MKR.5.1.26	Passage	No	Improve access	Reduce flow barrier	All areas that will immediately benefit coho salmon	3c
SONCC-MKR.5.1.26.1		*Identify areas where fish stranding occurs and develop a plan to create low flow channels, concentrate existing flows, and prevent stranding*				
SONCC-MKR.5.1.26.2		*Implement plan to prevent stranding*				
SONCC-MKR.5.1.71	Passage	No	Improve access	Reduce flow barrier	Population wide	3d
SONCC-MKR.5.1.71.1		*Identify areas where fish stranding occurs and develop a plan to create low flow channels, concentrate existing flows, and prevent stranding*				
SONCC-MKR.5.1.71.2		*Implement plan to prevent stranding*				
SONCC-MKR.5.1.23	Passage	No	Improve access	Remove barriers	All areas that will immediately benefit coho salmon	3c
SONCC-MKR.5.1.23.1		*Develop breaching and dam removal program to address man-made rock dams*				
SONCC-MKR.5.1.23.2		*Breach or remove man-made rock dams*				
SONCC-MKR.5.1.70	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-MKR.5.1.70.1		*Develop breaching and dam removal program to address man-made rock dams*				
SONCC-MKR.5.1.70.2		*Breach or remove man-made rock dams*				
SONCC-MKR.3.1.45	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	3c
SONCC-MKR.3.1.45.1		*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*				
SONCC-MKR.3.1.45.2		*If needed, develop plan to reduce effects of marijuana cultivation*				
SONCC-MKR.3.1.45.3		*Implement plan*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MKR.3.1.17	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	All areas that will immediately benefit coho salmon	3c
SONCC-MKR.3.1.17.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-MKR.3.1.17.2	*Implement water dedications to increase instream flows using the streamlined process*					
SONCC-MKR.3.1.59	Hydrology	No	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	3c
SONCC-MKR.3.1.59.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-MKR.3.1.59.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-MKR.3.1.59.3	*Implement coho salmon instream flow needs plan.*					
SONCC-MKR.8.1.20	Sediment	No	Reduce delivery of sediment to streams	Minimize surface erosion and mass wasting	All areas that will immediately benefit coho salmon	3c
SONCC-MKR.8.1.20.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-MKR.8.1.20.2	*Implement plan to stabilize slopes and revegetate areas through planting and best management practices*					
SONCC-MKR.8.1.73	Sediment	No	Reduce delivery of sediment to streams	Minimize surface erosion and mass wasting	Population wide	3d
SONCC-MKR.8.1.73.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-MKR.8.1.73.2	*Implement plan to stabilize slopes and revegetate areas through planting and best management practices*					
SONCC-MKR.8.1.21	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas that will immediately benefit coho salmon	3c
SONCC-MKR.8.1.21.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MKR.8.1.21.2	*Decommission roads, guided by assessment*					
SONCC-MKR.8.1.21.3	*Upgrade roads, guided by assessment*					
SONCC-MKR.8.1.21.4	*Maintain roads, guided by assessment*					
SONCC-MKR.8.1.74	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MKR.8.1.74.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MKR.8.1.74.2	*Decommission roads, guided by assessment*					
SONCC-MKR.8.1.74.3	*Upgrade roads, guided by assessment*					
SONCC-MKR.8.1.74.4	*Maintain roads, guided by assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MKR.10.7.55	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All areas that will immediately benefit coho salmon	3c
SONCC-MKR.10.7.55.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MKR.10.7.55.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MKR.10.7.63	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MKR.10.7.63.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MKR.10.7.63.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MKR.3.1.18	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-MKR.3.1.18.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-MKR.3.1.19	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-MKR.3.1.19.1	*Establish a comprehensive groundwater permit process*					
SONCC-MKR.3.1.42	Hydrology	No	Improve flow timing or volume	Increase instream flows	All areas that will immediately benefit coho salmon	3d
SONCC-MKR.3.1.42.1	*Install flow gages to ensure appropriate flows*					
SONCC-MKR.3.1.42.2	*Maintain flow gages annually*					
SONCC-MKR.3.1.67	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-MKR.3.1.67.1	*Install flow gages to ensure appropriate flows*					
SONCC-MKR.3.1.67.2	*Maintain flow gages annually*					
SONCC-MKR.16.1.28	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MKR.16.1.28.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MKR.16.1.28.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MKR.16.1.53	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-MKR.16.1.53.1		*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*				
SONCC-MKR.16.1.53.2		*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*				
SONCC-MKR.16.1.29	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MKR.16.1.29.1		*Determine actual fishing impacts*				
SONCC-MKR.16.1.29.2		*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*				
SONCC-MKR.16.1.54	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-MKR.16.1.54.1		*Determine actual fishing impacts*				
SONCC-MKR.16.1.54.2		*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*				
SONCC-MKR.16.2.30	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MKR.16.2.30.1		*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*				
SONCC-MKR.16.2.30.2		*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*				
SONCC-MKR.16.2.31	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MKR.16.2.31.1		*Determine actual impacts of scientific collection*				
SONCC-MKR.16.2.31.2		*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MKR.10.3.11	Water Quality	Yes	Protect cold water	Educate stakeholders	Population wide	BR
SONCC-MKR.10.3.11.1	*Develop an educational program that teaches stakeholders to reduce channel encroachment, reduce usage of toxic chemicals, maintaining septic systems, water conservation, and landscaping with native species*					
SONCC-MKR.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	BR
SONCC-MKR.2.2.3.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-MKR.5.1.25	Passage	No	Improve access	Reduce flow barriers	Dillon Creek, and all areas that will immediately benefit coho salmon	BR
SONCC-MKR.5.1.25.1	*Assess low flow tributaries and their sediment sources that contribute to seasonal flow barriers. Develop a plan to alleviate sediment delivery and remove current barriers*					
SONCC-MKR.5.1.25.2	*Alleviate sediment delivery in areas with low flow conditions and seasonal flow barriers as described in the plan*					
SONCC-MKR.3.1.16	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-MKR.3.1.16.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-MKR.7.1.7	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	BR
SONCC-MKR.7.1.7.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-MKR.7.1.7.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-MKR.7.1.7.3	*Plant vegetation to stabilize stream bank*					
SONCC-MKR.7.1.7.4	*Fence livestock out of riparian zones*					
SONCC-MKR.7.1.7.5	*Remove instream livestock watering sources*					

34. Upper Klamath River Population

Interior Klamath Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

8,500 Spawners Required for ESU Viability

1,400 mi^2 watershed (47% Federal ownership)

425 IP-km (264 IP-mi) (49% High)

Dominant Land Uses are Timber Harvest, Grazing, and Rural Development

Key Limiting Stresses are 'Barriers' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Dams/Diversions' and 'Roads'

Highest Priority Recovery Actions

• Remove or provide passage at Iron Gate, Copco 1, Copco 2, and JC Boyle Dams • Reduce road-stream hydrologic connection • Reduce warm water inputs by reducing tailwater from irrigation	• Increase beaver abundance • Re-connect the channel to off-channel ponds, wetlands, and side channels • Improve flow timing and volume by increasing flows and restoring peak flows

34.1 History of Habitat and Land Use

Hydrologic and geomorphic alteration of the Upper Klamath River basin has been occurring for over 100 years. Current facilities and operations for irrigation and hydropower include 5 dams and hundreds of miles of canals and pumps which support significant water withdrawals, transfers, and diversions throughout the sub-basin. In 1905, the U.S. Bureau of Reclamation began developing the Klamath Project near Klamath Falls, Oregon. Starting around 1912, construction and operation of the numerous facilities associated with the Klamath Project significantly altered the natural hydrographs of the Upper and Lower Klamath River and continues today. Marshes were drained, dikes and levees were constructed (National Research Council 2008), water withdrawal and transfer infrastructure was developed and in 1922 the level of Upper Klamath Lake was raised. The Link River and Keno dams also support the current irrigation project. The Klamath Project now consists of an extensive system of canals, pumps, diversion structures, and dams capable of routing water to approximately 171,300 acres of irrigated farmlands in the Upper Klamath River sub-basin (Hicks 2013).

PacifiCorp operates the Klamath Hydroelectric Project, consisting of five mainstem dams between river mile (RM) 190 and 233. The construction of Copco 1 Dam (RM 199) in 1918 created the first hydroelectric structure blocking salmon migration into the Upper Klamath River sub-basin. The construction of the impassable Copco 2 Dam (1925) and Iron Gate Dam (1962) followed. The dams block approximately 76 miles of coho salmon habitat, interrupt the natural passage of flow and sediment, alter the natural hydrograph, and degrade Klamath River water quality (USDOI and CDFG 2012). PacifiCorp's license expired on March 1, 2006, and the hydroelectric project is currently operating on annual extensions granted by the Federal Energy Regulatory Committee (FERC).

Processes are underway to provide long-term fisheries and ecological restoration through fish passage prescriptions or dam removal and to provide interim conservation for coho salmon prior to these large-scale restoration actions.

Hecht and Kamman (1996) analyzed the hydrologic records for similar water years (pre- and post-Klamath Project construction) at several locations throughout the Klamath River basin and concluded that the timing of peak and base flows changed significantly after construction of the Klamath Project, and that water release operations below Klamath Hydroelectric Project dams unnaturally increases flows in October and November and decreases flows in the late spring and summer as measured at Keno, Seiad, and Klamath. The modeled dataset also clearly shows a decrease in the magnitude of peak flows, a two-month shift in timing of flow minimums from September to July, and a reduction in the amount of discharge in the summer months. Hecht and Kamman (1996) also noted that water diversions in areas outside the Klamath Project boundaries occur as well and likely further influence the hydrology in these areas. NMFS and USFWS (2013) recently analyzed the effects of the Klamath Project on the Upper Klamath coho salmon population and found impacts to water quality, hydrologic function, habitat quality, habitat availability, and disease. In addition to the Klamath Project, agricultural diversions in both the Shasta and Scott rivers, especially during dry water years, can dewater sections of these rivers, impacting coho salmon in these streams as well as those in the Klamath River (Moyle 2002).

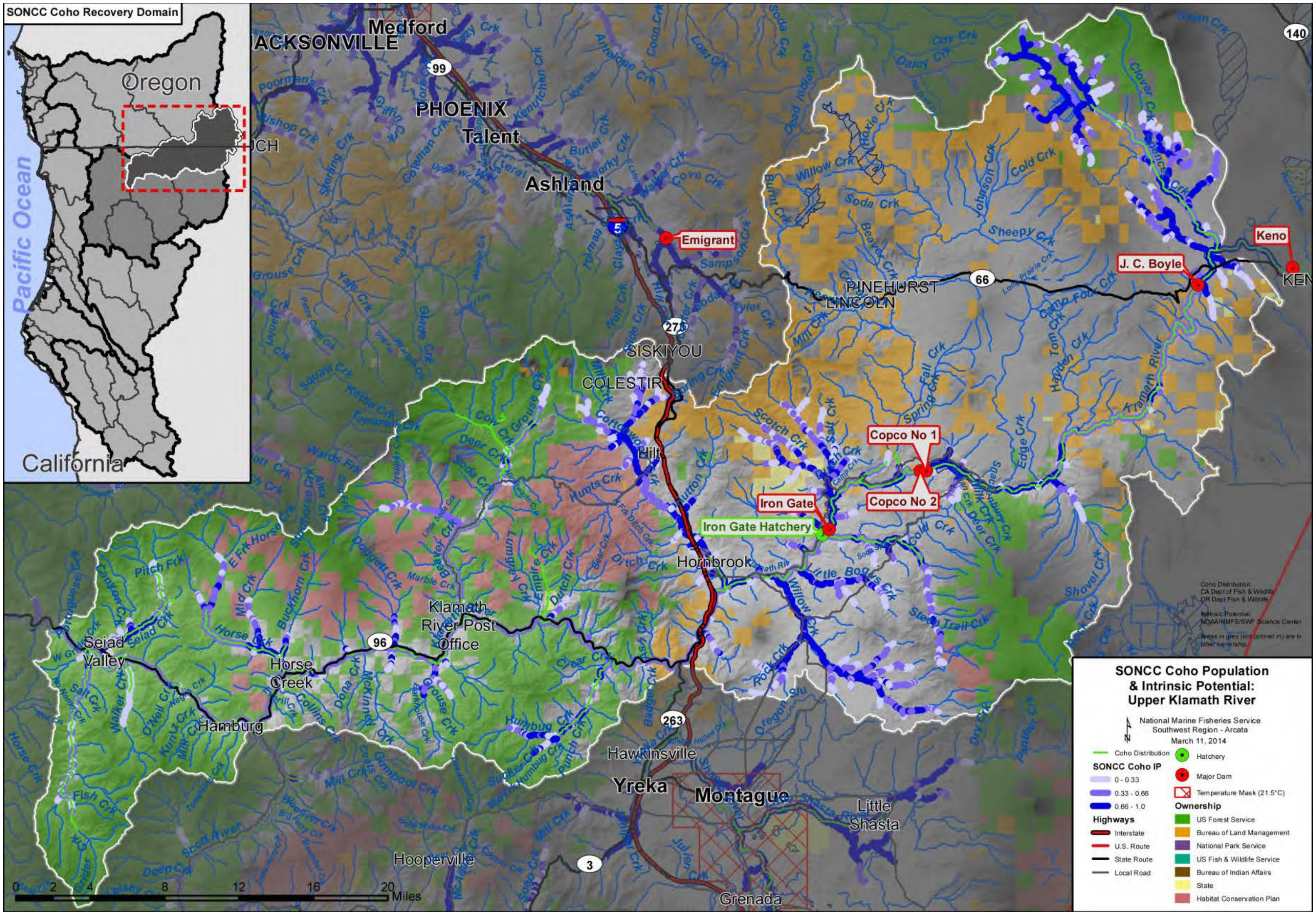

Figure 34-1. The geographic boundaries of the Upper Klamath River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Klamath River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

Furthermore, the U.S. Bureau of Reclamation's operation of the Rogue River basin project annually diverts an average of about 24,000 acre-feet of water from the Klamath River basin (Jenny Creek) to the Rogue River basin (U.S. Bureau of Reclamation 2009b), further impacting the hydrology in the Klamath River basin.

Timber production has historically been the dominant land use below Iron Gate Dam. Almost all of the Seiad Valley hydrologic subarea is managed by the Klamath National Forest and approximately half of the Beaver Creek hydrologic subarea is part of the Klamath National Forest, with the other half composed largely of private timber company holdings. The Klamath National Forest was among the largest timber-producing national forests in California from the 1950s until the advent of the Northwest Forest Plan and Aquatic Conservation Strategy in 1994.

Since that time, Klamath National Forest lands have continued to recover from high road densities and concomitant environmental impacts, namely high watershed erosion rates and compromised fish passage at road/stream crossings. In recent years, the Klamath National Forest has aggressively addressed fish passage issues on many of their roads, and aquatic conservation policies mandated under the 1994 Northwest Forest Plan have reduced timber harvest in sensitive areas and generally improved aquatic function in many Klamath River tributaries. Also, recently in watersheds under private ownership, habitat conservation plans (HCPs) are in place to minimize and mitigate timber harvest effects on listed SONCC coho salmon and its habitat (i.e., Fruit Growers HCP). The Hornbrook, Iron Gate and Copco hydrologic subareas lie outside the national forest boundaries, but share a legacy of human-caused disturbance centered on effects from the Klamath Hydroelectric Project dams and degraded riparian forests.

34.2 Historic Fish Distribution and Abundance

Historically, coho salmon are thought to have inhabited all accessible stream reaches within the Upper Klamath population unit up to, and including, Spencer Creek (Hamilton et al. 2005, Williams et al. 2006). The current upstream limit for Klamath River salmon is Iron Gate Dam at river mile 190. Based on the IP model, coho salmon likely occupied much of the area upstream of the Iron Gate Dam and occupied numerous large tributaries. Areas with the highest IP and therefore the likeliest places for historic coho salmon production are listed in Table 34-1.

Table 34-1. Tributaries with high IP reaches (IP > 0.66). Williams et al. (2006)

Subarea[1]	Stream Name	Subarea[1]	Stream Name
Seiad Valley	Seiad Creek	**Iron Gate**	Bogus Creek
	Horse Creek	**Copco**	Scotch Creek
Beaver Creek	Barkhouse Creek		Jenny Creek
	Humbug Creek		Spencer Creek
Hornbrook	Cottonwood Creek	**Hornbrook**	Little Bogus Creek
	Willow Creek		

[1]Subarea refers to hydrologic subarea (HSA) in the CALWATER classification system.

Little information exists to provide insight on the historical abundance of coho salmon within the Upper Klamath River sub-basin. Population estimates mostly arose from fishing and canning records within the Lower Klamath River and estuary, and reach-specific estimates for upstream sections of the river do not exist. Snyder (1931) reported the first commercial gill net catch of 11,162 coho salmon in the lower reaches of the Klamath River in 1919 and was the first author to report a concern for declining salmon populations in California, due to commercial fishing, forestry and agricultural practices. Long-term monitoring data suggests a marked decrease in abundance of adult coho salmon by the 1950s, which likely resulted from over-harvest and habitat loss (Klamath River Basin Fisheries Task Force 1991, Weitkamp et al. 1995, California Department of Fish and Game [CDFG] 2004b). By 1983, the annual escapement abundance of Klamath River basin adult coho salmon was estimated to range from 15,000 to 20,000 fish (Leidy and Leidy 1984). These estimates, which include hatchery stocks, could be less than six percent of the abundance in the 1940s (Weitkamp et al. 1995, CDFG 2004b). Ackerman et al. (2006) developed a run size approximation for tributaries in the Upper Klamath using reports from the USFWS and making the assumption that approximately 100 fish spawn in the mainstem. The total estimated returns for the population from 2001 to 2004 were between 600 to 4,000 fish, and returns to and strays from Iron Gate Hatchery make up a substantial portion of the overall population abundance (Ackerman et al. 2006).

34.3 Status of Upper Klamath River Coho Salmon

Spatial Structure and Diversity

The Upper Klamath River population is currently comprised of approximately 64 miles of mainstem habitat and numerous tributaries to the mainstem Klamath River upstream of Portuguese Creek to Iron Gate Dam. Historically, the population extended upstream of Iron Gate Dam to Spencer Creek. The PacifiCorp Hydroelectric Project, of which Iron Gate Dam is the lowest of four mainstem dams, blocks access to approximately 76 miles of spawning, rearing and migratory habitat for SONCC coho salmon (USDOI and CDFG 2012). As a result, coho salmon within the Upper Klamath River population spawn and rear primarily within several of the larger tributaries between Portuguese Creek and Iron Gate Dam, namely Bogus, Horse, Beaver, and Seiad creeks. Since 1965, local ranchers have constructed fish ladders enabling coho salmon to successfully spawn and rear in an additional six miles of habitat in upper Bogus Creek and adjacent Cold Creek. This work has been complemented by voluntary cattle exclusion riparian fence construction, riparian planting, irrigation pipe installation, cold water instream flow enhancement, and tailwater recovery along upper Bogus Creek (Hampton 2009). A small proportion of the population spawns within the mainstem channel, primarily within the section of the river several miles below Iron Gate Dam. Coho salmon parr and smolts rear within the mainstem Klamath River by using thermal refugia near tributary confluences to survive the high water temperatures and poor water quality common to the Klamath River during summer months.

Many of the streams comprising the Upper Klamath population unit are small and may go dry near their confluence with the mainstem Klamath River. Yet these intermittent tributaries sometimes remain important rearing habitat for coho salmon, when and where sufficient instream flows, water temperature, and habitat conditions are suitable to sustain them. Coho salmon have adapted life history strategies (spatial and temporal) to use intermittent streams. For example, adult coho salmon will often stage within the mainstem Klamath River at the mouth of natal streams until hydrologic conditions allow them to migrate into tributaries, where they are able to find more suitable spawning conditions, and juveniles can find adequate rearing conditions and cover. In summer when the lower sections of these tributaries may go dry, the shaded, forested sections upstream provide cold water over-summering rearing habitat for juvenile coho salmon. By early spring, when outmigration of yearling coho salmon primarily occurs, base flows of these small streams are relatively high and full connectivity to the mainstem Klamath River exists.

Surveys by California Department of Fish and Wildlife (formerly CDFG) between 1979 to 1999 and 2000 to 2004 showed coho salmon moderately well distributed downstream of Iron Gate Dam. Juveniles were found in 25of the 48 surveyed tributary streams, with sustained presence in Portuguese, Seiad, Grider, Beaver, Little Bogus, and Bogus creeks (Garwood 2012). Streams with coho salmon presence in both 1979 to 1999 and 2000 to 2004 included Grider, Seiad, Horse, Walker, Beaver, W. Fork Beaver, Cottonwood, Bogus, Little Bogus, and Dry creeks. The Karuk Tribe (2009) conducted juvenile surveys between 2002 and 2005, and found coho salmon using Tom Martin, Walker, Seiad, Grider, Beaver, Humbug, O'Neil, and Horse creeks. No juvenile coho salmon were found in Lumgrey, Willow, Bittenbender, Barkhouse, Empire, Cottonwood, Bogus, and Kuntz Creeks during these surveys. In Bogus Creek, adult coho salmon returns occurred every year between 1979 and 2004 (Garwood 2012); and every year between 2004 and 2013, and averaged 184 per year since 2004 (Knechtle and Chesney 2014). The Karuk Tribe found adult coho salmon spawning in Fort Goff, Grider, Horse, and Seiad creeks, during surveys in 2013-2014 (Corum 2014). No evidence of spawning was found in Little Horse Creek (Corum 2014).

The Upper Klamath River population is highly influenced by the Iron Gate Hatchery, and has likely experienced a loss of life history diversity due to environmental conditions and loss of habitat. Currently, genetic work is being conducted to determine the genetic makeup of wild and hatchery fish from the Upper Klamath and it is likely to show that the combination of high stray rates and inbreeding at the hatchery has reduced the genetic diversity of the population. Given that most of the fish in the population come from the hatchery and the fact that hatchery fish are also known to have reduced life history diversity (e.g., all released as yearling smolts from one location), the overall life history diversity of the population is likely limited. The loss of habitat upstream of Iron Gate Dam and poor conditions in the mainstem between April and September also contribute to the loss of life history diversity. Smolt and adult migration is now confined to a short period of time when conditions in the mainstem are favorable and mainstem rearing and spawning is likely reduced from historic levels given the degradation of mainstem habitat.

In summary, the more restricted and fragmented the distribution of individuals within a population, and the more diversity, spatial distribution, and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 20 coho salmon per IP-km of habitat are needed (8,500 spawners total) to approximate the historical distribution of Upper Klamath River coho salmon and habitat. The current population is well below this and has a reduced genetic and life history diversity.

Population Size and Productivity

If a spawning population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 425 coho salmon must spawn in the Upper Klamath River each year to avoid such effects of extremely low population sizes (depensation). The low risk spawner threshold for the population is 8,500 spawners.

Based on juvenile surveys in the Upper Klamath between 2002 and 2005 there is low production in the Upper Klamath tributaries with fewer than 200 juveniles found in most tributaries and most years (Karuk Tribe 2012). The greatest number of juveniles was just over 1000, in Horse Creek in 2005. Spawning surveys also give an indication of the population size and productivity. In 2012-2013 and 2013-2014, the total observed coho salmon adults for surveyed streams (excluding Bogus Creek) was at least 20 and 80, respectively, with the majority of coho salmon found spawning in Seiad Creeks (Corum 2014).

A weir on Bogus Creek, monitored returns to the hatchery, and various tributary spawner surveys provide some indication of what the population size might be presently (Figure 34-2). Annual returns to Bogus Creek are significantly affected by hatchery strays (i.e., 51 percent from 2004 to 2013) but have averaged 154 adult coho salmon during the 2004 to 2012 period (Knechtle and Chesney 2014). Tributary spawner surveys indicate low numbers of coho salmon (<100) in the remaining habitat. Using a variety of methods, including these data and an Intrinsic Potential (IP) database, Ackerman et al. (2006) developed run size approximations for tributaries in the Upper Klamath River reach. Ackerman et al. (2006) estimated the abundance of the Upper Klamath River population to be between 100 and 4,000 adults, far lower than the 8,500 spawners needed for this population to achieve a low extinction risk (Williams et al. 2008). Therefore, the Upper Klamath River population is at a high risk of extinction given its low population size and negative population growth rate.

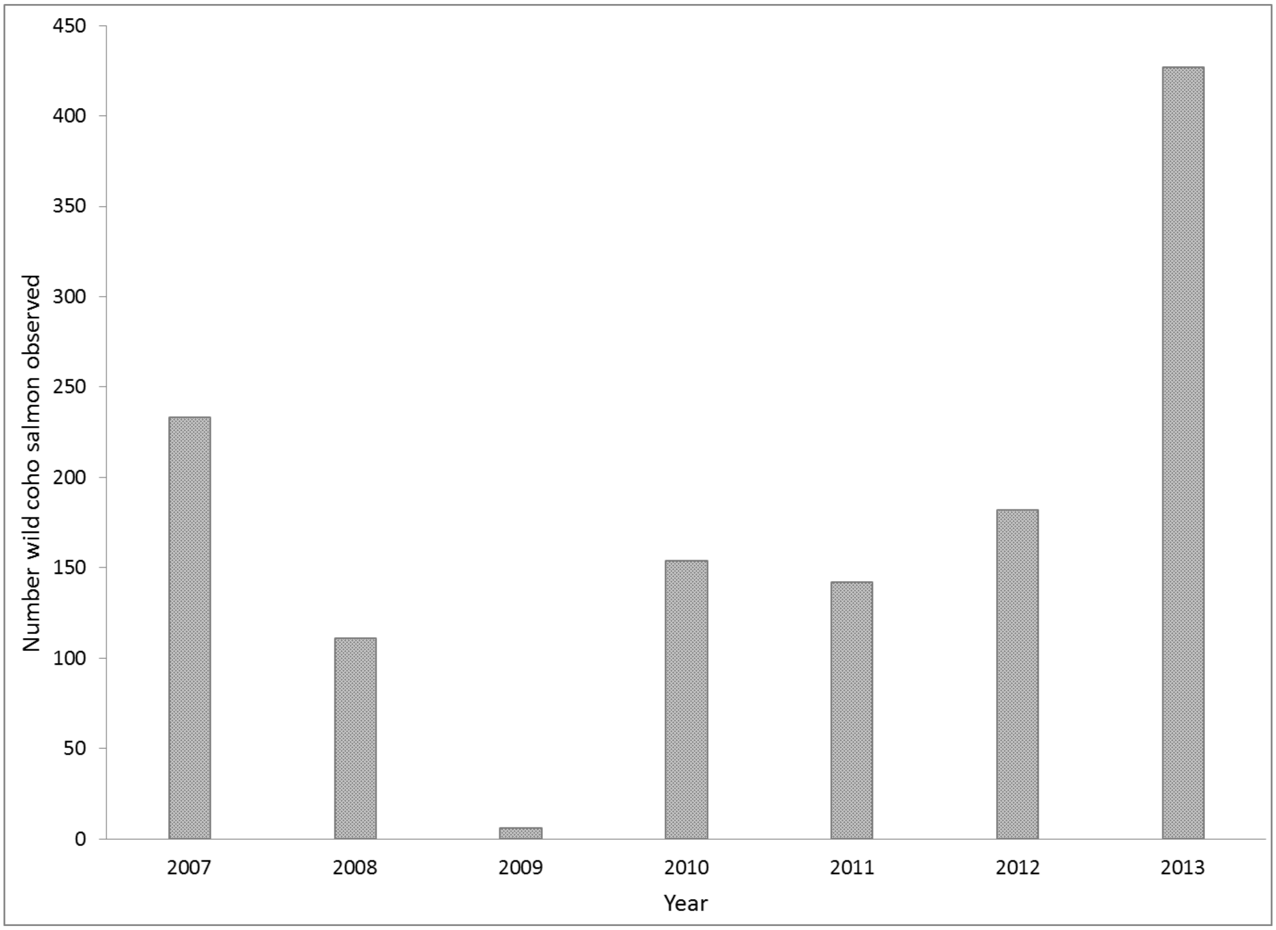

Figure 34-2. Returns of coho salmon to Bogus Creek, a tributary in the Upper Klamath population (Knechtle 2013)

The population growth rate of the Upper Klamath population has not been estimated but given the current trends in spawner abundance and the high incidence of hatchery fish and inbreeding depression, population growth is likely negative. The combination of low population abundance and a negative population growth rate mean that the population is at an elevated risk of extinction.

Extinction Risk

The Upper Klamath River population is at high risk of extinction because the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is likely less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, page 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Upper Klamath River population is a core, Functionally Independent population within the Interior Klamath River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Upper Klamath River core population needs to have at least 8,500 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Upper Klamath population may serve as a source of spawner strays for nearby populations. At present, the capacity of the Upper Klamath coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from the nearby populations in the Klamath basin may enhance recovery of the Upper Klamath River population. However, Upper Klamath River tributaries, refugia, and mainstem habitat function as migratory and rearing habitat for Scott and Shasta juveniles, smolts, and adults. Therefore restoration of the Upper Klamath River is important for recovery of these populations as well.

34.4 Plans and Assessments

Mid Klamath Watershed Council

Since 2001, the Mid Klamath Watershed Council (MKWC) has been engaged in habitat restoration work along the Klamath River corridor, including the Upper Klamath River area. Reports related to fisheries and aquatic resources, available via MKWC's homepage (http://www.mkwc.org), including the following:

> *Middle Klamath Restoration Implementation Plan, Instream Working Group* (Grunbaum et al. 2013)

The Instream Working Group's Instream Candidate Actions Table (Grunbaum et al. 2013) includes recovery actions that specifically address constraints to recovery in 35 tributary watersheds within the Mid Klamath Basin, and in 31 tributary watersheds within the Upper Klamath Basin. Though these tributaries are not all mentioned by name in the SONCC coho salmon ESU recovery plan, the recommended candidate actions in the table for each tributary watershed are incorporated into the SONCC recovery plan's recovery actions.

> *Middle Klamath Sub-basin Fisheries Resource Recovery Plan, December 1, 2008*

> *Off-Channel Coho Salmon Rearing Pond Projects: Seiad Creek and Grider Creek (2012 update)*

> *2008 DFG Klamath Tributary Fish Passage Improvement Results*

> *Restoring Coho Salmon in the Klamath River, One Beaver At A Time*

The Effect of the Klamath Hydroelectric Project on Traditional Resource Uses and Cultural Patterns of the Karuk People within the Klamath River Corridor (Salter 2003)

U.S. Forest Service

The Klamath National Forest (KNF) has conducted numerous watershed assessments and developed a Forest Land and Resource Management Plan for National Forest lands within the Upper Klamath River sub-basin. Relevant management plans and analysis reports that affect coho salmon in the Upper Klamath include:

Sufficiency Assessment: Forest Service and Bureau of Land Management Programs in Support of SONCC Coho Salmon Recovery (USFS and BLM 2011)

The USFS has adopted a Watershed Condition Framework assessment and planning approach (USFS and BLM 2011). The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, Seiad Creek and Antelope Creek were identified as high priority 6th field sub-watersheds in the Klamath National Forest (USFS and BLM 2011)

The Klamath National Forest Land and Resource Management Plan

Klamath National Forest Road Analysis

Forest-Wide Late Successional Reserve Analysis

Watershed Condition Assessment

Thompson/Seiad/Grinder Ecosystem Analysis

Horse Creek Watershed Analysis

Callahan Watershed Analysis

Karuk Tribal Fisheries Department and Restoration Division

Middle Klamath Restoration Partnership

Klamath River Basin Conservation Area Restoration Program

Mid Klamath Sub-basin Fisheries Resource Recovery Plan

In 2003, the Karuk Tribe developed the Mid Klamath fisheries resource plan (Soto et al. 2008) to identify core variables pertaining to ecological function in the sub-basin, and to provide management priorities and objectives to guide efforts to improve conditions in the sub-basin. The Tribe will administer the long-range plan, in cooperation with federal and state management agencies, private landowners, and local communities. The resource plan focuses on active restoration of those processes most degraded by historic and current land uses and passive restoration for protection of currently functioning sub-basin processes.

PacifiCorp Habitat Conservation Plan

In February 2012, NMFS issued an Incidental Take Permit for PacifiCorp's Habitat Conservation Plan (HCP; PacifiCorp 2012) to minimize and mitigate for the interim operations of PacifiCorp's Klamath Hydroelectric Project on the mainstem Klamath River (http://www.westcoast.fisheries.noaa.gov/publications/habitat/hcp_swr/pacificorps_hcp/pacificorp_klamath_coho_hcp_final.pdf).

Seven goals of the HCP's Coho Salmon Conservation Strategy were designed based on the conservation needs of SONCC coho salmon, and include the following: Goal I: offset biological effects of blocked habitat upstream of Iron Gate dam by enhancing the viability of the Upper Klamath coho salmon population; Goal II: enhance coho salmon spawning habitat downstream of Iron Gate Dam; Goal III: improve instream flow conditions for coho salmon downstream of Iron Gate dam; Goal IV: improve water quality for coho salmon downstream of Iron Gate dam; Goal V: reduce disease incidence and mortality in juvenile coho salmon downstream of Iron Gate dam; Goal VI: enhance migratory and rearing habitat for coho salmon in the Klamath River mainstem corridor; Goal VII: enhance and expand rearing habitat for coho salmon in key tributaries. More information about water use HCPs in the Upper Klamath can be found in Section 3.2.9.

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The recommendations developed by CDFG for the mid-Klamath population have been considered and incorporated into the recovery strategy and list of recovery actions for this population.

34.5 Stresses

Table 34-2. Severity of stresses affecting each life stage of coho salmon in the Upper Klamath River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Barriers[1]	-	Very High	Very High[1]	Very High	Very High	Very High
2	Adverse Hatchery-Related Effects	Very High	Very High	Very High	Very High	Very High	Very High
3	Altered Hydrologic Function[1]	Low	Medium	Very High[1]	High	High	High
4	Impaired Water Quality	Low	Medium	Very High	High	High	High
5	Altered Sediment Supply	High	High	High[1]	High	High	High
6	Lack of Floodplain and Channel Structure	Low	Very High	Very High	Very High	Medium	Very High
7	Increased Disease/Predation/Competition	Low	High	Very High	Very High	Medium	Very High
8	Degraded Riparian Forest Conditions	-	Medium	High[1]	High	High	High
9	Impaired Estuary/Mainstem Function	-	Medium	High[1]	High	Low	High
10	Adverse Fishery- and Collection-Related Effects		-	Low	Low	Medium	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

Several factors limit the viability of the Upper Klamath population. The most dominant of these factors stem from the effects of the mainstem hydroelectric dams and water diversions within and upstream of this population boundary on water quality, hydrologic function, floodplain and channel structure, disease, and habitat access upstream of Iron Gate Dam. The hatchery also plays an important role in limiting the Upper Klamath population through negative genetic and ecological interactions. Looking at the overall productivity of the population, the juvenile life stage is the most limited due to the degradation of summer and winter rearing habitat and the issues associated with disease and water quality that affect survival and growth in the mainstem Klamath.

Key limiting stresses are barriers, altered hydrologic function and, as a consequence, impaired water quality. The loss of approximately 76 miles of habitat upstream of Iron Gate Dam (USDOI and CDFG 2012), much of which is high quality spawning and rearing habitat, severely limits the spatial structure and natural productivity of the population. The operation of the Klamath Project and hydroelectric project has led to additional limiting stresses related to the loss of flow variability and impaired water quality. These impairments have led to the loss of rearing and migratory habitat and an increase in the incidence of disease among other, less significant impacts (NMFS 2012, NMFS and USFWS 2013).

Summer and winter rearing habitat for juveniles is limited in the Upper Klamath. The period of time when fry and juvenile rearing, as well as smolt migration, is possible along the mainstem, has been shortened and is therefore a temporal limitation. In the summer, the diversion and impoundment of water continues to lead to poor hydrologic function, disconnection and diminishment of thermal refugia, and poor water quality in tributaries and the mainstem. Most tributaries with summer rearing potential are highly impacted by agriculture and past timber harvest. Very few remaining areas exist downstream of Iron Gate Dam with the potential and opportunity for summer rearing. Based on the low abundance of streams with age-1 coho salmon, overwintering survival appears to be low, thus overwintering habitat may be limited in the Upper Klamath. Frequently, streams with juvenile coho salmon presence had no observed age-1 juveniles (Karuk Tribe 2012). Winter rearing habitat has been primarily impacted by the past mining and diking activities in the mainstem and many tributaries, which has led to the loss and degradation of floodplain and channel structure. The majority of winter habitat that does exist is small, degraded, and poorly connected. Because of the increased incidence of disease and water quality issues in the mainstem in late spring and summer, the time period of optimal rearing and migratory conditions is limited to early spring (March-May). After early spring, growth and survival are appreciably reduced (National Research Council 2004).

In order to improve the viability of this population, addressing these limiting stresses and improving habitat and conditions for the juvenile life stage are imperative. Addressing other stresses and threats and improving habitat for all life stages and life history strategies will also be an important component of recovery for this population.

Tributary thermal refugia are one of the most vital habitat types in the Upper Klamath population unit due to its importance for rearing and migration in the Klamath River. The Mid Klamath Watershed Council and Yurok Tribe have collected temperature data in tributaries and the mainstem Middle Klamath River (MKWC 2006) and surveyed potential refugia to assess where refugia areas are available and used by juvenile coho salmon. The tributaries in Table 34-3 below, though not an exhaustive list, provide cooler water temperatures important as refuges from the elevated water temperatures in the mainstem Klamath River. The presence of juveniles in these tributaries, especially when water temperatures in the mainstem Klamath River are high, supports the conclusion that they are used as refugia areas. Based on the estimated 250 cfs of constant cold groundwater accretion to the mainstem Klamath River in the JC Boyle reach, the highest quality refugia habitat likely lies upstream of Iron Gate Dam.

Table 34-3. Potential refugia areas in the Upper Klamath River.

Sub-basin	Stream Name	Sub-basin	Stream Name
Hornbrook	Bogus Creek	Hornbrook	Cottonwood Creek
Hornbrook	Willow Creek	Beaver Creek	Barkhouse Creek
Beaver Creek	Humbug Creek	Seiad Valley	O'Neil Creek
Beaver Creek	Beaver Creek	Seiad Valley	Seiad Creek
Seiad Valley	Horse Creek	Seiad Valley	Grider Creek
Seiad Valley	Walker Creek	Seiad Valley	West Grider
Seiad Valley	Tom Martin Creek	Seiad Valley	O'Neil Creek

Other important vital habitat exists in Seiad Creek where habitat conditions are sufficient to support consistent coho salmon use throughout the year. The distance from Iron Gate Hatchery also means that Seiad Creek has less hatchery influence than other, more proximate, tributaries. Restoration to improve winter rearing habitat in this watershed will add to its importance in supporting natural fish production in this population.

Barriers

Instream barriers are a very high stress to the population due to restricting spatial structure (i.e., prohibiting access to upstream habitat). The most significant barriers within the watershed are Iron Gate Dam, Copco 1 and 2 dams, and J.C. Boyle Dam, which have blocked upstream access to approximately 76 miles of coho salmon habitat for several decades (USDOI and CDFG 2012). Diversion dams, alluvial barriers, low flow conditions, and poorly functioning road/stream crossings also block passage by juvenile and/or adult fish in several mainstem tributaries within the watershed (e.g., Seiad and Cottonwood Creeks). Records indicate that there are approximately 43 total or partial road crossing barriers that could exist in the Upper Klamath population area (CalFish 2013). The most notable road-stream crossing barriers exist on Highway 96 at Tom Martin Creek and on Seiad Creek Road at Canyon Creek. Many push up dams and diversions seasonally block access to high IP and vital cold-water rearing habitat. A push-up dam on Horse Creek acts as a barrier when combined with low flow conditions in the stream, preventing both upstream and downstream access to high quality rearing habitat and refugia. Low flow conditions in Empire, Willow, Cottonwood, Lumgrey, Barkhouse, Seiad, Horse, and Humbug creeks create flow barriers as well (Mid Klamath Restoration Partnership 2010). Also, the reduction of flushing flows in the mainstem Klamath has caused alluvial barriers to seasonally form at the mouths of mainstem tributaries (e.g., Walker, O'Neil, and Grider Creeks) where they act as barriers to fish migration, further decreasing spatial structure and habitat availability (Mid Klamath Restoration Partnership 2010).

Adverse Hatchery-Related Effects

Iron Gate Hatchery (IGH), which is located in the Upper Klamath River population area, releases approximately 6 million Chinook salmon, 75,000 coho salmon, and 200,000 steelhead annually. The hatchery volitionally releases Chinook salmon from the middle of May to the end of June, a time when flows from Iron Gate Dam are usually in decline and water temperatures are increasing, further increasing stressful conditions for wild juvenile coho salmon. The proportion of hatchery fish among returning adult coho salmon increases in proximity to Iron Gate Hatchery, due to the homing of hatchery fish to the place they were born. Hatchery adult coho salmon are also observed in Bogus Creek, a tributary of the Klamath next to Iron Gate Hatchery. From 2004 to 2012, on average 51 percent of observed adults at Bogus Creek were of hatchery origin (Knechtle and Chesney 2014). Adverse hatchery-related effects pose a very high stress to all life stages because hatchery origin adults make up greater than 30 percent of the total number of adults (Appendix B). In January 2013, NMFS received an application from the California Department of Fish and Wildlife and PacifiCorp for a permit for scientific purposes, and to enhance the propagation and survival of SONCC coho salmon. This application included a Hatchery and Genetic Management Plan (HGMP) that specifies methods for the operation of the Iron Gate Hatchery coho salmon program. NMFS anticipates making a final decision on whether to issue the permit and approve the HGMP in 2014. If permitted, the HGMP incorporates artificial propagation, monitoring, and evaluation activities for the next ten years.

Altered Hydrologic Function

Coho salmon in the Upper Klamath are negatively impacted by the altered hydrologic function within the Upper Klamath River and its tributaries. Individual coho salmon, as well as their spawning and rearing habitat in the mainstem, are primarily impacted by irrigation water diversions upstream of Iron Gate Dam, within the Scott and Shasta watersheds, and by the Klamath hydroelectric project. Both the timing and volume of flows is manipulated by diversion and dam activities leading to altered life-history adaptations and degraded rearing and migratory conditions critical to juvenile coho salmon survival. The altered hydrologic regime and poor water quality conditions likely increase disease susceptibility within the mainstem Klamath River, elevating disease infection rates and ultimately the loss of juvenile coho salmon. Changes to the flow regime have also been linked to increased incidences of disease (Bartholomew 2008).

The altered hydrologic function is the result of a combination of anthropogenic and climatological factors, including surface diversions and groundwater pumping (NMFS 2012, NMFS and USFWS 2013). These activities have severely altered the natural timing and volume of flows in the mainstem Klamath River. This change in hydrologic function has shifted the timing and duration of the spring peak-flow event, causing spring flows to peak approximately a month earlier and subside to summer baseflow approximately two months earlier during most years (USDOI and CDFG 2012). As a result, important life history strategies/traits (e.g., smolt outmigration timing, spring juvenile/fry redistribution) have now been either modified or lost entirely due to the hydrologic shift. The earlier onset of summer baseflow conditions also prolongs poor water conditions and causes them to overlap with the timing of peak smolt outmigration through the mainstem reach.

In addition to altered hydrologic regimes in the mainstem Klamath River, several tributaries also experience significant alterations to their hydrology, and summer base flow are often too low to support rearing and migration. Low flow conditions in Empire, Willow, Cottonwood, Lumgrey, Barkhouse, Seiad, Horse, and Humbug creeks have been shown to create flow barriers and impaired summer rearing conditions (Mid Klamath Restoration Partnership 2010). Generally the flow regime has been rated as fair (partially functional) in Cottonwood Creek, Seiad Creek, and Walker Creek and poor (non-functional) in Beaver Creek, Humbug Creek, and Horse Creek

(Mid Klamath Restoration Partnership 2010). Bogus Creek and adjacent Cold Creek provide good habitat and cool water temperatures for rearing coho salmon (Hampton 2009). Grider Creek and Shovel Creek are thought to have functional flow regimes (Mid Klamath Restoration Partnership 2010).

Impaired Water Quality

Impaired water quality within the Upper Klamath River sub-basin creates a high stress for the population and is especially harmful for juvenile coho salmon. Water quality within the Upper Klamath sub-basin varies spatially and temporally. Water temperature and quality within both mainstem and tributary reaches are often stressful to juvenile and adult coho salmon during late spring, summer, and early fall months. Generally, water quality conditions are suitable for coho salmon from late fall through early spring. However, by late spring (April-May) water quality can become impaired, especially in the mainstem Klamath River, where the combination of elevated water temperatures and high nutrient loads can create stressful conditions for coho salmon and increase risks to survival of juveniles. Water quality is generally poor within the Upper Klamath watershed during much of the summer and early fall when mainstem water temperatures can exceed lethal thresholds above 25 °C. MKWC documented mainstem and tributary temperatures in the summer of 2006 and showed that while mainstem temperatures are often higher than the range of coho salmon suitability (>19 ºC), tributary temperatures are suitable (<19 ºC) in these areas for coho salmon in the summer (MKWC 2006).

Upstream impoundments, particularly PacifiCorp's Klamath Hydroelectric Project reservoirs, contribute to seasonal and daily changes in temperature regimes in the mainstem Upper Klamath. Seasonally, these impoundments create a thermal lag resulting in a delay in spring warming and fall cooling of mainstem temperatures (Karuk Tribe 2011, Beaman and Juhnke 2012). Daily, there is little diurnal variation in temperature and little if any of the natural nighttime cooling that would also help fish to recover from elevated daytime temperatures. Thermal impacts from the PacifiCorp Klamath Hydroelectric Project reservoirs diminish downstream from Iron Gate Dam until they become insignificant around the mouth of the Scott River (RM 144; PacifiCorp 2012). Summer water quality can vary within Upper Klamath River tributaries as well, and is heavily influenced by riparian corridor condition, instream sediment levels, and the extent to which diversions dewater the stream channel. Tributaries tend to have cooler stream temperatures in their upper reaches and warmer temperatures in their degraded lower reaches. Most reaches with IP have fair to poor daily mean and daily maximum water temperatures (>22 °C) during July and August each summer (Asarian and Kann 2013). Elevated seasonal stream temperatures impact juvenile coho salmon growth and survival during the summer, and, to a lesser degree, fry and smolt growth and survival in tributaries during late spring.

During the summer dissolved oxygen (DO) concentrations and pH can also become degraded downstream of Iron Gate Dam due to temperature trends and the decreased quality and quantity of water emanating from reservoirs upstream. DO and pH impacts from the PacifiCorp Klamath Hydroelectric Project reservoirs are, in turn, affected by water quality problems from upstream nutrient and organic matter loads from Upper Klamath Lake.

The mainstem Klamath River downstream of Iron Gate Dam generally has fair to poor DO conditions (<6.75 mg/l; Karuk Tribe 2011, Asarian and Kann 2013). Levels of pH in the mainstem are also rated as fair to poor (< 6.5 daily average minimum and >8.5 daily average maximum; Karuk 2011). Dissolved oxygen can reach as low as 5.5 mg/L in the mainstem downstream of the dam (North Coast Regional Water Quality Control Board 2010, Karuk Tribe 2011). PacifiCorp is currently implementing methods to ameliorate these water quality problems downstream from Iron Gate Dam. Data on PacifiCorp's turbine venting shows that DO concentrations immediately downstream of Iron Gate Dam are generally at least 85 percent saturation (i.e., >7 mg/L) with occasional days of 65 to 80 percent saturation (i.e., approximately 6 to 7 mg/L; PacifiCorp 2014).

Related to DO and temperature trends, pH tends to rise throughout the summer, peaking in late August (Karuk Tribe 2011) and fluctuating widely between day and night (NMFS 2007b). Elevated levels of nutrients and algae also contribute to poor water quality conditions since nutrient cycles and algae levels are altered by reservoir dynamics and can influence water quality in downstream reaches below Iron Gate Dam (Asarian and Kann 2013). Impaired water quality in the mainstem during the summer likely limits use of these habitats by juveniles and restricts rearing to tributary and confluence habitat where water quality is better. Poor water quality also contributes to increased stress, reduced growth, and increased susceptibility to disease.

Altered Sediment Supply

Altered sediment supply is considered a high stress to the population due to high fine sediment delivery and the lack of adequate spawning gravel. Past and present land use practices continue to deliver fine sediment into the mainstem and many important tributary streams between Iron Gate Dam and Seiad Creek (KNF 1993, KNF 1996, KNF 2002). High sediment levels degrade tributary rearing habitat by filling in pools and simplifying instream habitat complexity. Many Upper Klamath tributaries contain highly erodible sediment which, besides degrading habitat quality, can also lower egg survival and spawning success. Furthermore, the supply of spawning gravel has decreased due to blockage by the mainstem dams and tributary road crossings. The volume and quality of spawning gravel available to adult coho salmon is especially compromised below Iron Gate Dam where the majority of mainstem spawning occurs (PacifiCorp 2012). However, PacifiCorp has begun augmenting gravel in the mainstem Klamath River to minimize the geomorphic effects of the Klamath Hydroelectric Project.

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure presents a very high stress for the population and primarily affects fry, juveniles, and smolts. Tributary and mainstem habitat complexity is limited by a lack of coarse sediment and wood, modified flows, remnant dredge piles, and impaired riparian function. Additionally, many tributary streams suffer from high sediment levels, poor riparian habitat, and overall poor instream habitat complexity and volume. In many tributaries, fine sediment has also filled pools, off-channel ponds, and wetlands. Past mining activities and levy construction have also led to limited floodplain complexity and connectivity (e.g., Seiad, Horse, and Humbug Creeks). The primary issue in the mainstem is the removal of naturally deposited sediments by past mining activities combined with lack of transport flows which would lead to the creation and maintenance of side and off-channel habitat (Soto et al. 2003). Although large wood and complex floodplain habitat were not dominant features of the historic mainstem Klamath River channel, this area continues to lack rearing and spawning habitat. Floodplain connectivity (based on USFS judgment) is generally fair (partially functional) in the Beaver Creek, Seiad Creek, Walker Creek, Bogus Creek, and Shovel Creek sub-basins and generally poor (non-functional) in the Humbug Creek, Cottonwood Creek, and Horse Creek sub-basins (CAP data, Soto et al. 2003, KNF 2002, KNF 1996, KNF 1993). The one exception was Grider Creek which was rated as having very good (fully functional) floodplain connectivity (CAP data). Wood frequencies have not been quantified in many tributaries but in Camp Creek and at Jenny Creek they were found to be poor (<1 key piece/100m; ODFW CAP data). Juveniles and smolts are most limited by poor habitat complexity within tributary reaches and refugia due to the need for off-channel winter refugia and complex rearing and refugia habitat. Fry are affected by the lack of refugia from high flows and predation and a lack of complex rearing habitat in tributaries.

Increased Disease/Predation/Competition

The combined effect of increased disease, predation, and competition is an overall very high stress to coho salmon in this population. Of these three stresses, disease is the most significant; however competition and predation by hatchery fish are also issues occurring in all Klamath River populations. Pathogens that cause diseases in juveniles include *Ceratonova shasta, Flavobacterium columnare* (columnaris), Aeromonid bacteria, *Nanophyetus salmonicola*, and the kidney myxosporean *Parvicapsula minibicornis* (FERC 2007). Of the aforementioned biological vectors, infection by the myxozoan *C. shasta* (and co-infection with *P. minibicornis*) has the most significant effect on survival of coho salmon in the sub-basin (Nichols et al. 2003, Bartholomew 2008). Disease effects vary annually based on water temperature, water year, and other factors (Bartholomew 2008). Spatially and temporally, mortality rates from exposure to disease vary by location and month, but are consistently higher in the mainstem between Shasta River and the Scott River and are highest in May and June (Bartholomew 2012). Given that most juveniles rear in tributaries (Lestelle 2007, Sutton and Soto 2010), the greatest impacts are to rearing and dispersing fry, juveniles, and smolts during emigration. Average mortality is estimated to be approximately 50 percent at 17 °C and approximately 12 percent at 15 °C in the Upper Klamath and studies show mortality could be much higher at some sites (Figure 34-3). The long migration and exposure of this population to disease means that this population is one of the most susceptible to disease and most likely to experience abnormally high disease-induced mortality.

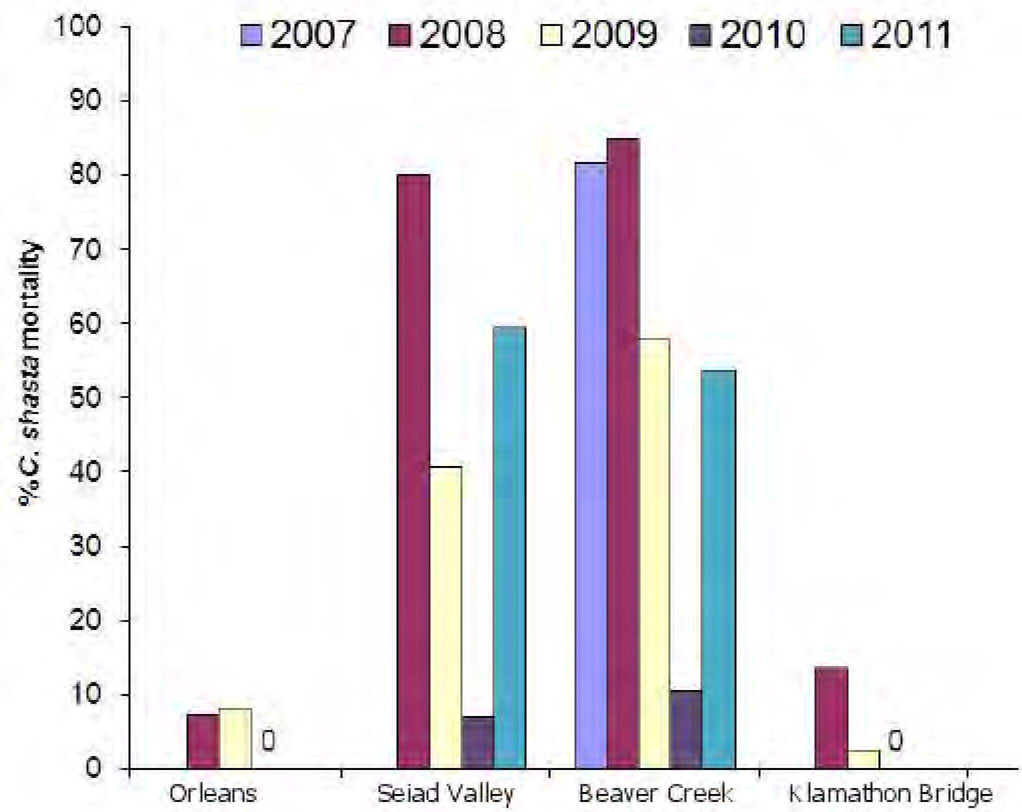

Figure 34-3. Percent mortality of juvenile coho salmon exposed in the Klamath River for 72 hours in June 2007- 2011. In 2011, coho were held only near Beaver Creek and Seiad Valley (Bartholomew 2012).

Researchers believe modifications to the river's hydrologic regime have likely created instream conditions that favor disease proliferation and fish infection (Stocking and Bartholomew 2007). Less frequent and lower magnitude flows are likely affecting disease transmission from adult salmon carcasses to the intermediate polychaete host, increasing the potential for juveniles and smolts to become infected. In an unaltered hydrologic regime, fall and winter freshets help distribute salmon carcasses downstream into lower sections of the watershed, effectively dispersing nutrients, as well as diluting infective spore densities that enter the aquatic environment as the carcasses decompose. Low stable flow regimes do not effectively redistribute carcasses within the reach between Iron Gate Dam and the Shasta River, resulting in high densities of decomposing fish downstream of popular spawning areas.

In addition to disease impacts, there are competition and predation pressures that act to limit coho salmon productivity and survival. Competition with hatchery fish for habitat and refugia may affect the growth and survival of juvenile coho salmon. Chinook, steelhead, and coho salmon fingerling released from Iron Gate Hatchery may not only compete with yearling and sub-yearling wild coho salmon but may also predate on sub-yearling coho salmon. Some steelhead may also remain in the Upper Klamath and exert additional predation pressure on juvenile coho salmon. These types of impacts have been identified in other Klamath tributaries such as the Trinity River (Naman 2008) but their prevalence and impacts are unknown for this population. Another important but unknown impact may be predation by non-native brown trout on juvenile coho salmon. Brown trout are rarely found in the Scott, Shasta, and Bogus Creek but they have been documented to co-occur with juvenile coho salmon and may have seasonal or local effects on juvenile populations (Hampton 2010).

Degraded Riparian Forest Conditions

Degraded riparian forest conditions are considered a high stress for this population because of the reduced quality and quantity of riparian forest along the mainstem and in tributaries of the Upper Klamath. The extent of degraded riparian habitat within the Upper Klamath River population is primarily due to grazing, altered hydrology, past mining, fire, and timber harvest. These disturbances create localized, short term reductions in riparian vegetation and/or long-term widespread loss of riparian forest. The extent of impacts to coho salmon depends on the degree and extent of coho salmon use of the area. Most stream reaches within the Upper Klamath are either lacking riparian forest altogether or lack complex, late seral forest. This lack of functional riparian forest has resulted in the degradation of water quality, unstable banks, and simplified channel and floodplain structure. Grazing and flow impairments along the mainstem and in tributaries such as Horse, Humbug, Willow, and Cottonwood creeks have severely degraded riparian function. Stream corridor vegetation was rated at fair (partially functional) to poor (non-functional) in all surveyed reaches of the Upper Klamath (CAP data, Soto et al. 2003, KNF 1993, KNF 1996, KNF 2002). Past mining activities and flood control in areas such as Seiad Valley and along the mainstem Klamath have also altered floodplain sediment, elevation, and connectivity and led to depleted riparian forests. The seasonal diversion of water in many Upper Klamath tributaries limits the availability of areas where riparian vegetation can persist.

Impaired Estuary/Mainstem Function

All salmon that originate from the Upper Klamath River migrate to and from the ocean through the mainstem Klamath River and the Klamath River estuary. The Klamath River mainstem and estuary play an important role by providing holding habitat and foraging and refuge opportunities for juvenile coho salmon and smolts from the Upper Klamath River sub-basin (Soto et al. 2008a, Hillemeier et al. 2009, Soto et al. 2013). Although short and small compared to the large size of the watershed, the estuary provides numerous habitat types and rearing habitat for juvenile coho salmon. The degraded condition that exists throughout the Klamath River basin may mean that the estuary plays an even larger role for all Klamath River populations by providing the opportunity for juvenile and smolt growth and available refugia prior to entering the ocean.

The estuary, although relatively intact, suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain (Hiner 2006). Levees along the lower Klamath and development on the floodplain have led to the loss and degradation of habitat in the estuary. Despite the degraded state of habitat in the estuary, research in two tributaries near the mouth of the Klamath River have shown that juveniles from natal streams in the Upper Klamath sub-basin disperse to and fully utilize small, coastal tributaries and estuarine habitats before moving out to the ocean, and that these fish are significantly larger and more robust than individuals who quickly outmigrate to the ocean (Soto et al. 2008a, Hillemeier et al. 2009). Mainstem conditions downstream in the Middle and Lower Klamath contribute additional stress to the population because of the propagation of issues related to disease and degraded water quality and habitat.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

34.6 Threats

Table 34-4. Severity of threats affecting each life stage of coho salmon in the Upper Klamath River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Dams/Diversions[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Roads[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
3	Hatcheries	Very High	Very High	Very High	Very High	Very High	Very High
4	Climate Change	Medium	Medium	Very High	Very High	Medium	Very High
5	Channelization/Diking	High	Very High	Very High	Very High	Very High	Very High
6	Agricultural Practices	High	High	High	High	High	High
7	High Severity Fire	Medium	Medium	Medium	Medium	Medium	Medium
8	Road-Stream Crossing Barriers	-	Medium	Medium	Medium	Medium	Medium
9	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
10	Fishing and Collecting	-	-	Low	Low	Medium	Low
11	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
12	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
13	Invasive Non-Native/Alien Species	Low	Low	Low	Low	Low	Low

[1] Key threats and limited life stage

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are dams/diversions and roads.

Dams/ Diversions

Irrigation and hydroelectric dams are a major threat to coho salmon within the Upper Klamath River watershed and cause a very high threat to all life stages. PacifiCorp's series of four mainstem hydroelectric dams, beginning with Iron Gate Dam at RM 190, preclude upstream passage of coho salmon into approximately 76 miles of historic habitat (USDOI and CDFG 2012). The threat from these mainstem dams will continue until fish passage or dam removal occurs, which is expected to occur in the 2020s either through dam removal if there is an affirmative Secretarial Determination under the terms of the Klamath Hydroelectric Settlement Agreement (KHSA), or through mandatory fishway prescriptions in the Federal Energy Regulatory Commission relicensing process.

Smaller private diversion dams also block passage on several important streams within the Upper Klamath, including Cottonwood Creek and Horse Creek. In addition to seasonal and permanent dams in the Upper Klamath, diversions in tributaries reduce flow and act as fish barriers when unscreened. There have been some efforts to screen diversions in Horse Creek and some other tributaries; however, the California Fish Passage Assessment Database (CalFish 2013) indicates that there could be over 60 additional diversions in the Upper Klamath sub-basin.

The Klamath River suffers from numerous threats to coho salmon. Foremost is the over-allocation (as defined by the 1992 Oregon Water Resources Commission) of water resources throughout the mainstem Klamath River and major tributaries. This over-allocation is generally acknowledged as the primary mechanism responsible for the poor water quality, elevated disease incidence, and impaired passage conditions common to much of the Klamath River basin. Water diversions in Empire, Willow, Cottonwood, Lumgrey, Barkhouse, Seiad, Horse, and Humbug creeks are known to impair and/or eliminate coho salmon habitat and water quality during critical low flow periods. Water diversions in the Scott and Shasta rivers also impair hydrologic function and water quality in the mainstem Klamath River, further exacerbating low flow conditions, high disease transmission rates, and poor water quality conditions. Flow barriers are common in the Upper Klamath and many of these low flow conditions are a direct result of legal and illegal summer diversions (Soto et al. 2003).

Roads

High road densities within the Upper Klamath sub-basin pose a very high threat to the coho salmon and its habitat. The construction and maintenance of roads across the landscape have detrimental effects on the essential features of coho salmon habitat primarily through hydrological effects (e.g., disconnecting watercourses) and through erosion and sedimentation. Road-related erosion is a problem in many of the larger tributaries downstream of the Shasta River where timber harvest was historically most pronounced. Watersheds with the highest road densities (>3 mi./sq. mi.) include Beaver, Horse, McKinney, Doggett, O'Neil, Empire-Lumgrey, Cottonwood, lower reaches of Grider Creek, and upper reaches of Humbug Creek and Seiad Creek (CAP data, KNF 1993, KNF 1996, KNF 2002). Road densities are substantially lower in tributaries upstream of Iron Gate Dam, due largely to the lack of timberland within the hydropower reach. Roads will continue to act as sediment sources to tributaries although the threat from roads is likely to decrease as roads on public land are decommissioned and upgraded.

Hatcheries

Hatcheries pose a very high threat to all life stages in the Upper Klamath River sub-basin. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Climate Change

Climate change poses a very high threat to this population. As the result of current fuel loads and the impacts of climate change, fire could have a major impact on habitat quality in the future. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 3 °C in the summer and by 1.3 °C in the winter. Recent studies have already shown that water temperatures in the mainstem Klamath River have already been increasing at a rate of 0.4 to 0.6 °C/decade since the early 1960s (Bartholow 2005). The season of high temperatures that are potentially stressful to salmon has lengthened by about 1 month and the average length of mainstem river with cool summer temperatures (<15 °C) has declined by about 5 mi/decade (Bartholow 2005). Annual precipitation in this area is already very low and is predicted to trend downward over the next century (Thieler and Hammer-Klose 2000). Snowpack in upper elevations of the basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009). The vulnerability of the Klamath estuary to sea level rise is low to moderate and therefore does not pose a significant threat to estuarine rearing habitat downstream. Juvenile and smolt rearing and migratory habitat in the Klamath River and its tributaries is most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Overall, the range and degree of variability in temperature and precipitation are likely to increase in all populations. Adult coho salmon will also be negatively affected by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Channelization/Diking

Although channelization and diking is not widespread throughout the watershed, stream reaches essential for successful juvenile rearing in the Upper Klamath have been extensively levied for flood control and agriculture. Roads and dredge tailings from past mining activities also act to channelize and dike some stream reaches in the Upper Klamath. Much of the floodplain area along the upper-Klamath River corridor, including the lower reaches of tributaries (e.g., Seiad, Horse, and Grider Creeks) where off-channel habitat could develop, is effectively channelized or diked. Providing additional off-channel habitat will provide increased rearing opportunities for the Upper Klamath River population, as well as improved non-natal rearing benefits for outmigrating juvenile fish from the Scott River and Shasta River coho salmon populations. The most affected streams include Seiad and Horse Creek although localized channelization and diking likely occurs in almost every tributary with extensive streamside private land (e.g., Cottonwood, Bogus, and Willow creeks). Dikes in affected reaches lead to floodplain disconnection and reduced habitat capacity. Overall, channelization and diking is a very high threat to the population since there is no current effort to restore existing channelized and diked reaches along the upper middle Klamath River corridor.

Agricultural Practices

Agricultural practices pose a high threat to Upper Klamath River coho salmon through effects on water quality, flow, bank stability, and riparian function. Runoff from agricultural lands has the potential to negatively impact water quality in the Klamath Basin by increasing nutrient loads, increasing biological oxygen demand, and increasing thermal loading (USGS 1999). Agricultural diversions from Upper Klamath Basin and from the larger tributary sub-basins in the Upper Klamath River watershed (e.g., Shasta and Scott rivers) have severely altered the timing, duration and volume of the historic Upper Klamath River hydrologic regime. Summer low-flow conditions now occur at an earlier date and persist for a longer period than historically occurred, subjecting rearing juvenile coho salmon to poor water quality for up to 4 months of the year. Smaller-scale agricultural diversions in tributaries such as Beaver, Willow, Grider, Bogus, Horse, Seiad, Walker, Elliot, Little Girder, Little Horse, and Tom Martin Creeks can lead to diminished and eventually the loss of summer rearing habitat and refugia, and to stranding in some instances. Another important impact of agricultural practices in the Upper Klamath is the negative effects of grazing on riparian vegetation and instream habitat. Grazing is common along many tributaries but the highest grazing intensity occurs on private land in Cottonwood, Bogus, Willow, Horse, and Beaver Creeks, and along the mainstem Klamath River corridor. Agriculture in general is highest within the lower reaches of the Willow Creek, Cottonwood Creek, and Bogus Creek watersheds where 5 to 10 percent of the sub-basin area is used for agriculture (CAP data, National Research Council 2004). With notable exceptions, such as riparian restoration-oriented ranch operations along Bogus and Cold creeks, failure to exclude cattle from riparian areas and to lower grazing intensity will continue to lead to poor water quality, bank instability, loss of riparian vegetation, and the simplification of stream habitat. Agricultural operations, if unaltered, will therefore continue to degrade instream habitat in many tributary reaches through impacts to water quality, flow, riparian function, and bank stability (62 FR 24588, May 6, 1997).

High Severity Fire

High severity fire is a medium threat to coho salmon in the Upper Klamath population unit and hazardous fuel loads have been identified in Seiad, Barkhouse, and Williams Creek sub-basins (Soto et al. 2008a). Historically, fire played a natural function within the Klamath River watershed, and small, low-intensity forest fires were common. However, more recently the fire regime within the basin has been altered as drought conditions and active fire suppression has increased the amount of understory brush available to burn. The result has been that large-scale, high severity forest fires are more common in the Upper Klamath. High severity fires can lead to increased erosion rates, loss of riparian forest, and decreased stability of streambanks and upslope areas in many areas of the basin. Erosion rates can be especially severe on steep hillslopes exposed to high-intensity burn conditions.

Road-Stream Crossing Barriers

Road-stream crossings continue to block fish passage within the Upper Klamath River watershed, although recent restoration efforts have addressed many of the problem culverts on National Forest land. A number of culverts located on private, county, and state roads continue to preclude upstream fish passage and constitute a medium threat to coho salmon. Road crossings on Highway 96 (Tom Martin) and Seiad Creek Road (Canyon Creek) have the greatest known impacts due to the high quality of habitat that exists in these areas.

Table 34-5. List of potential barriers in the Upper Klamath River.

IP Priority	Stream Name	Sub-basin	County
High	Canyon Creek	Seiad Valley	Siskiyou
High	Tom Martin	Beaver Creek	Siskiyou
Medium	Empire Creek	Beaver Creek	Siskiyou
Medium	Soda Creek	Beaver Creek	Siskiyou
Medium	Clear Creek	Beaver Creek	Siskiyou
Medium	Collins Creek	Beaver Creek	Siskiyou
Medium	Dona Creek	Beaver Creek	Siskiyou
High	McKinney Creek (LB+RB)	Beaver Creek	Siskiyou
Medium	Vesa Creek(LB+RB)	Beaver Creek	Siskiyou
High	Middle Fork Humbug Creek	Beaver Creek	Siskiyou
High	South Fork Humbug Creek	Beaver Creek	Siskiyou
Medium	Little Bogus Creek	Iron Gate	Siskiyou

Timber Harvest

Although timber harvest has the potential to adversely affect coho salmon or salmon habitat, most former timber lands in the Upper Klamath River sub-basin are now under sustainable timber harvest management. Potential timber resources are also limited in the Upper Klamath and future timber sales are likely to be small. Timber harvest has generally been greatest (>25 percent total area) in the upper reaches of Beaver Creek, Cottonwood Creek, and in Doggett Creek (CAP data, KNF 1996). The USFS, BLM, and private timber companies manage most timber land in the watershed and detrimental impacts on fish habitat from timber harvest are expected to remain medium to high until forest soils stabilize and priority stream crossings are upgraded. Federal agencies operate under the Aquatic Conservation Strategy of the Northwest Forest Plan and a portion of private timber lands are managed under the Fruitgrowers Habitat Conservation Plan (HCP). Overall, timber harvest is considered to be a high threat to the population.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Mining/Gravel Extraction

Though significant in the past, present and future mining activities pose a low threat to the population. Hydraulic mining (placer and suction dredging) can degrade habitat through the disturbance and alteration of streambed substrate. Oftentimes, material is excavated into tailing piles, leaving unnatural channel formations. The persistence of such features is variable, and associated impacts can be prolonged and widespread. The number of mining claims that could be used in the future suggests this is a threat that still needs to be monitored. Adverse effects could include increasing turbidity, modifying spawning channels, decreasing emergent macroinvertebrate prey, and disturbing and displacing juveniles and smolts from refugia. The level of this threat is primarily dependent on the types of methods used and the way in which these methods are applied.

Currently, mining is regulated by CDFW to ensure safe environmental practices and minimal impacts on salmon and salmon habitat. Regulations include special closed areas, closed seasons, and restrictions on methods and operations (Hillman et al. v. CDFG et al. 2009). Mining activities in the region have decreased significantly from historic levels, however recent mining operations had been increasing until the cessation of suction dredging permits by the state of California in 2009. In 2009, Governor Schwarzenegger signed into law SB 670 (Wiggins), instituting a moratorium on suction dredging (to include existing permit holders), with the exception of dredging for the purpose of maintaining energy or water supply management infrastructure, flood control or navigation. The California Department of Fish and Wildlife is currently prohibited by statute from issuing suction dredge permits. (Fish & G. Code, § 5653.1, subd. (b), making it unlawful to use any vacuum or suction dredge equipment in any river, stream, or lake in California (see http://www.dfg.ca.gov/suctiondredge). This prohibition will remain in effect until CDFW completes a court-ordered environmental review of its permitting program, and institutes any changes that are necessary to its former regulations. On June 28, 2013, the Office of Administrative Law (OAL) approved an emergency regulation proposed by the CDFW that changes the regulatory definition of suction dredging for purposes of Fish and Game Code section 5653. With OAL approval and related filing with the California Secretary of State, the new regulation is now in effect. Under this new regulation, the use of any vacuum or suction dredge equipment (i.e., suction dredging) is defined as the use of a suction system to vacuum material from a river, stream or lake for the extraction of minerals (Cal. Code Regs., tit. 14, § 228, subd. (a), effective June 28, 2013.)

Careful monitoring of mining activity will be necessary in the future to ensure that regulations properly condition mining activities, so that mining threats remain low.

Urban/Residential/Industrial Development

The number of people currently living in the Upper Klamath River watershed is small (likely less than a few thousand residents), and is unlikely to change significantly in the near future. Large residential and industrial development is not widespread in the Upper Klamath River watershed and therefore poses only a low threat to coho salmon. The largest cities and towns have populations well under 1,000 residents, and populations have remained unchanged or decreased over the past several decades (US DOC 2011). Impervious surface area is low throughout the Upper Klamath (0 to 5 percent based on CAP data, US DOC 2011). Small residential communities on important tributaries, such as Horse, Seiad and Beaver creeks will likely continue to impact water quality, instream habitat conditions, streamflow, and riparian vegetation. However these impacts are not believed to be increasing.

Invasive Non-Native/Alien Species

Several populations of non-native species exist below Iron Gate Dam and could pose a threat to the Upper Klamath population. The extent of this threat is currently unknown but presumed to be low. Brown trout are rarely found in Bogus Creek but they have been documented to co-occur with juvenile coho salmon and may have seasonal or local effects on juvenile populations (Hampton 2010). Populations of warm-water species are also established in the mainstem below Iron Gate Reservoir and may exert some competitive and predatory pressure on the population.

34.7 Recovery Strategy

The potential for coho salmon recovery in the Upper Klamath is high; however, the population is currently not viable and habitat is degraded and/or unavailable in many areas. Summer and winter rearing habitat is in poor condition in many areas and is limited in its extent and connection to adjacent stream reaches occupied by coho salmon. Mainstem conditions during the summer are unsuitable for migration and rearing. Hatchery influences on the population are very high. Recovery activities in the watershed should focus on the key limiting stresses/threats and life stage and restoration should include both short-term improvement of habitat, as well as long-term restoration of the function of the mainstem river.

The Klamath Basin Restoration Agreement and Klamath Hydropower Settlement Agreement have been signed and are awaiting Federal legislation that would authorize funding for habitat restoration programs and a determination by the Secretary of the Interior whether removal of four dams on the Klamath River (Iron Gate, Copco 1 and 2, and J.C. Boyle dams) would advance restoration of the salmonid fisheries of the Klamath Basin and is in the public interest. Over the long-term (>10 years), removing the PacifiCorp dams would allow coho salmon passage into 76 miles of habitat above the dams, and help to restore hydrological function through increased flow variability (NMFS 2007c, USDOI and CDFG 2012). As a result of restored hydrologic function, NMFS anticipates that disease rates in the Upper Klamath River will be reduced. Water quality benefits are also expected, which would reduce stresses to juvenile coho salmon that may reside in the mainstem Klamath River during late spring and summer (NMFS 2007b). Overall, the removal of the mainstem Klamath River dams and improved volitional fish passage throughout the PacifiCorp reach are the most significant actions that can be taken to restore the viability of the Upper Klamath population unit. As such, dam removal or, in the alternative, volitional fish passage past the four dams, are the highest priority for recovery of this population. If dam removal is complete, new recovery actions for the hydropower reach may need to be developed. PacifiCorp has received an incidental take permit under ESA Section 10(a)(1)(b), and is implementing several conservation measures, including: funding for fish disease research to benefit coho salmon; turbine venting to increase dissolved oxygen concentrations downstream of Iron Gate Dam; funding habitat enhancement projects, including gravel augmentation, downstream of Iron Gate Dam; providing large woody debris below Iron Gate Dam; and coordinating efforts with the U.S. Bureau of Reclamation and NMFS to allow for flow variability to the Klamath River.

Prior to dam removal, the restoration and maintenance of tributary water quality, hydrologic function, and floodplain and channel structure for spawning and rearing will help increase productivity, abundance, and distribution of the population. Recovery actions should focus on protecting and restoring those tributaries that have been identified as being important to coho salmon. In addition, hatchery reform at the Trinity and Iron Gate hatcheries is important to reducing negative interactions and allowing for a more natural population. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 34-6. Recovery action implementation schedule for the Upper Klamath River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.5.1.19	Passage	Yes	Improve access	Remove barriers	Iron Gate, Copco 1 and 2, and JC Boyle dams	1
SONCC-UKR.5.1.19.1	*Remove four Klamath Hydroelectric Project dams as provided in the KHSA or, in the alternative, construct and operate fishways prescribed by NMFS for Project relicensing*					
SONCC-UKR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Restore peak flows	Mainstem Klamath River	1
SONCC-UKR.3.1.5.1	*Assess current hydrograph and develop a flow variability/environmental water account plan to re-establish a natural hydrograph that reduces alluvial*					
SONCC-UKR.3.1.5.2	*Maintain minimum flow requirements below IGD and implement plan to restore a more natural hydrograph*					
SONCC-UKR.1.2.49	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary	1
SONCC-UKR.1.2.49.1	*Implement recovery actions for Lower Klamath River population that address the target "Estuary", including the creation/restoration of off-channel rearing habitat throughout the lower Klamath River*					
SONCC-UKR.30.1.25	Disease, Predation, Competition	No	Reduce disease	Disrupt the disease cycle between salmon, myxospore, polychaetes, and actinospore stages.	Population wide	1
SONCC-UKR.30.1.25.1	*Assess all means possible to disrupt disease cycle and develop a plan to do so*					
SONCC-UKR.30.1.25.2	*Disrupt the disease cycle, guided by assessment results*					
SONCC-UKR.5.1.20	Passage	Yes	Improve access	Reduce sediment barriers	Walker, O'Neil, Humbug, and Grider creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-UKR.5.1.20.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-UKR.5.1.20.2	*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*					
SONCC-UKR.5.1.79	Passage	Yes	Improve access	Reduce sediment barriers	Population wide	2b
SONCC-UKR.5.1.79.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-UKR.5.1.79.2	*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Seiad Valley, Beaver, Hornbrook, Cottonwood, Bogus, Grider, Little Grider, Willow, Horse, Little Horse, Walker, Elliott, and Tom Martin creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-UKR.3.1.6.1	*Develop program to decrease diversion during critical periods of seasonal low flows*					
SONCC-UKR.3.1.6.2	*Encourage users to reduce stream diversions during the summer by providing educational materials describing how to increase water use efficiency*					
SONCC-UKR.3.1.6.3	*Establish and provide consistent water master service to ensure water is allocated according to established water rights*					
SONCC-UKR.3.1.75	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-UKR.3.1.75.1	*Develop program to decrease diversion during critical periods of seasonal low flows*					
SONCC-UKR.3.1.75.2	*Encourage users to reduce stream diversions during the summer by providing educational materials describing how to increase water use efficiency*					
SONCC-UKR.3.1.75.3	*Establish and provide consistent water master service to ensure water is allocated according to established water rights*					
SONCC-UKR.3.1.66	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-UKR.3.1.66.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-UKR.3.1.66.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-UKR.3.1.77	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-UKR.3.1.77.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-UKR.3.1.77.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-UKR.5.2.24	Passage	Yes	Decrease mortality	Screen all diversions	Horse, Cottonwood, and Bogus creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-UKR.5.2.24.1	*Assess diversions and develop a screening program*					
SONCC-UKR.5.2.24.2	*Screen all diversions*					
SONCC-UKR.5.2.81	Passage	Yes	Decrease mortality	Screen all diversions	Population wide	2d
SONCC-UKR.5.2.81.1	*Assess diversions and develop a screening program*					
SONCC-UKR.5.2.81.2	*Screen all diversions*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.2.1.4	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Mainstem Klamath corridor, Seiad, Bogus, Cottonwood, Willow, Barkhouse, Humbug, O'Neil, Beaver, Horse, Tom Martin, and Grider creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-UKR.2.1.4.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UKR.2.1.4.2	*Place instream structures, guided by assessment results*					
SONCC-UKR.2.1.71	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-UKR.2.1.71.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UKR.2.1.71.2	*Place instream structures, guided by assessment results*					
SONCC-UKR.26.1.65	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-UKR.26.1.65.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-UKR.2.2.3	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	High IP sub-watersheds (especially, Seiad, Horse, Little Horse, Cottonwood, and Tom Martin creeks), and all streams where coho salmon would benefit immediately	2b
SONCC-UKR.2.2.3.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-UKR.2.2.3.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-UKR.2.2.73	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-UKR.2.2.73.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-UKR.2.2.73.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-UKR.2.2.2	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Seiad, Horse, Little Horse, and Cottonwood creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-UKR.2.2.2.1	*Assess instream flow conditions and side channel connectivity and develop a plan to obtain adequate flows for channel connectivity*					
SONCC-UKR.2.2.2.2	*Mechanically alter side channels, off channel ponds and wetlands to achieve connectivity*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.2.2.72	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Re-connect channel to existing off-channel ponds, wetlands, and side channels	Population wide	2d
SONCC-UKR.2.2.72.1	*Assess instream flow conditions and side channel connectivity and develop a plan to obtain adequate flows for channel connectivity*					
SONCC-UKR.2.2.72.2	*Mechanically alter side channels, off channel ponds and wetlands to achieve connectivity*					
SONCC-UKR.2.2.1	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Seiad and Horse creeks, and all areas where coho salmon would benefit immediately	2b
SONCC-UKR.2.2.1.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-UKR.2.2.1.2	*Remove levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-UKR.17.2.18	Hatcheries	No	Reduce adverse hatchery impacts	Identify and reduce impacts of hatchery on SONCC coho salmon	Iron Gate Hatchery	2b
SONCC-UKR.17.2.18.2	*Implement Hatchery and Genetic Management Plan and revise when necessary*					
SONCC-UKR.8.1.28	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Beaver, Horse, Walker, McKinney, Cottonwood, Doggett, Kohl, Empire, Lumgrey, and Dutch creeks, and all areas where coho salmon would benefit immediately	2b
SONCC-UKR.8.1.28.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-UKR.8.1.28.2	*Decommission roads, guided by assessment*					
SONCC-UKR.8.1.28.3	*Upgrade roads, guided by assessment*					
SONCC-UKR.8.1.28.4	*Maintain roads, guided by assessment*					
SONCC-UKR.8.1.83	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2d
SONCC-UKR.8.1.83.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-UKR.8.1.83.2	*Decommission roads, guided by assessment*					
SONCC-UKR.8.1.83.3	*Upgrade roads, guided by assessment*					
SONCC-UKR.8.1.83.4	*Maintain roads, guided by assessment*					
SONCC-UKR.30.1.26	Disease, Predation, Competition	No	Reduce disease	Conduct monitoring and research actions as described in the Klamath River Fish Disease Research Plan	Mainstem Klamath River	2b
SONCC-UKR.30.1.26.1	*Develop monitoring plan and research actions as described in the Klamath River Fish Disease Research Plan*					
SONCC-UKR.30.1.26.2	*Implement Klamath River Fish Disease Research Plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.10.1.16	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Reduce warm water inputs	Bogus, Willow, Horse, Seiad, Beaver, Barkhouse, Tom Martin, Elliott, and Cotttonwood creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-UKR.10.1.16.1	*Develop a program that identifies, designs, and constructs projects that will reduce warm tailwater input*					
SONCC-UKR.10.1.16.2	*Implement tailwater reduction program*					
SONCC-UKR.10.1.68	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Reduce warm water inputs	Population wide	2d
SONCC-UKR.10.1.68.1	*Develop a program that identifies, designs, and constructs projects that will reduce warm tailwater input*					
SONCC-UKR.10.1.68.2	*Implement tailwater reduction program*					
SONCC-UKR.5.1.21	Passage	Yes	Improve access	Remove structural barriers	Highway 96 crossing on Tom Martin Creek and Seiad Creek Road culvert on Canyon Creek (tributary to Seiad), and all streams where coho salmon would benefit immediately	3a
SONCC-UKR.5.1.21.1	*Assess road-stream crossing barriers and prioritize for removal*					
SONCC-UKR.5.1.21.2	*Remove road-stream crossing barriers and upgrade culvert*					
SONCC-UKR.5.1.80	Passage	Yes	Improve access	Remove structural barriers	Population wide	3b
SONCC-UKR.5.1.80.1	*Assess road-stream crossing barriers and prioritize for removal*					
SONCC-UKR.5.1.80.2	*Remove road-stream crossing barriers and upgrade culvert*					
SONCC-UKR.3.1.48	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Seiad, Horse, Little Horse, and Cottonwood creeks, and all streams where coho salmon would benefit immediately	3a
SONCC-UKR.3.1.48.1	*Install flow gage to ensure appropriate flows for coho salmon*					
SONCC-UKR.3.1.48.2	*Maintain flow gage annually*					
SONCC-UKR.3.1.74	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	3b
SONCC-UKR.3.1.74.1	*Install flow gage to ensure appropriate flows for coho salmon*					
SONCC-UKR.3.1.74.2	*Maintain flow gage annually*					
SONCC-UKR.3.2.12	Hydrology	Yes	Increase water storage	Improve regulatory mechanisms	Population wide	3a
SONCC-UKR.3.2.12.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.3.2.11	Hydrology	Yes	Increase water storage	Increase beaver abundance	Seiad, Horse, Cottonwood, Little Horse, Horse, and Beaver creeks, and all streams where coho salmon would benefit immediately	3a
SONCC-UKR.3.2.11.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-UKR.3.2.11.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-UKR.3.2.11.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-UKR.3.2.78	Hydrology	Yes	Increase water storage	Increase beaver abundance	Population wide	3b
SONCC-UKR.3.2.78.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-UKR.3.2.78.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-UKR.3.2.78.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-UKR.5.1.22	Passage	Yes	Improve access	Remove push-up dam type barriers	Horse Creek	3b
SONCC-UKR.5.1.22.1	*Develop a plan to remove the push up dam and increase flows*					
SONCC-UKR.5.1.22.2	*Remove push up dam, guided by the plan*					
SONCC-UKR.5.1.22.3	*Install flow measuring devices to ensure that water rights and flows are maintained*					
SONCC-UKR.5.1.22.4	*Maintain flow measuring devices*					
SONCC-UKR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3b
SONCC-UKR.3.1.8.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-UKR.3.1.8.2	*Implement water dedications to increase instream flows using the streamlined process*					
SONCC-UKR.3.1.9	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3b
SONCC-UKR.3.1.9.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-UKR.3.2.10	Hydrology	Yes	Increase water storage	Improve regulatory mechanisms	Population wide	3b
SONCC-UKR.3.2.10.1	*Establish a comprehensive groundwater permit process*					
SONCC-UKR.3.1.64	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	3b
SONCC-UKR.3.1.64.1	*Identify and cease unauthorized water diversions*					
SONCC-UKR.3.1.76	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-UKR.3.1.76.1	*Identify and cease unauthorized water diversions*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.3.1.67	Hydrology	No	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	3b
SONCC-UKR.3.1.67.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-UKR.3.1.67.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-UKR.3.1.67.3	*Implement coho salmon instream flow needs plan.*					
SONCC-UKR.7.1.13	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Private lands along the mainstem Klamath Corridor, Horse, Cottonwood, Willow, Bogus, and Beaver creeks, and all areas where coho salmon would benefit immediately	3b
SONCC-UKR.7.1.13.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-UKR.7.1.13.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-UKR.7.1.13.3	*Plant vegetation to stabilize stream bank*					
SONCC-UKR.7.1.13.4	*Fence livestock out of riparian zones*					
SONCC-UKR.7.1.13.5	*Remove instream livestock watering sources*					
SONCC-UKR.7.1.82	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-UKR.7.1.82.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-UKR.7.1.82.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-UKR.7.1.82.3	*Plant vegetation to stabilize stream bank*					
SONCC-UKR.7.1.82.4	*Fence livestock out of riparian zones*					
SONCC-UKR.7.1.82.5	*Remove instream livestock watering sources*					
SONCC-UKR.8.2.27	Sediment	No	Increase spawning gravel	Enhance spawning substrate	Mainstem, downstream of Iron Gate dam	3b
SONCC-UKR.8.2.27.1	*Develop a spawning substrate management plan that identifies quantity, quality, location, and timing of gravel supplements*					
SONCC-UKR.8.2.27.2	*Supplement gravel, guided by the plan*					
SONCC-UKR.8.1.29	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Watersheds that provide natal habitat and/or thermal refugia for coho salmon, and all areas where coho salmon would benefit immediately	3c
SONCC-UKR.8.1.29.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-UKR.8.1.29.2	*Implement plan to stabilize slopes and revegetate areas*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.8.1.84	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-UKR.8.1.84.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-UKR.8.1.84.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-UKR.10.2.51	Water Quality	No	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	3c
SONCC-UKR.10.2.51.1	*Develop a pesticide management plan*					
SONCC-UKR.10.2.51.2	*Implement pesticide management plan and technical assistance program*					
SONCC-UKR.10.2.69	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-UKR.10.2.69.1	*Develop a pesticide management plan*					
SONCC-UKR.10.2.69.2	*Implement pesticide management plan and technical assistance program*					
SONCC-UKR.10.7.63	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-UKR.10.7.63.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-UKR.10.7.63.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-UKR.10.7.70	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-UKR.10.7.70.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-UKR.10.7.70.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-UKR.16.1.30	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UKR.16.1.30.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-UKR.16.1.30.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-UKR.16.1.61	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-UKR.16.1.61.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-UKR.16.1.61.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.16.1.31	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UKR.16.1.31.1	*Determine actual fishing impacts*					
SONCC-UKR.16.1.31.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-UKR.16.1.62	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-UKR.16.1.62.1	*Determine actual fishing impacts*					
SONCC-UKR.16.1.62.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-UKR.16.2.32	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UKR.16.2.32.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-UKR.16.2.32.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-UKR.16.2.33	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UKR.16.2.33.1	*Determine actual impacts of scientific collection*					
SONCC-UKR.16.2.33.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-UKR.5.1.23	Passage	Yes	Improve access	Reduce flow barriers	Empire, Willow, Cottonwood, Lumgrey, Barkhouse, Seiad, Horse, and Humbug creeks	BR
SONCC-UKR.5.1.23.1	*Assess low flow tributaries and their sediment sources that contribute to seasonal flow barriers. Develop a plan to alleviate sediment delivery and remove current barriers*					
SONCC-UKR.5.1.23.2	*Alleviate sediment delivery in areas with low flow conditions and seasonal flow barriers as described in the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UKR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	BR
SONCC-UKR.3.1.7.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-UKR.7.1.14	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce fire hazard	Private land in the Upper Klamath Basin	BR
SONCC-UKR.7.1.14.1	*Develop fire hazard reduction educational materials for landowners*					
SONCC-UKR.7.1.14.2	*Develop a plan for fire break stewardship and defensible space*					
SONCC-UKR.7.1.14.3	*Implement fire-safe community action plans in identified areas*					
SONCC-UKR.7.1.15	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Seiad, Barkhouse, and Williams creeks	BR
SONCC-UKR.7.1.15.1	*Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime that benefits coho habitat*					
SONCC-UKR.7.1.15.2	*Carry out fuel reduction projects such as thinning and prescribed burning, guided by the strategic plan*					

35. Salmon River Population

Interior Klamath Stratum

Non-Core 1, Potentially Independent Population

High Extinction Risk

Population likely below depensation threshold

450 spawners needed for ESU Viability

751 mi^2 watershed (99% Federal ownership)

115 IP-km (71 IP-mi) (2% High)

Dominant Land Uses are Wilderness, Conservation, and Vegetation Management via Commercial Thinning and Fuels Treatment

Key Limiting Stresses are 'Lack of Floodplain and Channel' and 'Structure'Degraded Riparian Conditions'

Key Limiting Threats are 'Climate Change' and 'High Severity Fire'

Highest Priority Recovery Actions

• Increase large woody debris (LWD), boulders, and other instream structure • Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows • Re-establish a natural fire regime	• Remove, setback, or reconfigure historic mine tailings • Protect existing or potential cold water refugia • Increase instream flows guided by NCRWQCB TMDL Implementation Plan

35.1 History of Habitat and Land Use

Karuk, Shasta, and Konomihu Indians first inhabited the Salmon River. As in the past, the Karuk and Shasta still emphasize the importance of Salmon River aquatic resources in their ceremonial and daily use activities (Elder et al. 2002). Starting in the 1850s, land use changes in the Salmon River watershed, such as large scale hydraulic mining and timber harvest, began to alter river channels, tributaries, and riparian areas. Between 1870 and 1950, an estimated 15 million cubic yards of sediment was discharged into the Salmon River as a result of gold mining activities (Elder et al. 2002).

Major channel and landscape modifications ensued, especially in the upper South Fork of the Salmon River. Mining activities impacted the landscape, vegetation, soil, water quality, and channel structure in many fish-bearing streams (United States Forest Service [USFS] 1995c). Many of these impacts are still apparent on the many bare slopes and large tailing piles seen throughout the watershed. Remnant mine tailings and riparian disturbance continue to affect coho salmon habitat in the Salmon River and mined-over floodplains and terraces have remained poorly vegetated many decades after large-scale mining ended. The removal of soil down to bedrock in the Petersburg and Summerville areas has severely hampered vegetation growth (USFS 1994a).

When mining activities peaked in the watershed, the Salmon River and many of its tributary streams were dammed, diverted, or drained, which blocked fish migration (Taft and Shapovalov 1935, Handley and Coots 1953). A dam near Sawyers Bar on the North Fork of the Salmon River prevented fish from passing until the 1950s. Another dam located four to five miles above the Forks of Salmon on the South Fork of the Salmon River blocked migration for at least 50 years (Elder et al. 2002).

Over the years, major flood events have led to large scale disturbance and landscape modification. Historical accounts indicate major floods in 1861 to 1862 and again in 1889 to 1890 (McGlashan and Briggs 1939). Major floods in the Salmon River also occurred in 1953, 1955, 1964, 1970, 1971, 1972, 1974, and 1997 (Elder et al. 2002). The floods of 1955, 1964, and 1970 to 1974 created large scale landslide episodes and the 1964 flood resulted in major stream channel widening and modification (Elder et al. 2002). Floods caused channel migration, aggradation, scour, and widespread loss of riparian vegetation, with most low gradient floodplains stripped of riparian vegetation and covered with fresh sediment.

Timber harvest historically occurred in much of the watershed. Early timber harvest in the Salmon River basin was associated with mining and homesteading activities, with commercial harvest on public land beginning in earnest in the 1950s. Federally-managed land comprises nearly 99 percent of the Salmon River basin. By 1974, there were approximately 7,500 acres of harvested public land in the watershed, and by 1989, there were about 30,000 acres (Elder et al. 2002). To date, timber has been harvested from 47,995 acres (NCRWQCB 2005b), or 10 percent of the watershed. Prior to implementation of the Northwest Forest Plan, timber harvest extended into the riparian zone in many areas of the watershed (USFS 1994a). Two of the most significant outcomes of these timber harvest activities have been the associated changes in the natural fire regime and the substantial building of road networks throughout the basin.

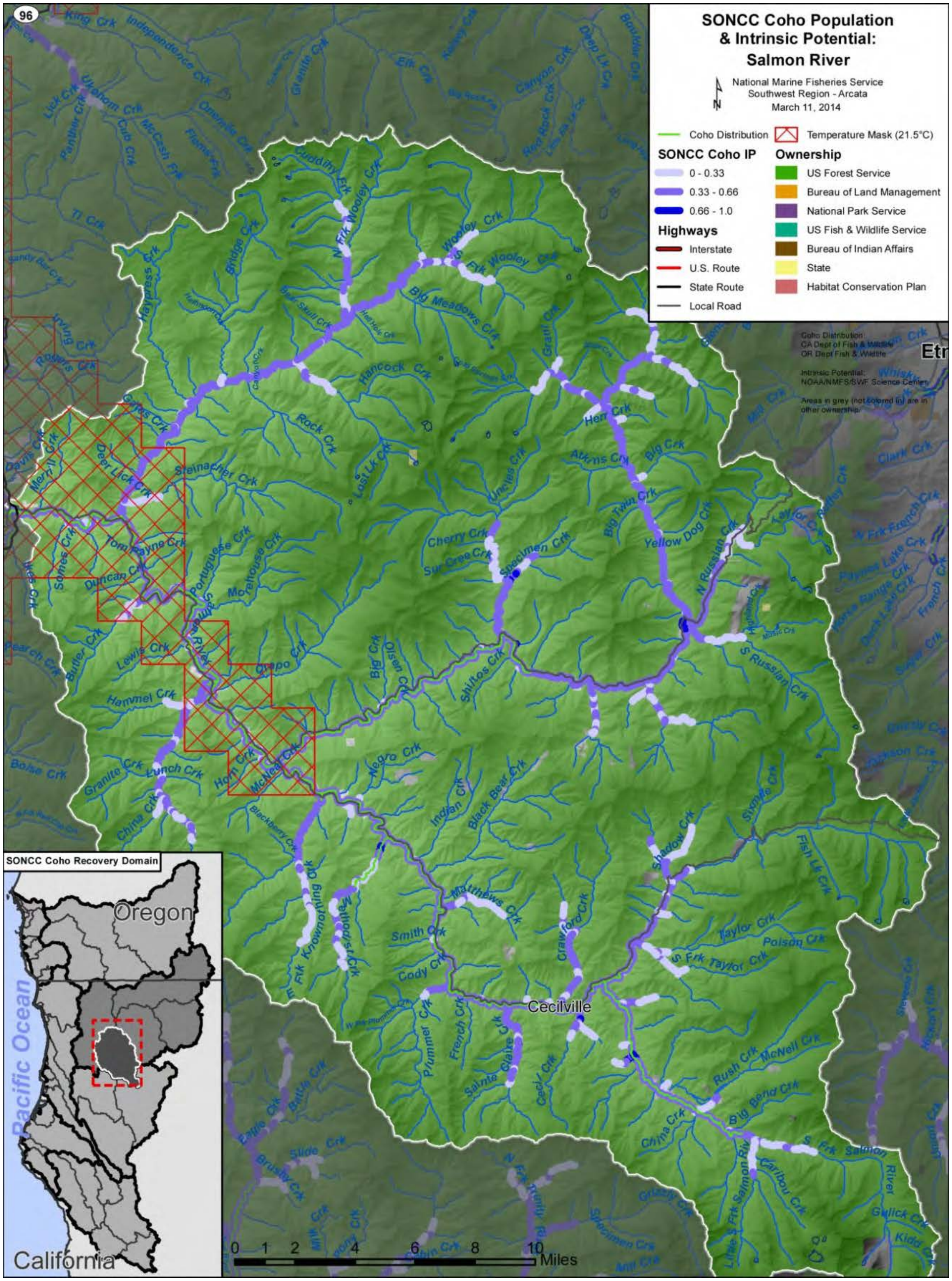

Figure 35-1. The geographic boundaries of the Salmon River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon). land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Klamath River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

Much of the damage to riparian areas in the Little North Fork is the result of landslides associated with road construction and timber harvest that occurred in the early 1970s, in conjunction with major flood events (USFS 1995c). Over the past 50 years, roads have been an on-going source of sediment to streams through surface erosion and landslides. By 1944, there were about 188 miles of roads in the Salmon River watershed, most built in association with timber harvest. By 1989, the amount of road on federal lands had increased to 766 miles (USFS 2011a). Currently, there are over 900 miles of federal and private roads in the watershed, mostly located in the Klamath National Forest. As of 2011, an active Klamath National Forest road decommissioning and storm-proofing program has inventoried the Salmon River Basin's 766 miles of federally-maintained roads, completed decommissioning of 84.4 miles of roads with high sediment source potential, and storm-proofed 76.2 miles of priority roads (USFS 2011a).

35.2 Historical Fish Distribution and Abundance

The 480,619 acre Salmon River watershed hosts spring and fall runs of Chinook salmon, coho salmon, and steelhead; although many of these runs exist as remnant populations. Little is known about historic run sizes of coho salmon in the Salmon River sub-basin. The IP model suggests the Salmon River has a moderate carrying capacity for coho salmon, with less than 5 kilometers having a high IP value (>0.66; Figure 35-1). The majority of the 115 IP-km of potential habitat has a medium IP value (0.33 to 0.66) and portions of many small tributaries have low IP value (<0.33). Historic coho salmon habitat in the Salmon River includes 105 miles found along the mainstem and several tributaries, and run sizes were on the order of 2,000 adults per year (California Department of Water Resources [CDWR] 1965). Data collected from the early 1960s show coho salmon runs in the Salmon River were already on the decline, with California Department of Fish and Wildlife (CDFW; formerly California Department of Fish and Game [CDFG]) estimating an annual coho salmon spawning escapement for that year of only 800 (CDFG 1965). This decline continued between 1985 and 1991, based on data from a weir operated by CDFW near the mouth of the Salmon River in conjunction with spawning ground surveys, when adult abundance estimates fluctuated between a record low of only two coho salmon in 1985 and a high of 75 in 1987 (CDFG 1992).

Juvenile presence/absence and abundance data from a variety of surveys in the late 1970s to late 1990s indicate that many of the tributaries throughout the watershed were being used for rearing (Brownell et al. 1999). Juvenile coho salmon were found in 11 tributaries in the watershed including tributaries to the lower Salmon, Wooley Creek, and the North and South Fork Salmon (Brownell et al. 1999).

35.3 Status of Salmon River Coho Salmon

Spatial Structure and Diversity

Twelve percent of the 1,414 miles of stream within the Salmon River watershed are able to support anadromous salmonids, due to the mountainous topography and associated hydrology of the landscape (Elder et al. 2002). Coho salmon habitat includes the mainstem Salmon River, Wooley Creek, the North Fork and South Fork Salmon Rivers, and the lower reaches of a few smaller tributaries. For this reason, coho salmon in the Salmon River population are naturally restricted in their distribution.

Known coho salmon spawning has been observed in the Nordheimer Creek, Logan Gulch, Brazil Flat, and Forks of Salmon areas along the mainstem Salmon River, in the Knownothing and Methodist Creek reaches of the South Fork Salmon River, and in the lower North Fork Salmon River (Salmon River Restoration Council [SRRC] 2007, SRRC 2010a). The total linear stream distance used by spawning coho salmon from 2004 to 2010 is at least 8 km of surveyed stream habitat. Surveys suggest that specific spawning areas are re-visited each year and that fish in certain spawning areas may have specific life history traits, such as different run timing (Pennington, N., pers. comm., 2009). Based on the low hatchery influence and small population size, the genetic structure of the population likely retains much of its wild character, but overall the level of natural genetic diversity has likely declined.

Juvenile coho salmon have been found rearing in most of the available tributary habitat with moderate or high IP values. These streams are tributaries to the South Fork Salmon (Knownothing and Methodist Creek), at least nine tributaries to the North Fork Salmon, and in mainstem Salmon River tributaries of Nordheimer and Butler Creeks (SRRC 2008a). The lower reaches of these tributaries provide substantially cooler summer habitat than mainstem river habitat. Current data only includes presence/absence information; however, there is some indication that juvenile coho salmon move up from the mainstem Klamath River into the cooler Salmon River tributaries during summer months when stressed by mainstem water temperatures (USFS 2009b). Juveniles found in surveys are thought to be of both natal and non-natal origin.

The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 35 coho salmon per IP-km of habitat are needed (4,000 low-risk spawner threshold) to approximate the historical distribution of Salmon River coho salmon and habitat. Based on current spawning densities and locations, the Salmon River population’s spatial structure and diversity appear limited compared to historic conditions.

Population Size and Productivity

Survey data indicates that there are low numbers of coho salmon, and that the population is below depensation levels. In most years, only a handful of adults and/or redds are found during the spawning season. Annual returns of adults are likely less than 50 per year (SRRC 2008b). Since stream flow level and visibility in the Salmon River watershed often make coho salmon surveys difficult or impossible, these estimates could be the result of the inability to count all individuals present as well as the low abundance of the population.

Spawning surveys in the late 1980s (USFS 1991) and early 1990s failed to document the existence of coho salmon (Olson and Dix 1992). Since 2002, the SRRC along with CDFW, the Karuk Tribe, the USFS and the USFWS have conducted spawning and juvenile surveys throughout the watershed. Annual adult coho salmon abundance in the Salmon River varied between 0 and 14 spawning adults from 2002 to 2005 (SRRC 2006). As mentioned above, coho salmon spawning has been observed in the Nordheimer Creek; Logan Gulch, Brazil Flat, and Forks of Salmon areas of the mainstem Salmon River; in the Knownothing and Methodist Creek reaches of the South Fork Salmon River; and in the Lower North Fork Salmon River (SRRC 2010a). In spawning/redd surveys in 2003 and 2004, which covered a large extent of suspected coho salmon distribution within the watershed, only 3 and 14 coho salmon were observed respectively (SRRC 2006). Surveys in 2006 resulted in observations of one adult coho salmon and five redds in Knownothing and Nordheimer Creeks (SRRC 2007). Between 2002 and 2007, a total of 18 adults (average of 3 spawners per year) and 12 redds were found in approximately 25 km of surveyed habitat. In 2009, surveys limited to Knownothing and Nordheimer Creeks resulted in the observation of 7 redds in Nordheimer Creek (SRRC 2010a).

Young of the year (YOY) and yearling abundance is also low in the Salmon River, indicating that production is low. Between 2002 and 2004, only 112 YOY and 2 yearlings were captured during outmigrant trapping in the lower Salmon River at RKM 1.5 (Sartori 2006). Juveniles have been found utilizing the lower reaches of many of the tributary streams during both the winter and summer; however, abundance data is unavailable (SRRC 2010a). Some juveniles likely originate from outside the Salmon River and rear in the Salmon River (USFS 2009b).

Extinction Risk

The Salmon River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Salmon River population is a non-core, Potentially Independent population within the Interior Klamath River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, but strongly influenced by immigration from other populations such that they did not exhibit independent dynamics (Williams et al. 2006). The Salmon River population is strongly influenced by upstream populations. Adult strays from these populations spawn and interact with coho salmon in the Salmon River. To contribute to stratum and ESU viability, the Salmon River non-core population should have at least 450 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Furthermore, the Salmon River population will contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to other Interior Klamath River populations.

35.4 Plans and Assessments

State of California

Salmon River Total Maximum Daily Load for Temperature and Implementation Plan
http://www.swrcb.ca.gov/northcoast/water_issues/programs/tmdls/salmon_river/

The North Coast Regional Water Quality Control Board (NCRWQCB) identified the Salmon River as an impaired water body under the Clean Water Act Section 303(d) as a result of excessive stream temperatures and nutrients. Because the U.S. Forest Service controls 98.7% of the Salmon River watershed, and has designated this watershed as a high priority in a restoration strategy, the TMDL relies on a Memorandum of Understanding (MOU), the terms of which link the existing USFS analysis and commitments to TMDL objectives and load allocations. The load allocation, when achieved, is expected to result in the attainment of the applicable water quality standard for temperature for the Salmon River and its tributaries. This TMDL focuses on stream temperature conditions in the watershed, for which the Salmon River is listed under Section 303(d). Because of a recommendation to the State Water Resources Control Board to delist the Salmon River for nutrients, there is currently only a TMDL for temperature.

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish and Game Commission in February 2004. The recommendations developed by the Coho Recovery Team and CDFW for the Salmon River basin have been considered and incorporated into the table of population-specific recovery actions at the end of this document.

The Salmon River Restoration Council (SSRC)

SRRC Salmon River Sub-basin Restoration Strategy
http://www.srrc.org/publications/general/SRRC%20Salmon%20River%20Sub-basin%20Restoration%20Strategy.pdf

The 2002 Salmon River restoration strategy, jointly developed by the Klamath National Forest and SRRC, was built upon watershed analyses, transportation planning documents and other administrative investigations. The focus of the strategy is on restoring the biological, geologic, and hydrologic processes that shape aquatic habitat and the resulting plan focuses on reduction of upslope risks and hazards in watersheds with high quality habitat and native fish populations. Restoration objectives and recommendations on target watershed conditions are included in the strategy.

Salmon River Road Sediment Source Assessment (2001)

Private Roads Sediment Reduction Project, Final Report (2011)
http://www.srrc.org/publications/programs/roads/Salmon%20River%20Private%20Roads%20Sediment%20Reduction%20Project%20Final%20Report.pdf

Salmon River Riparian Assessment, 2006 to present

Salmon River Cooperative Noxious Weed Program Strategy for Restoring Native Plant Communities (2003)

Limiting Factors for Salmon River Spring Chinook Life Stages (draft)

U.S. Forest Service – Klamath National Forest (KNF)

Evaluation of Fish Habitat Condition and Utilization in Salmon, Scott, Shasta, and Mid Klamath Sub-basins 1988/89.

Forest-Wide Late Successional Reserve Assessment (1999)

Salmon Sub-Basin Sediment Analysis (1994)

Upper South Fork of the Salmon River Ecosystem Analysis (1994)

South Fork of the Salmon River Ecosystem Analysis (1994)

Main Salmon Ecosystem Analysis (1995)

North Fork Watershed Analysis (1995)

Lower South Fork of the Salmon River Ecosystem Analysis (1997)

North Fork Salmon River Watershed Access and Travel Management Plan (1998)

Upper South Fork Salmon River Watershed Access Analysis (1997)

Ukonom Travel and Access Management Plan (1996)

Klamath National Forest Forestwide Roads Analysis (2002)

Roads Analysis Process (RAP) for North (2003) and South Forks of Salmon River (2005)

Klamath Motorized Travel Management Plan, Siskiyou County, California (2010)

Sufficiency Assessment: Forest Service and Bureau of Land Management Programs in Support of SONCC Coho Salmon Recovery (USFS and BLM 2011).

Klamath Motorized Travel Management Plan, Siskiyou County, California (2010)

The KNF, with partner Northern California Resource Center, completed a Forest-wide assessment of fish passage at road stream crossings during 2002-2004. Since then, the KNF has upgraded 7 crossings in the Salmon River Watershed to allow for free passage of all aquatic organisms. Four of these crossings are just upstream of coho salmon critical habitat and three are within critical habitat on Methodist, Cecil, and Taylor creeks. Currently the KNF, along with partner Salmon River Restoration Council, are planning the Hotelling Gulch aquatic habitat restoration project that would provide aquatic organism passage at a county road crossing and access to approximately 1.4 miles of potential habitat in this SF Salmon River tributary. The KNF will continue to pursue this and other fish passage restoration projects where barriers to fish passage are identified.

The USFS has adopted a Watershed Condition Framework assessment and planning approach (USFS and BLM 2011). The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, the South Fork of the Salmon River was identified as a high priority 6th field sub-watershed in the Klamath National Forest (USFS and BLM 2011).

Salmon River Fire Safe Council

Recent Salmon River Community Wildfire Protection Plans
http://www.srrc.org/publications/index.php

The Salmon River Fire Safe Council formed in 2000 in order to gain more involvement from agencies and the community on fire issues. The mission of the Salmon River Fire Safe Council is to help plan, implement and monitor the reinstatement of natural fire regimes in the Salmon River ecosystem in a manner that protects life and property, improves forest health, and enhances the resources valued by its stakeholders. The Fire Safe Council has been working on two levels of fire planning. They have completed a draft Community Wildfire Protection Plan for the entire watershed and are working to develop more detailed Community Wildfire Protection Plans for the towns and neighborhoods in the watershed. The SRRC and the Forest Service work together to develop partnership agreements and memorandums of understanding for various resource protection, enhancement, and awareness projects in the Salmon River watershed. Through the Fire Safe Council, there is coordination of fire planning and fuel reduction activities with community members, the Karuk Tribe, CalFire, US Fish & Wildlife Service, National Marine Fisheries Service, Salmon River Volunteer Fire and Rescue, the Salmon River and Orleans Ranger Districts, and others.

35.5 Stresses

Table 35-1. Severity of stresses affecting each life stage of coho salmon in the Salmon River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	High	High	High[1]	Medium	Medium	High
2	Degraded Riparian Forest Conditions[1]	-	High	High[1]	Medium	Medium	High
3	Impaired Water Quality	Low	Medium	High	Medium	Medium	Medium
4	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
5	Altered Sediment Supply	Medium	Medium	Medium	Low	Low	Medium
6	Impaired Estuary/Mainstem Function	-	Low	High	High	Low	High
7	Increased Disease/Predation/Competition	Low	Low	Medium	Medium	Medium	Medium
8	Altered Hydrologic Function	Low	Low	Medium	Low	Low	Low
9	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
10	Barriers	-	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages and Habitat

Lack of floodplain and channel structure and degraded riparian forest conditions are the key limiting stresses for the Salmon River population of coho salmon, with the juvenile life stage being the most limited. Water quality and riparian conditions are both degraded in the watershed and off-channel habitat is minimal due to the bedrock geology and steep terrain. The SRRC analyzed what limiting factors were important for Spring Chinook salmon in the watershed and found that temperature (in the mainstem Klamath and Salmon River), pool size and quantity, thermal barriers, flow, disease, and sediment embeddedness were all important factors limiting productivity of that population and likely the Salmon River coho salmon population as well (SRRC 2008b).

The juvenile life stage is likely the most limited and quality summer and winter rearing habitat is likely lacking as vital habitat for the population. Juvenile summer rearing habitat is impaired by high temperatures with few thermal refugia areas accessible. Winter off-channel rearing habitat is naturally lacking and may force juveniles downstream where they may rear in the estuary or in off-channel habitat in the mainstem (NMFS 2007b).

Lack of Floodplain and Channel Structure

Floodplain and channel structure are generally based on physical characteristics that create complex habitat (e.g., pool depths, substrate size, and large woody debris quantity). Floodplain and channel structure in the Salmon River generally do not support many of the life history requirements of coho salmon due to the natural confinement of the watershed and the high frequency of disturbance. The IP model supports this presumption based on the low amount of high IP habitat in the Salmon River (Figure 35-1). Human-related activities have further limited floodplain, channel form, and function by altering floodplain habitat through mining activities (e.g., South Fork Salmon), changes in the natural fire regime, and erosion related to road-building and timber harvest. Natural disturbance regimes have been impacted by human activities and the consequences for floodplain and channel structure are that some disturbances such as fire and slope failure are more common and intense. Large wood is often flushed from the system by flooding and the associated stream power of the Salmon River. Because large wood typically influences the deposition and sorting of sediment, the loss of wood has led to excessive mobilization and input of sediment to streams. Floodplain habitat is often naturally disconnected due to steep canyon walls, but in some cases floodplains have been disconnected by large scale landslides, road building, and mine tailings. Sediment loading in some areas has filled pool habitat and simplified stream reaches.

Because off-channel and low-velocity habitat is already limited in the basin, any loss or alteration of existing habitat can have a disproportionate negative impact. Effects of floodplain and channel structure on the egg stage occur from channel confinement, substrate size, and the amount of bedrock in some reaches. Effects on fry and juveniles occur from the loss and degradation of off-channel and low-velocity rearing and refugia habitat, and to a lesser extent on smolts. Lack of floodplain and channel structure is a medium stress to adults due to a lack of suitable spawning habitat and altered channel form and function.

Degraded Riparian Forest Conditions

The recovery of riparian vegetation height and extent from past disturbances is expected to be the most important factor at a landscape scale in lowering stream temperatures toward natural levels (NCRWQCB 2005b). Riparian forests in the Salmon River have been primarily impacted by disturbances such as flooding and fire. Although these disturbances are natural to the Salmon River, their increased frequency and severity have caused large scale impacts to ecosystem processes. Based on the altered composition (decreased diversity and age class distribution) and decreased size of vegetation, the poor condition of riparian forests within the Salmon River watershed is a high stress to the fry and juvenile coho salmon life stages and medium stress for other life stages. Available data (USFS 2000c) indicate that lack of riparian cover is of particular concern in the North Fork and South Fork Salmon Rivers where there has been more than 25 percent (of which more than 10 percent was somewhat recent) disturbance. By comparison, the riparian corridors along the lower mainstem Salmon River and Wooley Creek are considered "very good" (fully functioning), and contain less than 10 percent disturbance (5 percent fairly recent) (USFS 2000c). Many riparian areas have been altered by large mass wasting events, high severity fires, and anthropogenic activities. Almost 25 percent of riparian areas have been scoured by debris torrents or degraded by fire (USFS 1994a) and only 27 percent of riparian areas have forest cover greater than 70 percent crown closure (USFS 1995d). Disturbance has resulted in fewer large trees in the riparian area, especially conifers, and a much greater extent of bare areas. Most of these changes are attributed to the 1964 flood, while others are attributed to disturbance by human activity or a combination of floods, fires, and human activity (USFS 1995d).

Currently riparian vegetation consists of fewer stands of large, dense conifers than were present before Euro-American settlement. The lack of functional riparian forest throughout the basin also limits the amount of large wood entering streams, leads to increased erosion and bank instability, and can lead to high stream temperatures. In areas where riparian forest conditions are impaired, rearing habitat for fry and juveniles is likely limited and/or impaired and holding habitat for adults is often lacking. Water quality is also impaired in many of these areas and can affect growth and survival of juveniles during the summer.

Impaired Water Quality

Although data indicate that water quality is good for many parameters, the Salmon River experiences impaired temperatures (>17^{o} C) (NCRWQCB 2005b), fair dissolved oxygen (DO) (8.5 to 8.75), and elevated pH levels (8.5 to 8.75; Wilkie and Wood 1995) at times during the summer, early fall and especially during low-flow conditions. Aquatic invertebrate EPT and species richness scores were both indicative of good aquatic health in the watershed although there are potentially site-specific issues with contamination from past mining activities and fire retardant misapplication. Little information is available on the extent of contamination from these types of activities. Water temperature is the most significant issue affecting water quality in the Salmon River and exerts a stress on all life stages of coho salmon in the Salmon River population. Data from throughout the basin indicates that impaired water temperatures, sometimes exceeding sublethal levels (i.e., >17^{o}C) occur during late summer in all the major tributaries and mainstems of the North Fork, South Fork, and Lower Salmon (NCRWQCB 2005b). This results in a high stress on juveniles, a medium stress on fry, smolt and adult, and a low stress on the egg life stages. Most tributary temperatures are below lethal levels (NCRWQCB 2005b).

In areas that would be cooled by riparian shade (e.g., smaller tributaries), the reduction and compositional alteration of riparian vegetation along the river and its tributaries has led to increased water temperatures. This issue is exacerbated in dry years when stream flows are low, and in summer and early fall when water temperatures are highest. The only sources of cool water are smaller tributaries with adequate shading. The lack of available cool summer habitat is especially stressful for rearing juveniles, which can be at risk of reduced growth, disease, infection, and eventual mortality during these periods.

Adverse Hatchery Related Effects

No hatcheries are present, and no artificial propagation occurs in the Salmon River population area, but Iron Gate Hatchery is located upstream on the Klamath River. Strays from other Klamath Basin hatcheries are known to utilize the Salmon River for spawning and potentially rearing (Pennington, N., pers. comm., 2008). The proportion of spawning adults in the Salmon River that are from a hatchery is unknown. Adverse hatchery-related effects pose a medium risk to all life stages, due to the presence of Iron Gate Hatchery and Trinity River Hatchery in the Klamath basin (Appendix B).

Altered Sediment Supply

The quality and type of sediments delivered to stream channels within the Salmon River watershed do not generally present a significant stress to coho salmon. Based on measurements of fine sediments in channels (i.e., V*; Cover et al. 2008, USFS 2010a, SRRC 2011), there is little accumulation of fine sediment in channels and pools within the watershed, except in Crapo Creek and Taylor Creek. In areas where excess sediment loading has occurred, the early life stages of coho salmon are most affected since it often results in simplified rearing habitat and impaired water quality. Due to the steep slopes and localized soil instability, sediment loading in the Salmon River continues to be elevated in some reference stream reaches, resulting in an overall medium stress for the population.

Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the Salmon River migrate to and from the ocean through the mainstem Klamath River and the Klamath River estuary. Also, due to the lack of winter rearing habitat in the Salmon River, many juveniles move downstream during high flows and must find rearing and refugia habitat in the lower Klamath River and estuary. The importance of the lower basin to this population is largely unknown. However, a proportion of the coho salmon population likely spend a substantial amount of time rearing downstream of the Salmon River. For coho salmon that rear downstream of the Salmon River, the mainstem and estuary conditions play an important part in their growth and survival. Other coho salmon may pass through the mainstem and estuary on their way to and from the ocean, using these habitats primarily for migration. Although small compared to the large size of the watershed, the estuary provides rearing habitat for juvenile coho salmon. The estuary, although relatively intact, suffers from impaired water quality, elevated sedimentation, loss of habitat, and disconnection from tributary streams and the floodplain. More information about the Klamath River estuary can be found in the Lower Klamath River population profile.

Elevated water temperatures, sedimentation, disease, and degraded habitat conditions exist in mainstem reaches. Juveniles, smolts, and adults in mainstem habitats are stressed by the degraded conditions in these migratory and rearing habitats. Disease, access and availability of rearing and migratory (holding) habitat, and lack of connectivity between tributaries and the mainstem are all issues that impact the quality of rearing and migratory habitat downstream of the Salmon River. Although the prevalence of diseases is low in mainstem reaches downstream of the Salmon River, disease is still an issue when water temperatures are high and fish are stressed.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Increased Disease/Predation/Competition

Although disease, predation, and competition are not limiting factors for coho salmon in the Salmon River, adult coho salmon migrating through the Klamath River to spawn in the Salmon River are exposed to disease as are juveniles and smolt that redistribute to find rearing habitat in the mainstem Klamath or are outmigrating through the mainstem. For this reason, disease is considered a medium stress for juveniles, smolt, and adults. Pathogens that cause diseases in juveniles and adults include *Ceratonova shasta*, Ichthyopthirius *multifilis* (Ich*), Flavobacterium columnare* (columnaris), Aeromonid bacteria, *Nanophyetus salmonicola*, and the kidney myxosporean *Parvicapsula minibicornis* (Federal Regulatory Energy Commission (FERC) 2007, National Research Council (NRC) 2004). Disease occurs when conditions for the pathogen are favorable and when fish are susceptible. Ich and columnaris were responsible for the significant die-off event in the Lower Klamath River in the summer of 2002. Infection by *P. minibicornis* may occur at a prevalence of greater than 50 percent of juvenile coho salmon. It is unknown how often they cause direct mortality (Bartholomew and Courter 2007). Juvenile mortality rates from short term and longer term exposures at various locations in the Klamath River vary by location and time of year. Between 2008 and 2010 mortality ranged from 0 to less than 10 percent at the Orleans site (Bartholomew 2012). Further discussion of disease issues occurring in the mainstem Klamath River is included in the Upper, Middle, and Lower Klamath population profiles.

Altered Hydrologic Function

Altered hydrologic function is a medium stress for juvenile coho salmon and a low stress for all other life stages. There is little impervious surface area within the watershed and no major barriers or diversions to block or reduce flow. However, there are numerous small diversions throughout the watershed that can have a cumulative impact on the amount of surface flow, particularly diminished summer flows from tributaries that provide rearing refugia for juvenile salmonids (USFS 2011b). The lower Salmon River was ranked by the U.S. Forest Service as having a “fair,” or partially functional flow regime (USFS 2000c). This was based on the timing, rate of change, and/or duration of mid-range discharges, which were considered to impair aquatic habitat availability in this drainage area. Though diversions may have localized effects, overall peak and low flows are thought to remain primarily unaltered in this area.

Barriers

Although several man-made barriers exist on small tributaries throughout the Salmon River, most of these barriers exist outside the range of coho salmon and do not impede access (CalFish 2013). Several fish passage barriers at road-stream crossings have been prioritized for fish passage in the past but the most significant barriers have been removed or remediated (Taylor et al. 2002). An example of coordinated barrier removal is the Whites Gulch Dam removal project (http://www.srrc.org/programs/riparian.php), and the subsequent upgrade of a Siskiyou County road crossing downstream on lower Whites Gulch in August 2009. One remaining large barrier associated with the road crossing over lower Hotelling Gulch, is under review for barrier removal (USFS 2010b). In addition to man-made barriers, natural seasonal low flow barriers block passage to some reaches. Because many tributaries provide thermal refuge when mainstem water temperatures rise in the summer, ensuring access to all fish bearing tributaries is important.

35.6 Threats

Table 35-2. Severity of threats affecting each life stage of coho salmon in the Salmon River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Climate Change[1]	Medium	Medium	Very High[1]	Very High	Medium	Very High
2	High Severity Fire[1]	Medium	Medium	Medium[1]	Medium	Medium	Medium
3	Roads	Medium	Medium	Medium	Medium	Medium	Medium
4	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
5	Mining/Gravel Extraction	Low	Medium	Medium	Medium	Low	Medium
6	Fishing and Collecting	-	-	Low	Low	Medium	Low
7	Dams/Diversions	Low	Low	Low	Low	Low	Low
8	Invasive Non-Native/Alien Species	Low	Low	Low	Low	Low	Low
9	Agricultural Practices	Low	Low	Low	Low	Low	Low
10	Timber Harvest	Low	Low	Low	Low	Low	Low
11	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
12	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low

[1] Key limiting threats and limited life stage
[2] Channelization/Diking is not considered a threat to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are climate change and high severity fire.

Climate Change

The greatest threat is likely from climate change, particularly from the predicted changes in temperature and precipitation. Climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperatures show a large increase over the next 50 years (see Appendix B for modeling methods). Average ambient temperature could increase by up to 3 °C in the summer and by 1.3 °C in the winter. Recent studies have already shown that water temperatures in the mainstem Klamath River have been increasing at a rate of 0.4 to 0.6 °C/decade since the early 1960s (Bartholow 2005). The season of high temperatures that are potentially stressful to salmon has lengthened by about 1 month and the average length of mainstem river with cool summer temperatures (<15 °C) has declined by about 8.2 km/decade (Bartholow 2005). Annual precipitation in this area is already low and is predicted to trend downward over the next century, while snowpack in upper elevations of the basin is expected to decrease with changes in temperature and precipitation regime (California Natural Resources Agency 2009). Juvenile rearing and migratory habitat in the Salmon River and mainstem Klamath River is most at risk to climate change as are migratory conditions in the Klamath River for adults. Increasing ambient temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Overall, the range and degree of temperature increase and precipitation volatility are likely to continue in all populations. Eggs and fry will be impacted by larger and more frequent flooding and mass wasting events than have historically occurred, which will be especially significant in this area due to the steep terrain and unstable geology. Adults will also be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

High Severity Fire

The Salmon River watershed is naturally a fire-adapted landscape with a relatively frequent recurrence of wildfire. The fire regime historically was highly variable in terms of frequency, severity, and spatial pattern (Frost and Sweeney 2000). The predominant fire regime was relatively frequent (every 10 to 50 years) low and moderate severity, with varying-sized patches of high severity fire. However, because of land management activities over the past 150 years including clearcut timber harvest and fire suppression, high fuel loading occurs throughout the watershed and causes fires to burn much hotter and longer. In many lower and mid-elevation areas and in high elevation areas that have not burned in the last 45 years, current vegetative structure and patterns strongly favor high severity, frequent fires (SRRC 2007).

After several fires in 1917 and 1918, which burned 6,270 and 15,660 acres respectively, effective fire suppression began in the 1920s and continues to the present in some areas. Without natural fire on the landscape to reduce fuel loads, areas without fuels treatment now have a higher risk of catastrophic fire. The result is an ecosystem with more frequent, more intense fires. In the latter quarter of the 20th century, high severity fires became more common and more detrimental to watershed health. An estimated 29 percent of the Salmon River watershed has burned since the early 1970s with isolated pockets of high severity fires occurring in some sub-watersheds (Elder et al. 2002). Under natural fire regimes, a much higher percentage of the watershed likely would have been affected by fire; however, these fires would have been at a much lower intensity, thereby preventing high severity, stand replacing fires as seen recently. Recent efforts have shifted from suppression to strategic landscape level fuels reduction, prescribed fire, and controlled burns as a means to mitigate high severity fire.

The impacts to coho salmon associated with high severity fire make this an immediate threat to this population. Fires affect salmon and salmon habitat in the Salmon River in a number of ways. Catastrophic fires denude riparian areas, which in turn increase water temperatures through the loss of riparian shading. Snow pack and water retention has been reduced in denuded areas, affecting the hydrology of the basin (Vajda et al. 2006). Fire in upslope areas has also led to increased soil erosion and sediment delivery, which has resulted in stream aggradation, pool filling, and in extreme cases landslides, debris torrents, or other forms of mass wasting (Elder et al. 2002). Recent large-scale fires that resulted in lost or degraded coho salmon habitat include the Forks Complex (37,000 acres in 2013), Backbone and Red Spot (6,324 acres in 2009), Ukonom Complex (80,000 acres in 2008), and the Uncles Complex (48,085 acres in 2006; SRRC 2010b). Current efforts to reduce fuels and reintroduce low intensity fire into the landscape through fire use and under-burning aim to address this problem and should lessen this threat over time.

At present, fuel loading is a high hazard in many areas of the watershed, and the Salmon River Sub-basin Restoration Strategy (Elder et al. 2002) identifies fire as the primary long-term risk to the aquatic and terrestrial ecosystems within the Salmon River watershed, due to resulting impacts on sediment and water temperatures (Elder et al. 2002).

Roads

Sedimentation from roads will continue to detrimentally impact the population. Road-related sediment mobilizations, however, are expected to decrease over time as road decommissioning and upgrading continues by the Klamath National Forest. Existing roads are considered a medium threat to all life stages of coho salmon in the Salmon River. In 2011, there were over 900 miles of roads within the Salmon River watershed. Most of these roads are within the South Fork and North Fork Salmon River drainages and their density within specific drainages is variable. The drainages with the highest density of roads (very high; >3 mi./sq. mi.) include Negro Creek, McNeal Creek, Eddy Gulch, Cecil Creek, Indian Creek, and Crawford Creek. At least 14 other drainages have a rating of "high" road density (2.5 to 3.0 mi. /mi^2; Elder et al. 2002). At these levels, salmon habitat is considered to be "not properly functioning" or as having degraded functions (NMFS 1996) due to the impacts of increased sedimentation, riparian condition, hydrology, water quality, slope stability, habitat complexity (especially large wood transportation and delivery), and fish passage.

In the Salmon River watershed, roads account for 90 percent of the human caused sediment and 43 percent of expected surface erosion (Elder et al. 2002). Roads have a significant impact on slope stability in an area which is naturally prone to landslides and erosion. Roads are significantly correlated with the number of landslides within the watershed, with roaded areas in the Salmon River watershed being 27 times more likely to yield landslides than undisturbed sites (De la Fuente and Elder 1998). When roads are built within the riparian corridor, they impact stream habitat through the loss and/or degradation of riparian function. Within the Salmon River basin, approximately 79 miles of roads are within Riparian Reserves (USFS 1995c). Within these areas, opportunities for the establishment of riparian vegetation are limited, particularly along major road arteries that track the mainstem and forks of the Salmon River. Given the elevated summer water temperatures along these reaches of the Salmon River, it will be important to reduce the impacts of roads in order to increase riparian shading and decrease stream filling due to sedimentation. In order to address sediment source issues on 15 road-related sediment mobilization sites within the Salmon River watershed, the Salmon River Private Roads Sediment Reduction Project (PWA 2011) has upgraded and decommissioned approximately 3.1 miles of roads in the Salmon River basin. The Klamath National Forest also continues to mitigate road-related hydrologic connection on public land in the Salmon River watershed, has implemented many road decommissioning and storm proofing projects in the

South Fork Salmon River watershed, and is implementing several road improvement projects in the North Fork Salmon River and Upper South Fork Salmon River watersheds (Perrochet, J., pers. comm., 2011). These efforts should reduce the impacts of roads on watershed conditions in the future.

Hatcheries

Hatcheries pose a medium threat to all life stages in Salmon River watershed. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Mining/Gravel Extraction

Several thousand acres of public lands are currently reserved as mining claims including more than 400 placer and lode mining claims in the Salmon River basin (Elder et al. 2002). Most mining activity is currently pursued at a part-time or hobby level by individuals. The active gold mining occurs mostly as placer mining along the South Fork Salmon and Knownothing Creek, as hard-rock mining at the Discovery Day Mine, and as recreational gold suction dredging or panning has occurred at various locations throughout the Salmon River watershed. The last commercial gold mine closed in the 1990s (Elder et al. 2002), while three hard rock mining special use permits were issued during the 2000s. Overall, mining activities in the Salmon River have decreased significantly from historic levels, though there remain significant legacy effects from remnant tailing piles associated with past placer mining. Suction dredge mining had been increasing until the cessation of suction dredging permit issuance by the state of California in 2009. In response, high banking practices (processing gravel materials along the shoreline) are becoming more common. The potential for future mining operations, and the number of claims that could be utilized, suggest that mining/gravel extraction is a medium threat to coho salmon.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Dams/Diversions

Although small scale diversions and dams exist within the watershed, they are mostly confined to smaller tributaries and are not believed to significantly impact coho salmon. The diversions that exist are mostly associated with mining activities and residential use, and may have the cumulative potential to affect stream hydrology or migration and rearing of juveniles. Other dams may include small dams for recreational use (e.g., swimming holes) and are monitored opportunistically by CDFW and SRRC during surveys.

Invasive Non-Native/Alien Species

Noxious weeds in the Salmon River watershed have become an ongoing problem throughout the basin. Fire and fire suppression crews are thought to play a major role in the introduction and establishment of weed species. The SRRC manages a noxious weed program for 11 species of weeds found in the watershed and has been successful in hindering the establishment and spread of these species. The SRRC has eradicated 99 percent of the largest infestation of spotted knapweed. Invasive species are currently considered a low threat to this population because of the success of this program.

Agricultural Practices

Unlike the upper Klamath Basin, the Salmon River watershed does not lend itself to large-scale agricultural or grazing, although grazing has occurred within the watershed at some level since the mid-1800s. The Salmon River watershed is highly forested and steeply sloped, and current grazing is primarily within transitory rangeland in or adjacent to USFS wilderness areas. There are currently four grazing allotments within the boundary of the watershed: Big Flat, Carter Meadows, Garden Gulch, and South Russian Creek. The total area of these allotments is small, and the Klamath National Forest currently manages these areas for ecological benefits (USFS 1995c). In terms of grazing impacts, there is little evidence to suggest a direct linkage between existing grazing management and increased stream temperatures in the Salmon River watershed. Most grazing occurs in the headwater drainages well above anadromous fish habitat and current levels likely do not pose a significant threat to coho salmon. Therefore, agricultural practices are considered a low threat for all life stages.

Timber Harvest

Timber harvest, although once a major land use in the basin and a significant threat to coho salmon, is now restricted to just a few thousand acres of upland habitat. Much of the land that was once logged is now part of National Forest Riparian Reserves, Late Successional Reserves, or wilderness, none of which are designated for timber harvesting. Since 2000, timber harvesting and other vegetation treatments have primarily emphasized maintenance and/or improvement of resource values and objectives, such as maintenance of habitat diversity and strategic wildfire hazard reduction. Timber harvest is a low level threat for the population.

Urban/Residential/Industrial Development

Residences are dispersed throughout the watershed with concentrations located in, or near, the towns of Sawyers Bar, Cecilville, Somes Bar, and Forks of Salmon. In addition, the community is made up of several outlying small neighborhoods and isolated forest residencies. With only 250 residents within the watershed, and expected future population growth under 2 percent, urban, residential, and industrial development is very minor and is considered a low threat to coho salmon in this population.

Road-stream Crossing Barriers

Several road-stream crossing within the watershed are considered barriers to adult and juvenile coho migration. The SRRC has helped to identify the known man-made fish barriers in the Salmon River watershed and is cooperating with partners to remove these barriers. Several were ranked as priorities for removal by the Siskiyou County Culvert Inventory and Fish Passage Evaluation (Taylor et al. 2002) with four of the top six priority sites in the Salmon River watershed. Currently, all four fish passage issues have been, or are currently being, addressed by the SRRC, the county, and their partners. Several impassable culverts have already been replaced (Whites Gulch, Kelly Gulch, Merrill Creek) and the remaining significant barrier on lower Hotelling Gulch is undergoing a feasibility study for treatment. Because of the limited scope of this problem in the watershed and the ongoing efforts to address it, road-stream crossing barriers in the watershed currently constitute a low threat to coho salmon.

35.7 Recovery Strategy

Summertime temperatures and a lack of winter rearing habitat remain the greatest stresses for juvenile coho salmon and overall the small population size limits the potential for natural salmon recovery. Restoration opportunities are limited on private land because the majority of land in the watershed is public and managed by the U.S. Forest Service as a Key Watershed under the Northwest Forest Plan (USFS 1994a); however, many of the hurdles facing restoration in other watersheds are not present in the Salmon River.

Improvements of mainstem rearing and migratory habitat are expected to occur as a result of recovery actions in the three mainstem Klamath River populations. It is expected that the threat from climate change will be mitigated by addressing the key limiting stresses. By improving connection to off channel habitat and increasing riparian cover, water temperatures should cool and slow water refuge habitat will be improved to help buffer against the warming summer climate and large flow events in the winter. Specific emphasis has been placed in this recovery strategy on meeting habitat needs associated with the current TMDL for temperature (NCRWQCB 2005b) and on the recommendations outlined in the Salmon Sub-basin Restoration Strategy (Elder et al. 2002).

The highest priority should be improving the quality and extent of rearing habitat and refugia. For summer rearing, reducing water temperatures in the watershed, along with protecting and restoring thermal refugia is the top priority. For winter rearing, improving connectivity to existing off-channel habitat, and increasing the extent and quality of winter rearing areas is essential. Juvenile rearing habitat, located primarily in lower tributary reaches, should be restored or re-created wherever possible, to provide increased opportunities for winter rearing in the watershed. Efforts to improve riparian habitat condition such as planting and protecting riparian vegetation will be important to the long term recovery strategy. The effects of fishing on this population’s ability to meet its viability criteria should be evaluated.

Table 35-3 on the following page lists the recovery actions for the Salmon River population.

Table 35-3. Recovery action implementation schedule for the Salmon River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SalR.2.1.8	Floodplain and Channel Structure	Yes	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately, guided by Karuk tribe data, SRRC Riparian assessment information, CDFW, or USFS data.	2a
SONCC-SalR.2.1.8.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SalR.2.1.8.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-SalR.2.1.38	Floodplain and Channel Structure	Yes	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-SalR.2.1.38.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SalR.2.1.38.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-SalR.2.1.7	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately, guided by Karuk tribe data and SRRC Riparian assessment information.	2a
SONCC-SalR.2.1.7.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SalR.2.1.7.2	*Place instream structures, guided by assessment results*					
SONCC-SalR.2.1.37	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-SalR.2.1.37.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SalR.2.1.37.2	*Place instream structures, guided by assessment results*					
SONCC-SalR.2.2.25	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure historical mine tailings	In areas that would benefit coho immediately	2a
SONCC-SalR.2.2.25.1	*Assess feasibility of mine tailing manipulation that includes restoring the natural channel form and floodplain connectivity*					
SONCC-SalR.2.2.25.2	*Implement mine tailing restoration actions guided by feasibility assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SalR.7.1.2	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Basin-wide, guided by priorities in USFS WCF and SRCC WCPP	2b
SONCC-SalR.7.1.2.1	*Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime*					
SONCC-SalR.7.1.2.2	*Carry out fuel reduction or modification projects such as thinning, prescribed burning, and piling, guided by the plan*					
SONCC-SalR.26.1.33	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-SalR.26.1.33.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-SalR.3.1.4	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately, guided by NCRWQCB 2005 TMDL Implementation Plan	2c
SONCC-SalR.3.1.4.1	*Assess basin wide water diversion projects and prioritize areas in need of increased flows. Develop a plan to obtain adequate flows for riparian resources*					
SONCC-SalR.3.1.4.2	*Reduce diversions, guided by the plan*					
SONCC-SalR.3.1.4.3	*Assess potential for vegetation management projects to improve flow timing or volume*					
SONCC-SalR.3.1.39	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-SalR.3.1.39.1	*Assess basin wide water diversion projects and prioritize areas in need of increased flows. Develop a plan to obtain adequate flows for riparian resources*					
SONCC-SalR.3.1.39.2	*Reduce diversions, guided by the plan*					
SONCC-SalR.3.1.39.3	*Assess potential for vegetation management projects to improve flow timing or volume*					
SONCC-SalR.10.3.5	Water Quality	No	Protect cold water	Protect existing or potential cold water refugia	All streams where coho salmon would benefit immediately	2c
SONCC-SalR.10.3.5.1	*Develop resource protection measures for mining, water drafting, fire suppression, and other actions to avoid adverse effects to water temperature in coho habitat*					
SONCC-SalR.10.3.5.2	*Develop educational materials for landowners to expand stewardship program*					
SONCC-SalR.10.3.5.3	*Develop an emergency action plan and implement measures to protect thermal refugia during excessively long warm or dry periods*					
SONCC-SalR.10.3.35	Water Quality	No	Protect cold water	Protect existing or potential cold water refugia	Population wide	2d
SONCC-SalR.10.3.35.1	*Develop resource protection measures for mining, water drafting, fire suppression, and other actions to avoid adverse effects to water temperature in coho habitat*					
SONCC-SalR.10.3.35.2	*Develop educational materials for landowners to expand stewardship program*					
SONCC-SalR.10.3.35.3	*Develop an emergency action plan and implement measures to protect thermal refugia during excessively long warm or dry periods*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SalR.10.2.6	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	All streams where coho salmon would benefit immediately, using WCF and road inventory data to update Salmon River SRR strategy	2c
SONCC-SalR.10.2.6.1	*Implement the Salmon River TMDL Implementation Plan for temperature*					
SONCC-SalR.10.2.6.2	*Identify, inventory and develop mitigation plan for discharge and polluted sites (e.g., nutrients, algae, metals, coliform) that are not road related*					
SONCC-SalR.10.2.6.3	*Implement mitigation plan for discharge and polluted sites*					
SONCC-SalR.10.2.34	Water Quality	No	Reduce pollutants	Reduce point- and non-point source pollution	Population wide	2d
SONCC-SalR.10.2.34.1	*Implement the Salmon River TMDL Implementation Plan for temperature*					
SONCC-SalR.10.2.34.2	*Identify, inventory and develop mitigation plan for discharge and polluted sites (e.g., nutrients, algae, metals, coliform) that are not road related*					
SONCC-SalR.10.2.34.3	*Implement mitigation plan for discharge and polluted sites*					
SONCC-SalR.5.1.10	Passage	No	Improve access	Remove barrier	Lower reaches of tributaries (e.g., Nordheimer Creek) and all streams where coho salmon would benefit immediately	3a
SONCC-SalR.5.1.10.1	*Restore and maintain habitat connectivity between the Salmon River and tributaries where low flow or sediment aggradation has been known to restrict coho salmon passage*					
SONCC-SalR.5.1.40	Passage	No	Improve access	Remove barrier	Population wide	3b
SONCC-SalR.5.1.40.1	*Restore and maintain habitat connectivity between the Salmon River and tributaries where low flow or sediment aggradation has been known to restrict coho salmon passage*					
SONCC-SalR.5.1.43	Passage	No	Improve access	Remove barrier	Nordheimer Creek	3a
SONCC-SalR.5.1.43.1	*Determine whether to maintain or decommission the Nordheimer Creek fish ladder*					
SONCC-SalR.5.1.9	Passage	No	Improve access	Restore access to overwinter areas	All streams where coho salmon would benefit immediately, guided by 5 Counties data and SRRC Riparian Assessment information; including Hotelling Gulch, Little Cronan Gulch	3a
SONCC-SalR.5.1.9.1	*Identify and prioritize removal of remaining high priority barriers that prevent access to side channels and over wintering areas, and allow passage of all coho life stages*					
SONCC-SalR.5.1.9.2	*Remove or modify high priority barriers to allow passage of coho salmon at all life stages*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SalR.5.1.41	Passage	No	Improve access	Restore access to overwinter areas	Population wide	3b
SONCC-SalR.5.1.41.1	*Identify and prioritize removal of remaining high priority barriers that prevent access to side channels and over wintering areas, and allow passage of all coho life stages*					
SONCC-SalR.5.1.41.2	*Remove or modify high priority barriers to allow passage of coho salmon at all life stages*					
SONCC-SalR.7.1.1	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	High IP sub watersheds, guided by SRRC Riparian Assessment information	3b
SONCC-SalR.7.1.1.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-SalR.7.1.1.2	*Thin, or release conifers, guided by the plan*					
SONCC-SalR.7.1.1.3	*Plant conifers, guided by the plan*					
SONCC-SalR.7.1.1.4	*Control non-native/invasive species in prioritized areas*					
SONCC-SalR.8.1.26	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	In areas that would benefit coho immediately	3b
SONCC-SalR.8.1.26.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-SalR.8.1.26.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-SalR.8.1.3	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Areas identified in USFS WCF and SRCC WCPP, all streams where coho salmon would benefit immediately	3c
SONCC-SalR.8.1.3.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-SalR.8.1.3.2	*Decommission roads, guided by assessment*					
SONCC-SalR.8.1.3.3	*Upgrade roads, guided by assessment*					
SONCC-SalR.8.1.3.4	*Maintain roads, guided by assessment*					
SONCC-SalR.8.1.42	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-SalR.8.1.42.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-SalR.8.1.42.2	*Decommission roads, guided by assessment*					
SONCC-SalR.8.1.42.3	*Upgrade roads, guided by assessment*					
SONCC-SalR.8.1.42.4	*Maintain roads, guided by assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SalR.10.7.32	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-SalR.10.7.32.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-SalR.10.7.32.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-SalR.10.7.36	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-SalR.10.7.36.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-SalR.10.7.36.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-SalR.1.2.20	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary	3d
SONCC-SalR.1.2.20.1	*Implement recovery actions for Lower Klamath River population that address the target "Estuary", including the creation/restoration of off-channel rearing habitat throughout the lower Klamath River*					
SONCC-SalR.16.1.11	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SalR.16.1.11.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-SalR.16.1.11.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-SalR.16.1.30	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-SalR.16.1.30.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-SalR.16.1.30.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-SalR.16.1.12	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SalR.16.1.12.1	*Determine actual fishing impacts*					
SONCC-SalR.16.1.12.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SalR.16.1.31	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-SalR.16.1.31.1	*Determine actual fishing impacts*					
SONCC-SalR.16.1.31.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-SalR.16.2.13	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SalR.16.2.13.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-SalR.16.2.13.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-SalR.16.2.14	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SalR.16.2.14.1	*Determine actual impacts of scientific collection*					
SONCC-SalR.16.2.14.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					

36. Scott River Population

Interior Klamath Stratum

Core, Functionally Independent Population

Moderate Extinction Risk

Population likely above depensation threshold

6,500 Spawners Required for ESU Viability

813.4 mi^2 watershed (37% Federal ownership)

250 IP-km (155 IP-mi) (78% High)

Dominant Land Uses are Agriculture, Ranching, and Forest Vegetation Management via Commercial Thinning and Fuels Treatment

Key Limiting Stresses are ‘Altered Hydrologic Function’ and ‘Degraded Riparian Forest Conditions’

Key Limiting Threats are ‘Agricultural Practices’ and ‘Dams/Diversions’

Highest Priority Recovery Actions

• Increase beaver abundance	• Remove, setback, or reconfigure levees and dikes
• Construct off channel-ponds, alcoves, backwater habitat, and old stream oxbows	• Increase instream flows
• Restore natural channel form and function	• Improve irrigation practices

36.1 History of Habitat and Land Use

Habitat for coho salmon within the Scott River basin has been altered by numerous human activities, affecting both instream conditions and adjacent riparian and upland slopes. Alterations to habitat and changes in land uses include previous removal of beaver, road construction, agricultural practices, river channelization, dams and diversions, timber harvest, mining/dredging, gravel extraction, high severity fires, and rural residential development. These anthropogenic impacts, combined with natural factors such as recurring floods (e.g., 1955, 1964, and 1997) erosive soil, and a warm and dry climate, have simplified, degraded, and fragmented migrating, spawning, and rearing habitat throughout the Scott River basin.

Agriculture and grazing have been, and continue to be the major land use in the Scott Valley, with commercial timber harvest and recreation in wilderness areas predominating in upland areas. Water diversions for agricultural practices, groundwater extraction, cattle grazing, residential/domestic water use, and flood control have diminished surface flows and greatly reduced or eliminated access to and use of historical coho salmon habitat in the Scott Valley (California Department of Fish and Game [CDFG] 2002b). In addition, livestock grazing persists in six Klamath National Forest grazing allotments in the Marble Mountains along the western boundary of the Scott River basin (U.S. Forest Service [USFS] 2006). Diminished allotment grazing and improved monitoring of grazing allotment condition and trend began in 2006, and is designed to detect changes in water quality (QVIR 2012) and to inform changes in grazing pressure, timing, and duration, as needed (NMFS 2010, NRST 2013).

Approximately one-third of the Scott Basin is managed by the US Forest Service or the Bureau of Land Management, particularly the upper elevations of the watersheds on the western perimeter of the Scott Basin (Westside drainages; Harter and Hines 2008). The loss of vegetative cover, bank erosion, and reduced stream flow has increased summer water temperatures throughout the watershed, decreasing the quantity and quality of rearing habitat, and limiting the fitness and survival of juveniles throughout the system. Additionally, decreases in habitat complexity through the loss of woody debris, instream cover, deep pools, accessible off channel habitat, and temperature-buffered water sources have contributed to reduced summer and winter rearing capacity for juvenile coho salmon (CDFG 2002).

Road construction and ground disturbance have adversely affected water quality and flows in the Scott River basin. The quantity and location of vegetation removal, surface grading, and ground compaction have modified drainage patterns and surface runoff throughout the basin. Such modification has also exacerbated surface erosion resulting in excess sediment delivery to coho salmon habitat (National Research Council [NRC] 2004). Land use activities involving vegetation removal have also led to mass wasting by reducing root soil binding strength and decreasing the extent of riparian buffers where sediment and polluted water can be intercepted before entering watercourses (USFS 2000d).

Following the floods of the 1930s, the US Army Corps of Engineers, at the request of Siskiyou County, removed the remaining vegetation through the middle of the Scott Valley, straightened portions of the Scott River channel, and built levees for flood control. Additional flood control levees were later built along lower Etna, Kidder and Moffett creeks (Mack 1958, Scott River Watershed Council [SRWC] 1997). Channelization of the mainstem Scott River has resulted in

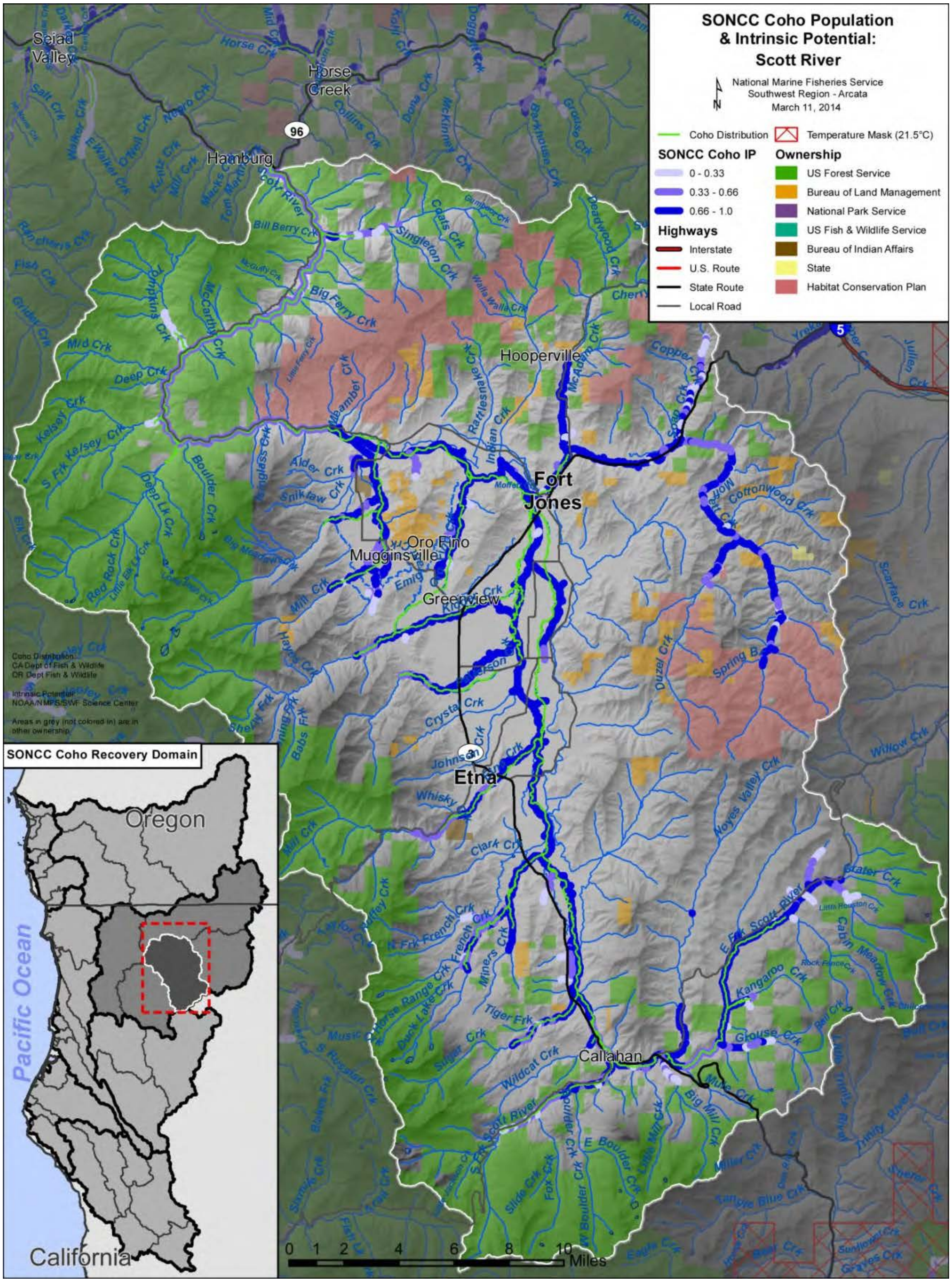

Figure 36-1. The geographic boundaries of the Scott River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Klamath River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

channel simplification and incision, channel destabilization, and vegetation instability in areas immediately adjacent to and contained by these levees (SRWC 2005, Van Kirk and Naman 2008). Channelization has also exacerbated the accumulation of large volumes of coarse sediment in transitional reaches of tributaries to the Scott River, contributing to diminished surface flow, stream flow disconnection, barriers to fish passage, and increased need to tap groundwater resources.

Investigation of the relationship between groundwater and surface flow has been undertaken via a community groundwater study plan (Harter and Hines 2008), an integrated hydrologic model (Foglia et al. 2013), a groundwater conditions study (Popadopolous 2012), and a groundwater management and enhancement plan (Scott Valley Groundwater Advisory Committee 2012). These studies help document interactions between groundwater use and water availability in adjacent riparian habitat. Many beaver ponds, which historically provided important impoundments and diverse channel margin habitat attractive to coho salmon, were lost with the removal of beavers from the valley (SRWC 2005, CDFG 2009a). These changes in habitat have decreased the availability and extent of off-channel rearing habitat, altered the hydrology of the lower mainstem river, and caused changes in bedload movement and available spawning habitat throughout the channelized area (Mack 1958). This alteration of habitat, that accompanied the loss of beavers, has further decreased the fitness and survivability of coho salmon in the Scott River basin. Beaver reoccupation of portions of the mainstem Scott River, French Creek, Sugar Creek, and Shackleford/Mill creeks is occurring, and is expected to progressively expand and improve coho salmon rearing habitat (Pollock et al. 2012).

Mechanized timber harvest began in the 1950s, and overstory removal was the dominant regeneration harvest method (USFS 2006). From the 1960s to the 1980s, clear-cutting was common, and many plantations were established on KNF-managed lands in the Scott River basin. Timber harvest practices changed in the early 1990s with clear cutting practices giving way to selective cutting on KNF-managed land, using reduced impact timber harvesting methods. Legacy clear cut and plantation areas, along with lands affected by wildland fires, have created large stands of young, regeneration forests in upland portions of the Scott River basin (USFS 2000d). Road building, tree felling, skidding, and haul road use adversely affected water quality and peak/base flows in coho salmon habitat. Ground disturbance, compaction, and/or vegetation removal adjacent to streams during timber harvest modified drainage patterns and surface runoff, exacerbating surface erosion, creating a hydrologic connection to the stream network, and resulting in sediment delivery to coho salmon habitat downstream (Sommarstrom et al. 1990). Sediment source reduction projects were implemented during the 1990s and 2000s, treating significant sediment-generating road segments on both public and private lands.

Pervasive changes to the landscape began in 1850 with the discovery of gold, when many riparian areas along the Scott River and its tributaries were disturbed by gold mining of alluvial deposits using panning, sluicing, or dredging (i.e., placer mining). Dredge mining, using pressurized water later became common along many streams, and continued through the 1940s (USFS 2006). Large areas were stripped of vegetation and the remaining gravel deposits were hydraulically or mechanically worked to retrieve deposited gold. These activities left a legacy of unvegetated, heavily disturbed gravel deposits (e.g., tailings piles) mostly devoid of soil, and created permanent changes in floodplain and channel characteristics. Tailing piles are especially apparent along nearly five miles of the mainstem Scott River downstream from Callahan, and are common along many tributaries to the Scott River. Floating dredge operations occurring there from the mid-1930s through the early 1950s have reconfigured the entire Scott River valley, confining the active Scott River to one side of its historical floodplain. Many riparian areas in the Scott River basin were poorly vegetated and erodible (USFS 1997b) until livestock exclusion fencing and riparian restoration efforts began in the 1990s. Recent stream bank stabilization, bio-engineering efforts, riparian planting, and beaver habitat enhancement are all contributing to progressive improvement of riparian habitat conditions, in both quality and quantity (SRWC 2005, NCRWQCB 2009).

36.2 Historical Fish Distribution and Abundance

The Scott River basin has historically been an important native coho salmon river in the Interior Klamath River diversity stratum (Brown et al. 1994, Moyle et al. 2008, Garwood 2012). In 1851, George Gibbs noted that Native American health improved when salmon were present in interior areas of the Klamath Basin, including the Scott Valley area (Heizer 1972). In recent times, spawning and/or redds of coho salmon have been observed in the mainstem Scott River and its tributaries, including: East Fork Scott River, South Fork Scott River, Sugar Creek, French Creek, Miners Creek, Etna Creek, Kidder Creek, Patterson Creek, Shackleford Creek, Mill Creek, Canyon Creek, Kelsey Creek, Tompkins Creek, and Scott Bar Mill Creek (Soil Conservation Service 1972, CDFG 1974, Maurer 2005, Yokel 2007-2011, Calfish 2013). The IP model shows the highest values (IP > 0.66) throughout the Scott Valley and low gradient reaches of tributaries to the Scott River (Table 36-1.). Other Scott River tributaries that have high IP include Rail, Kangaroo, Grouse, Sniktaw, Emmigrant, Oro Fino, Cottonwood and Duzel creeks.

Table 36-1. Tributaries with high IP reaches (IP > 0.66); Williams et al. 2006.

Subarea	Stream Name	Subarea	Stream Name
Scott Valley	Shackleford Creek[1]	**Scott Valley**	Wildcat Creek
	Mill Creek[1]		Etna Creek[1]
	French Creek[1]		Boulder Creek[1]
	Miners Creek[1]		Kidder Creek[1]
	South Fork Scott River[1]		Noyes Valley Creek
	Sugar Creek[1]		Moffett Creek
	Wooliver Creek[1]	**Scott Bar**	Canyon Creek[1]
	Big Mill Creek[1]		Kelsey Creek[1]
	East Fork Scott River[1]		Mill Creek (near Scott Bar)[1]
	Patterson Creek[1]		Tompkins Creek[1]

[1] Denotes a "Key Stream" as identified in the State of California's Coho Recovery Strategy, and in which SONCC coho salmon have been observed since 2001.

Coho salmon abundance prior to the mid-20th century is available primarily via anecdotal accounts, with little numerical information. The California Department of Water Resources (CDWR 1965) estimated the Scott River's adult coho salmon population in the early 1960s to be 2,000. Lanse (1971) estimated that a total of 111 juvenile and zero adult coho salmon were harvested by anglers in a study of the mainstem Scott River from its mouth to the town of Callahan. Between 1982 and 1991, the California Department of Fish and Wildlife (formerly CDFG), operated a weir in the Scott River at river kilometer 2.6 (RM 1.6) near the confluence with the Klamath River to obtain fall-run Chinook salmon escapement estimates (Knechtle 2008). At this location, the counting weir was vulnerable to high flows that generally forced the removal of the weir before the conclusion of the coho salmon migration and spawning period (early November through January). However, early returning coho salmon were counted while the weir was operating (Table 36-2.).

Table 36-2. Number of adult coho salmon observed at the Scott River weir. Weir was operated by the CDFG Klamath River Project (Shasta Scott Recovery Team 2003).

Year	Dates of Operation	Jacks	Adults	Total*
1982	9/14 to 10/29	0	5	5
1983	9/14 to 11/03	1	21	22
1984	9/10 to 10/31	12	38	50
1985	9/03 to 11/12	0	1	1
1986	9/11 to 11/19	18	49	67
1987	9/25 to 11/18	12	248	260
1988	9/24 to 11/09	No coho salmon reported		
1989	9/08 to 10/22	1	7	8
1990	9/08 to 10/28	1	6	7
1991	9/10 to 11/05	0	3	3

*Total numbers of coho salmon observed should not be construed as escapement values as the weir was removed prior to the peak adult coho salmon migration.

Coho salmon juveniles were found regularly in several French Creek reaches as part of an annual September electrofishing monitoring effort by the French Creek Watershed Advisory Group (1992). Beginning in 1993, coho salmon juveniles were documented in French Creek for the first time, with 7 coho salmon found only in Miner's Creek and none in the other five reach sites. In 1996, 50 juvenile coho were estimated for three sites in the mainstem of French Creek but none in Miner's Creek. A total of 215 coho salmon juveniles were found in 1999, with 65% of these at the Miner's Creek site. In 2000, two juveniles were observed at one site, with 15 fish observed at two sites in 2001. In 2002, the 3-year population pattern emerged again but this time in record numbers, with 628 coho salmon juveniles identified at 5 sites (Maria 2002). Incidental observations indicate that French Creek coho salmon production may be increasing, though formal quantitative monitoring is not currently being conducted to confirm these observations.

Coho salmon spawning surveys were initiated in the Scott River watershed in the fall 2001/winter 2002 spawning year (Maurer 2002), yielding 173 live adult coho salmon observations. These spawning grounds surveys have been conducted yearly since then to provide annual estimates and distribution of returning adult SONCC coho salmon (Yokel 2011, Yokel 2013). In 2007, the CDFW installed a new resistance board weir and video counting flume in the Scott River at river kilometer 29.3 on public lands managed by the Klamath National Forest. Operation of this weir has improved the CDFW's ability to monitor adult coho salmon returns to the upper reaches of the Scott River. In addition, CDFW has increased efforts to document the number and distribution of adult coho salmon spawning in the mainstem and tributaries downstream of the video weir. These two efforts, along with spawning ground surveys conducted by the SRCD in the upper Scott River and tributary streams entering Scott Valley, have improved the accuracy of adult coho salmon population estimates in recent years. Data for 2013 indicate that at least 2,731 adult coho salmon returned to the Scott River upstream of the video weir (Figure 36-2; Knechtle 2014).

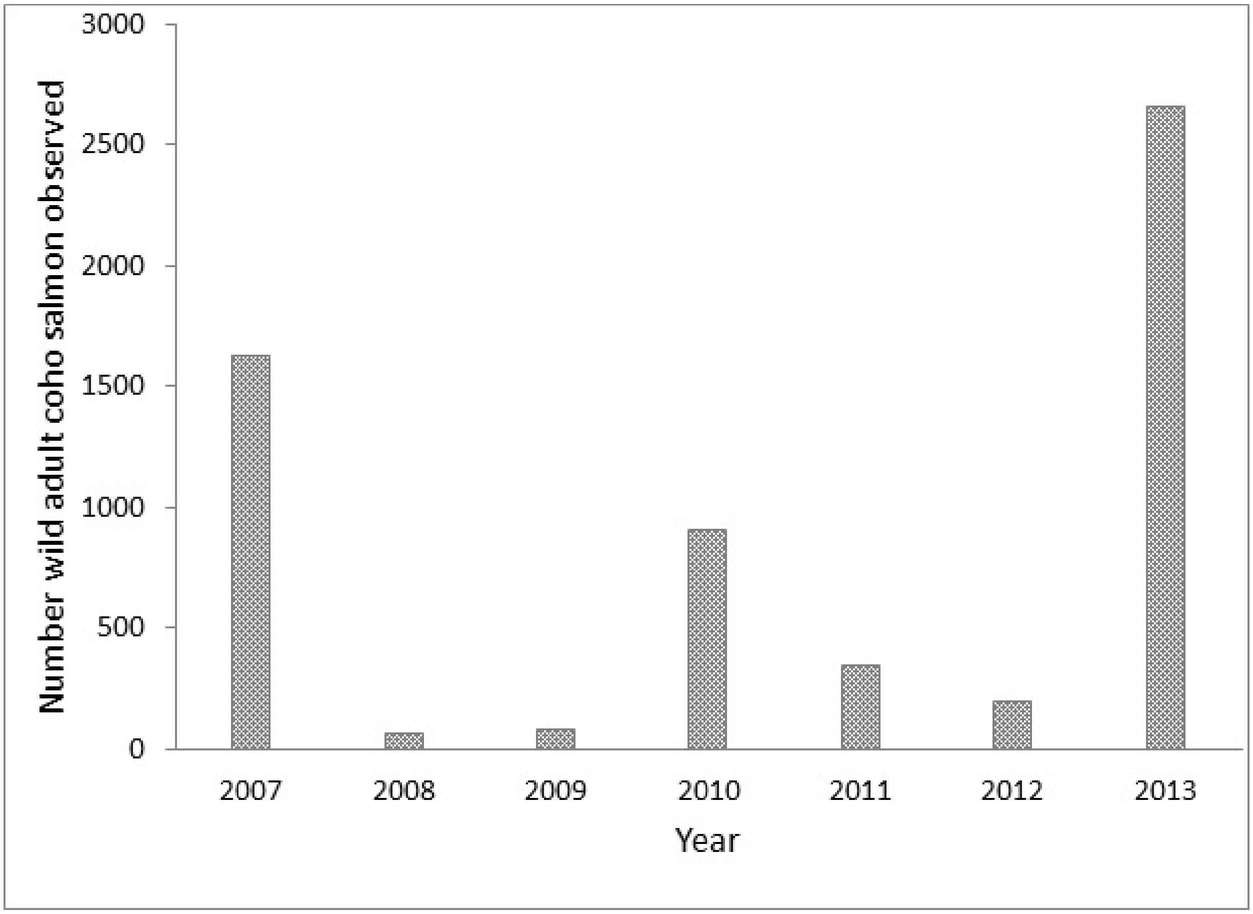

Figure 36-2. Adult escapement (ages 2 and 3) to the Scott River (video weir) (Knechtle and Chesney 2013, Knechtle 2014).

36.3 Status of Scott River Coho Salmon

Spatial Structure and Diversity

The diversity and complexity of the physical and environmental conditions found within the Scott River basin have contributed to the evolutionary legacy of coho salmon in the SONCC ESU, and contributed to this population being considered a Functionally Independent population (Williams et al. 2008). Juvenile fish have been found rearing in the mainstem Scott River, East Fork Scott River, South Fork Scott River, Shackleford Creek and its tributary Mill Creek, Etna Creek, French Creek and its tributary Miners Creek, Sugar Creek, Patterson Creek, Kidder Creek, Canyon Creek, Kelsey Creek, Tompkins Creek, and Mill Creek (near Scott Bar) (Shasta Scott Recovery Team 2003, Yokel 2006, CDFG 2008a, Calfish 2013). Adult coho salmon surveys of the Scott River and its tributaries have been occurring since 2001, and in French

Creek from 1992 to 2005 (CDFG 2006). This monitoring has documented the varying strength of the three coho salmon brood years in the above-mentioned portions of the Scott River basin, with the eleven most productive of these tributaries (East Fork Scott River, South Fork Scott River, Sugar Creek, French Creek, Miners Creek, Etna, Kidder Creek, Patterson Creek, Shackleford Creek, Mill Creek, and Canyon Creek) consistently sustaining rearing salmon juveniles in limited areas (Maurer 2006, Cramer Fish Sciences et al. 2010). Mill (Shackleford) Creek, for example, supports coho salmon every year, at densities that approach 20 redds/km. The other mentioned tributaries do not consistently sustain juvenile coho salmon, due to a lack of both available spawning and rearing habitat. Yokel (2006) notes that density of adult coho salmon spawning activity as well as the ability of juvenile salmon to emigrate or immigrate determine the extent of juvenile coho salmon presence in the Scott River basin. Physical stream characteristics play a significant role in constraining both the density of spawning activity and juvenile fish movement. The diversity of this population is, therefore, restricted by both available spawning and rearing habitat.

There have only been three confirmed observations of hatchery origin coho salmon recoveries in the Scott River. In 2009, one adult male coho salmon (39 cm fork length) with a right maxillary bone clip, indicating a fish released from Trinity River Hatchery, was sampled about 150 meters upstream from the confluence of the Scott River with the Klamath River (Knechtle and Chesney 2011). Two adult coho salmon of hatchery origin with a left maxillary clip (Iron Gate Hatchery origin) were observed passing through video counting flume during the 2012 season. Based on this information, CDFW estimated the portion of hatchery origin coho salmon in the Scott River was 0.81% (Knechtle and Chesney 2013). Although some exchange of genetic material from hatchery origin coho salmon is present within the Scott River either from straying of Iron Gate Hatchery origin coho salmon directly or secondarily through straying of natural origin Shasta River coho salmon, which does experience a high rate of straying from Iron Gate Hatchery, straying in the Scott River does not appear to be substantial and should not detract from its status as the most productive natural stock in the upper Klamath River basin (Garza 2012).

There are limited impacts from releases of coho salmon smolts from the Iron Gate Hatchery to the Scott River SONCC coho salmon population. These limited impacts include competition for freshwater habitat among juvenile coho salmon rearing and migration. Such habitat is expected to decrease in the future due to climate warming (Mote et al. 2003, Battin et al. 2007). Therefore, competition for limited thermal refugia areas will increase. Bartholow (2005) found a warming trend of 0.5 °C/decade in the Klamath River and a decrease in average length of river with temperatures below 15 °C (8.2 km/decade), underscoring the importance of thermal refugia areas. Hatchery releases are expected to remain constant during this period of diminished freshwater habitat availability. This will serve to increase detrimental impacts to naturally produced coho salmon from density-dependent mechanisms in the freshwater environment as climate warming continues. In this way, hatcheries will likely adversely impact the effective use of habitats by natural coho salmon in the future, if shared use of these habitats by natural and hatchery stocks exceed capacity limitations and food supplies.

Population Size and Productivity

NMFS determined at least 242 coho salmon must spawn in the Scott River each year to avoid such effects of extremely low population sizes. Adult spawning surveys and fish counting weir information that restarted in 2007 indicate adult spawning coho salmon number approaching 1,000 or more every third brood year (Figure 36-2), with abundance numbers ranging from 60 to 355 during other two brood years.

The number of smolts produced per returning adult (Table 36-3) provides a measure of freshwater survival in the Scott River Basin. When redd and juvenile abundance is below carrying capacity, the number of smolts produced per adult can be used to infer habitat condition, and trends between years, for coho salmon (Knechtle and Chesney 2013).

Table 36-3. Coho salmon adult and smolt point estimate and number of coho salmon smolts produced per adult for the Scott River (Knechtle and Chesney 2013).

Adult Return Year	Adult Estimate	Smolt Year	Smolt Point Estimate	Smolts produced per adult
2007	1622	2009	62207	38.35
2008	63	2010	1979	31.41
2009	81	2011	275	3.40
2010	927	2012	50315	54.28

Extinction Risk

The Scott River population is at moderate risk of extinction because the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one, but the ratio is less than the minimum required spawner density (both criteria described in Williams et al. 2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Scott River population is a core, Functionally Independent population within the Interior Klamath River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Scott River core population needs to have at least 6,500 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population, the Scott River population may serve as a source of spawner strays for nearby populations in the Klamath Basin.

36.4 Plans and Assessments

Siskiyou Resource Conservation District (RCD)

https://www.facebook.com/pages/Siskiyou-RCD/159947554025556

The Siskiyou RCD works to identify and address conservation and restoration needs through voluntary landowner and resource user participation, and by providing technical, financial, and educational leadership, primarily within the Scott River Basin. The Siskiyou RCD performs an extensive array of projects to protect the natural resources and the rural lifestyle of the Scott River watershed. RCD projects include agricultural and diversion improvement, barrier removal, riparian protection and enhancement, riparian bioengineering and planting, water conservation, fisheries and wildlife habitat improvement, water quality monitoring, and biological monitoring.

Siskiyou RCD Long Range Plan 2005-2009 (Siskiyou RCD 2005)

The Long Range Plan (Siskiyou RCD 2005) and its successor, are the guiding documents that set priorities for the Siskiyou RCD over a five-year period. The plans include the goals for programs and actions necessary to address identified objectives. Plans are subject to revision, when needed, to ensure that the RCD's programs are meeting the needs of its cooperators.

Scott River Watershed Council

Scott River Watershed Council Strategic Action Plan
http://scottriver.net/
https://www.facebook.com/ScottRiverWatershedCouncil

This watershed action plan sets priorities for future actions and practices to restore and manage Scott River basin resources, emphasizing salmonids. This plan builds on previous fall flows (SRWC 1999) and fish habitat & population studies (SRWC 1997), emphasizing restoration of native anadromous fish stocks. The action plan includes: analysis of current and historic conditions, identification of limiting factors, data and restoration needs (including type and location), prioritization of restoration project opportunities, and monitoring plans. A 2005 draft version of a limiting factor analysis of the Scott River coho salmon population was included as an appendix to the Strategic Action Plan. An update of the action plan began in 2011 and is still underway. Current work focuses on floodplain and wetlands habitat restoration to enhance rearing opportunities for salmonids.

Scott River Water Trust

Annual monitoring reports
www.scottwatertrust.org

Created in 2007, the Scott River Water Trust is the first water trust organization established in California. Its purpose is to supplement instream flows for coho salmon, Chinook salmon, and steelhead in critical habitat reaches of the Scott River and its tributaries, while providing financial compensation to agricultural water users. The Water Trust undertakes voluntary water leases with water users to forego irrigation water use in the summer and stockwater use in the fall. Assessments have identified the following streams where freshwater survival and growth of over-summering coho salmon and steelhead can provide the greatest benefit: French Creek, Shackleford Creek, Sugar Creek, Patterson Creek, South Fork, and East Fork. Each lease site is monitored to document the amount of water being leased, the instream flow, fish species presence, and water temperature. After irrigation season ends in late September, the fall season can create special flow needs if autumn rains arrive late and adult spawning salmonids need to reach good spawning gravels. To help improve upstream migration access, the Water Trust often leases stockwater rights in the mainstem Scott River. Spawning surveys then verify the upper extent where redds, carcasses, or live fish are located, which help inform water leasing priorities for the next year. Through 2013, the Water Trust has annually secured the following: 181 to 477 acre-feet of surface water leases, benefitting from 2.6 to 11.8 miles of stream habitat downstream; and fall leases of up to 1147 acre-feet.

Scott Valley Groundwater Advisory Committee

Voluntary Groundwater Management and Enhancement Plan

In 2013, the Siskiyou County Board of Supervisors approved the Voluntary Groundwater Management and Enhancement Plan (Scott Valley Groundwater Advisory Committee 2012). The purpose of the plan is to provide a voluntary, locally driven direction for the management and enhancement of the Scott Valley groundwater basin that is mutually beneficial for the community and environment. Specific objectives include:

1. Develop improved understanding of how groundwater and surface water behave.
2. Continue to maintain the long-term viability of the aquifer.
3. Reduce the conflict between groundwater use and other uses of water; scientifically validate the effect of groundwater use on salmon and steelhead use of the Scott River and its tributaries.
4. Improve public understanding of how agriculture uses wells and applies irrigation to local crops.
5. Identify non-agricultural water demands.
6. Identify groundwater use efficiency and enhancement projects and implement through grants, agencies and the community.

Scott River Watershed Coalition of Fire Safe Councils

The Mission of the Scott River Watershed Coalition of Fire Safe Councils is to promote collaboration in the Scott River Watershed to increase the likelihood of local community survival in the event of a catastrophic wildland fire. The coalition was formed in 2007 to marshal the resources of six volunteer fire safe councils operating in the Scott River watershed. The six fire safe councils are the French Creek Fire Safe Council, the Lower Scott River Fire Safe Council, the Quartz Valley Fire Safe Council, the Rattlesnake Creek Fire Safe Council, the Scott Bar Fire Safe Council and the Scott Valley Fire Safe Council.

http://www.californiaresourcecenter.org/viewpage.php?page_id=63

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish and Game Commission in February 2004. This report contains specific pilot program recovery recommendations for coho salmon in the Scott River Watershed that include: improved water management/water use efficiency, water augmentation, improved habitat management, protection, assessment and monitoring, and outreach and education. The recommendations developed by CDFW for the Scott River have been considered and incorporated into the recovery strategy and list of recovery actions for this population.

Total Maximum Daily Loads
http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/scott_river/

Clean Water Act Section 303(d) requires each state to develop a list of impaired waters where pollution controls are not sufficient to attain or maintain applicable water quality standards and a total maximum daily load (TMDL) for each pollutant of concern in each of the listed impaired waters. In December 2003, the USEPA published the final Total Maximum Daily Loads (TMDL) for temperature and sediment for the Scott River. On December 7, 2005, the North Coast Regional Water Quality Control Board adopted Resolution No. R1-2005-0113, amending the Water Quality Control Plan for the North Coast Region (Basin Plan) to include the Action Plan for the Scott River Watershed Sediment and Water Temperature Total Maximum Daily Loads. The TMDL and Action Plan set load allocations and assigned implementation responsibilities.

Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program
http://www.krisweb.com/biblio/gen_usfws_kierassoc_1991_lrp.pdf

In 1986, the Klamath River Basin Fishery Resources Restoration Act was enacted to help rebuild anadromous fish populations in the basin. The "Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program" was produced by the Klamath River Basin Fisheries Task Force (1991) with assistance from Kier Associates. This plan emphasized diversion improvement / barrier removal to provide fish passage, spawning survey assessments, watershed education, and communication.

U.S. Forest Service – Klamath National Forest

Watershed and Road Analyses by the Klamath National Forest
http://www.fs.usda.gov/detail/klamath/landmanagement/planning/?cid=STELPRDB5109804

The KNF completed the Callahan (USFS 1997b) and Lower Scott Watershed Analyses (USFS 2000d) that assess resource conditions in the uplands of the southern and northern boundaries of the Scott River basin. The KNF has also completed a Forest-wide Roads Analysis (USFS 2002) that provides recommendations for road maintenance, road closures, and road decommissioning projects to reduce road-related erosion on KNF-managed lands. Prioritized road storm proofing and decommissioning on KNF-managed lands in the Scott River watershed is ongoing.

The KNF, with partner Northern California Resource Center, completed a Forest-wide assessment of fish passage at road stream crossings during 2002-2004. Since then, the KNF has upgraded 9 crossings in the Scott River Watershed to allow for free passage of all aquatic organisms. Most of these crossings are just upstream of coho salmon CH and one is within CH on Scott Bar Mill Creek. The KNF will continue to pursue fish passage restoration projects where barriers to fish passage are identified.

The USFS has adopted a Watershed Condition Rating and Watershed Condition Framework (WCF) assessment and planning approach (USFS and BLM 2011) (http://www.fs.usda.gov/main/klamath/landmanagement/planning). The WCF is a comprehensive approach for proactively implementing integrated restoration within priority watersheds on national forests and grasslands. The WCF provides the Forest Service with an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales. As part of the WCF, Sugar Creek was identified as a high priority 6th field sub-watershed for comprehensive restoration in the Klamath National Forest (USFS and BLM 2011). Currently the KNF is near completion of planning on the Sugar Creek Watershed Improvement Project and is in the process of selecting the next highest priority sub-watershed in the Scott Basin for comprehensive restoration.

Instream water right for fish and wildlife resources within the Klamath National Forest

The 1980 Scott River Decree includes an allocation for an instream flow right to the U.S. Forest Service at the USGS gauge downstream from Fort Jones, CA, to provide minimum subsistence-level fishery conditions including spawning, egg incubation, rearing, downstream migration, and summer survival of anadromous fish. To meet this purpose, the Scott River Decree provides for instream flows of 150 cubic feet per second (cfs) from April to June 15, 100 cfs from June 16 to June 30, 60 cfs from July 1 to July 15, 40 cfs from July 16 to July 31, 30 cfs in August and September, 40 cfs in October, and 200 cfs from November to March. These flows were anticipated to be provided in all years with an exception given for critically dry water years. However, since 1980, when the decree was finalized, the requirements for this water right have rarely been satisfied during the critical summer and fall seasons. In addition to the allotment described above, the U.S. Forest Service has an additional right to stream flow in the Scott River measured at the USGS gage downstream from Fort Jones for incremental fish flows and for recreational, scenic, and aesthetic purposes. The quantities described for this right are slightly greater than described above. These flow targets are routinely not met during the summer and fall, regardless of water year type.

French Creek Watershed Advisory Group

Created in 1990 as pilot study for the State Board of Forestry, the 12-member French Creek Watershed Advisory Group, comprising landowners and agencies, has worked cooperatively to reduce excessive granitic sediment delivery to French Creek to protect salmonid habitat. A granitic soil assessment identified roads as the major source of human-induced sedimentation (Sommarstrom et al. 1990). As a result, the French Creek Watershed Advisory Group developed and approved a Road Management Plan in 1992, followed by a Monitoring Plan and then a Fuel and Fire Management Plan. Road rehabilitation work on public and private roads has included outsloping and rocking sections of upslope roads that would have a high delivery rate of sediment to French Creek and its tributaries. Fine sediment levels in pools were assessed over time, indicating a decline in sediment from 31.6% in 1992 to 7.5% by 1994 (Power and Hilton 2003), and reaching 14.1% in 2012 (Farber and Nicolls 2012). Steelhead and coho salmon juvenile use at six survey reaches were electrofished annually to measure abundance and biomass from 1992-2005: coho numbers went from 0 to 628 in the surveyed reaches, with the discovery of one strong brood year class with two much weaker cohorts (CDFG 2006, Sommarstrom 2011).

Quartz Valley Indian Reservation

The Quartz Valley Indian Reservation (QVIR) undertakes resource assessment and monitoring in cooperative efforts to restore the Scott River basin (http://www.qvir.com), particularly in water quality monitoring. QVIR participates in coho salmon spawning surveys, and serves in an advisory capacity to the Scott River Watershed Council. QVIR is currently undertaking studies of the Shackleford/Mill Creek watershed.

36.5 Stresses

Table 36-4. Severity of stresses affecting each life stage of coho salmon in the Scott River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Hydrologic Function[1]	High	Very High	Very High[1]	Very High	Medium	Very High
2	Degraded Riparian Forest Conditions[1]	-	Very High	Very High[1]	Very High	Medium	Very High
3	Impaired Water Quality	Very High	High	High	High	Very High	Very High
4	Impaired Estuary/Mainstem Function	-	Low	High	High	Low	High
5	Lack of Floodplain and Channel Structure	Medium	High	Very High	High	High	Very High
6	Altered Sediment Supply	Very High	Very High	Medium	Medium	High	Very High
7	Adverse Hatchery-Related Effects	Medium	Medium	Medium	Medium	Medium	Medium
8	Increased Disease/Predation/Competition	Low	Medium	High	High	Medium	High
9	Barriers	-	Low	High	Low	Low	Low
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The limiting stresses for the Scott River coho salmon population are the degraded riparian habitat conditions and altered hydrologic function that are occurring throughout the basin. These stresses are limiting the fitness and survival of juvenile coho salmon throughout the Scott River basin, by decreasing access to off-channel rearing habitat, creating stressful and lethal water quality conditions, decreasing water quantity and spawning habitat (Cramer Fish Sciences et al. 2010), and disconnecting floodplains and other off channel rearing habitat. The juvenile life stage is currently the limiting freshwater life stage for continued viability and success of the Scott River coho salmon population (CDFG 2004b, SRWC 2005).

Numerous water diversions, associated small diversion dams and interconnected groundwater extraction for agricultural purposes, and the diking of the mainstem Scott River have reduced summer and winter rearing habitat in the Scott River basin, limiting juvenile success. Although rearing habitat still exists in some of the key west-side tributaries, access to and from these areas is often hindered by dams and diversions, the existence of alluvial sills, the formation of thermal barriers at the confluence of tributaries and loss of surface flow connectivity between critical rearing pools in summer. Where passage is possible, juvenile fish can reach thermal refugia pools along both the mainstem Scott River and key west-side tributaries, where the water temperature can be several degrees cooler than in adjacent channels. A list of these known thermal refugia for rearing is in Table 36-5. These refugia areas occur in reaches with high IP and are vital to the continued existence and success of coho salmon in the Scott River. Expansion of these critical refugia habitats will aid in recovery.

Table 36-5. Potential refugia areas in the Scott River basin (Yokel 2006).

Subarea	Stream Name	Subarea	Stream Name
Scott Bar	Scott River from Boulder Creek to Tompkins Creek	Scott Valley	Shackleford/Mill Creek
Scott Valley	French Creek	Scott Bar	Canyon Creek
Scott Valley	Patterson Creek	Scott Bar	Kelsey Creek
Scott Valley	Kidder Creek	Scott Bar	Tompkins Creek
Scott Valley	South Fork & East Fork Scott River		

Excessive surface and groundwater extraction lowers the water table, often leading to the complete loss of riparian vegetation. Loss of riparian vegetation can lead to stream channelization and bank stabilization for flood protection. When high flows compromise channelization and stabilization efforts, the usual response is to further channelize and armor streambanks, aggravating riparian habitat loss. In contrast, any effort that serves to raise the groundwater table can help reverse the cycle of riparian habitat degradation.

Altered Hydrologic Function

Altered hydrologic function presents a very high stress for all life stages, with the exception of the egg stage (high) and the adult stage (medium). Water quantity and flow regime is poor in the southern portion of the Scott Valley from Etna Creek to about Noyes Valley Creek. The East Fork Scott River often becomes nearly dewatered during the summer, due to water diversions. Portions of the Scott Canyon area upstream from River Mile 15, in contrast, have fair water quantity (North Coast Regional Water Quality Control Board [NCRWQCB] 2005c). Numerous legal and some illegal water diversions occur throughout the basin, decreasing summer flows, increasing water temperature to lethal levels, and generally extending the period of surface flow disconnection on the valley floor.

Water rights on the Scott River have been fully adjudicated in the Superior Court of Siskiyou County through three separate decrees, the Shackleford Creek Decree (No. 13775) in 1950, the French Creek Decree (No. 14478) in 1958, and the Scott River Decree (No. 30662) in 1980. Of the three decrees, the Scott River Decree describes the water allocations for the vast majority of the watershed and unfortunately, there is no watermaster service for this large geographic area. As a result, there is no accounting of the actual timing or volumes of water diverted for the vast majority of the watershed. In addition, the Department of Water Resources terminated their watermaster service for the Shackleford and French Creek Decrees at the end of the 2011 irrigation season. A new Scott/Shasta Special Water Master District began operation in 2012. Since that time, quantification of surface water withdrawals has been inconsistent, particularly in the Shackleford watershed where several water right holders opted out of the new watermaster service, further reducing management and regulation of water diversions in Scott Valley.

Currently, valley-wide agricultural water diversions, groundwater extraction, and drought have all combined to cause premature surface flow disconnection along the mainstem Scott River. In addition, summer flows has continued to decrease significantly over time, further exacerbating detrimental effects on coho salmon in the basin. These conditions restrict or exclude available rearing habitat, elevate water temperature, decrease fitness and survival of over-summering juveniles, and sometimes result in juvenile fish strandings and death.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions, caused by conversion of historic valley wetlands and riparian corridors to agricultural lands, pose a very high stress to all juvenile life stages and a medium stress to adults. Stream corridor shade is generally poor on the Scott Valley, due to both the loss of a functional floodplain and riparian community from agricultural encroachment, and solar exposure caused by the north-south orientation of the mainstem Scott River from Callahan downstream to Ft Jones, CA. Further downstream, the Scott Canyon area has fair to good shade cover, but spawning and rearing habitat is limited due to the steeper terrain. Dredge mining ended around 1950, but many riparian areas in the Scott River basin remain poorly vegetated, incised, and erodible up to the present day (USFS 1997b). This is especially apparent along the nearly five mile long “tailings pile reach” of the Scott River downstream from Callahan. Floating dredge operations there have reconfigured the upper reach of the valley in this area, confining the active Scott River channel to one side of its historic floodplain.

The clearing of extensive beaver-occupied wetlands and swamp forests, which once covered much of the Scott Valley, has resulted in relict valley riparian forests that are often devoid of canopy cover, or at best, dotted with willow, alder, and cottonwood clumps. This has reduced channel margin habitat and associated cover, which is favored by juvenile coho salmon, while increasing solar exposure and water temperature during the summer and early fall. Also, straightening, rocking, and confinement of channels on the valley floor has resulted in high intensity, bank-eroding flood events that have carried away remaining riparian vegetation and soil from riparian gallery forests, creating additional areas lacking riparian vegetation and further increasing water temperatures (CDFG 2004b, SRWC 2005). Stream bank stabilization, bio-engineering efforts, riparian planting, and beaver habitat enhancement (NCRWQCB 2009), occurring since the 1990s, are contributing to progressive improvement of riparian habitat conditions.

Impaired Water Quality

Water quality is a high to very high stress for all life stages, and is caused by the degraded riparian forest condition in the valley, extensive agricultural and grazing activities, and over allocated water withdrawal occurring throughout the basin. High water temperatures and increased nutrient and sediment loading have created poor water quality conditions in many side channel and off-channel rearing areas used by coho salmon. Water quality has been found to be good in perennial flowing tributaries, which allows juvenile coho salmon to rear as long as sufficient surface flows continue through the summer (French Creek Watershed Advisory Group 1992, Quigley et al. 2001, Sommarstrom 2001). However, water quality conditions are poor overall, being thermally stressful for juvenile fish throughout summer and much of the fall, especially in and adjacent to the mainstem Scott River (NCRWQCB 2004, Bowman 2010, QVIR 2011).

Benthic macroinvertebrate richness and Ephemeroptera/Plecoptera/Trichoptera taxa metrics range from fair to poor in Kelsey and Tompkins creeks, but are very good in much of lower Canyon Creek, upper French Creek, and the upper portions of tributaries to the Scott River (Chesney and Yokel 2003, 2006). Water temperatures in the summer are poor throughout the mainstem Scott River (QVIR 2011), Wildcat Creek, Patterson Creek, and lower French Creek, while water temperatures are generally fair (current indicator status 16.74 ^{o}C) in the upper reaches of other perennial tributaries. Water quality degrades continuously through the summer in the Scott River, and also in the terminal reaches of its tributaries. By July, lethal water temperatures of 80 °F (26.7 °C) routinely occur in the mainstem Scott, including portions of the Scott River Canyon (Chesney and Yokel 2003). Potential Hydrogen ion (pH) levels have been reported as poor near the mouth of the Scott River and fair where the lower Scott Valley enters the Scott River Canyon. Dissolved oxygen daily averages have been measured as progressively lowering from 11to 8 mg/L during the summer, reaching their lowest level during summer nights (QVIR 2011). All of these water quality impairments reduce juvenile opportunities for survival through the summer and decrease the viability of the population overall.

Impaired Estuary/Mainstem Function

This stress refers to the estuary and mainstem conditions in the Klamath River, since this population is part of a larger basin containing multiple populations. Degraded mainstem conditions in both the Scott River and the Klamath River create a low stress for fry, a high stress for juveniles, and a very high stress for smolts and adults. Mainstem conditions in the Scott River contribute to this stress because of reduced water quality, sedimentation, channel aggradation, and degraded habitat in mainstem reaches. Conditions in the Klamath River mainstem and estuary are important to this population since all salmon that originate from the Scott River migrate to and from the ocean through the mainstem Klamath River and the Klamath River estuary. This can be detrimental for juveniles when high concentrations of *C. shasta*, *P. minibicornis*, and other pathogenic diseases are occurring. Additionally, because of the long distance that this population must travel to and from the ocean, the time spent in the mainstem Klamath River may increase stress associated with mainstem conditions and residence time during late spring and summer when water quality conditions typically deteriorate.

The degraded conditions that exist throughout the Klamath Basin may mean that the estuary plays an enhanced role for all Klamath anadromous fish populations, by providing the opportunity for juvenile and smolt growth and refuge prior to entering the ocean (Wallace 1995). Juveniles, smolts, and adults transitioning through mainstem and estuarine habitat are stressed by the degraded conditions in these migratory zones, suffer from the lost opportunities for increased growth, and consequently experience a lower survival rate. The loss and degradation of estuarine and mainstem habitat is considered a high to very high stress for the population, with the most affected life stages being juveniles, smolts, and adults, due to degradation of rearing and migratory habitat. Although short and small compared to the large size of the watershed, the estuary does provide numerous habitat types and rearing habitat for juvenile coho salmon. The estuary, although relatively intact, suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain (Hiner

2006). Levees along the Lower Klamath and development on the floodplain have led to the loss and degradation of habitat in the estuary. More information about the Klamath River estuary can be found in the Lower Klamath population profile.

Lack of Floodplain and Channel Structure

The ongoing alteration of floodplain and channel structure from mining and other anthropogenic activities has reduced complex channel margin and pool habitat availability, disconnected the floodplain from the adjacent channel, and simplified instream habitat throughout the Scott River basin, creating a high stress for all life stages except for the egg stage (medium) and the juvenile stage (very high). In many locations, especially along the mainstem Scott River near Callahan, Oro Fino Creek and in lower Kidder Creek, large areas have been stripped of vegetation and the remaining gravel deposits have been hydraulically or mechanically worked to retrieve deposited gold and/or aggregate. These activities have left a legacy of unvegetated, heavily disturbed gravel deposits mostly devoid of soil and have caused disconnections between floodplains and instream channel habitats.

Coho salmon need channel margins, complex woody debris, undercut banks, beaver-influenced wetlands (Yokel 2006) and associated deep pools to rear in and for adults to rest in while migrating upstream. Monitoring data indicate that pool frequency is poor throughout the watershed, while pool depth varies from poor in Miners Creek to good or very good in French Creek. While it is encouraging that pool depth in some areas is good or very good, these areas may not always be accessible to rearing salmonids due to poor water quality conditions that create thermal barriers and physical barriers due to sediment deposition coupled with low flows. Compounding these issues is a lack of woody debris, both large and small, which is also an important component of rearing habitat, as it creates complex channel structure. Woody debris is lacking throughout the mainstem Scott River and its tributaries. Surveys assessing rearing habitat associated with complex woody debris confirm juvenile coho salmon presence around woody debris, and that such wood recruitment is lacking both in the Scott Valley and along tributary reaches above the valley (Yokel 2006).

Altered Sediment Supply

Altered sediment supply occurring in the Scott River imposes a medium stress to juvenile and smolt, high stress to adults, and a very high stress to the egg and fry coho salmon life history stages. The movement of fine sediment into streams can cause substrate embeddedness, preventing spawning and smothering eggs in redds. Additionally, excessive levels of fine sediment in pools and low gradient reaches of the Scott River and its tributaries also reduce the amount of rearing habitat available for juvenile coho salmon (USFS 2000d, NCRWQCB 2006a, CDFG 2009a, Cramer Fish Sciences et al. 2010). While unaltered background levels of sediment were around 10 percent volumetrically, monitoring in the French Creek watershed has shown large fluctuations in the percentages of fine sediment occurring in this watershed (Sommarstrom et al. 1990). Data from the early 1990s indicate a high of approximately 32 percent fine sediment occurring in French Creek in 1992, decreasing to approximately 7.5 percent by 1994 (Power and Hilton 2003), and then reaching a dynamic level of approximately 14 percent in 2012 (Farber and Nicolls 2012). More recent monitoring indicates that there is still a large percentage of fine sediment in the channel substrate in the upper portions of French

Creek, which is one of the two most productive spawning and rearing tributaries in the Scott River basin.

Excessive fine sediment loading was also found to cause poor substrate conditions in Miners (French/Miners) Creek, Sugar Creek and the lower mainstem of the Scott River. The largest causes of the altered sediment supply throughout the Scott River are the high density of unpaved and unmaintained roads and other compacted surfaces, unstable lands, and streamside degradation, which all mobilize excessive fine sediment into the mainstem Scott River and its tributaries. Large areas of erosive decomposed granite originating from slopes on the west side of the Scott Valley contribute to these high percentages of fine sediment in channel substrate. These unstable conditions are exacerbated by detrimental anthropogenic land uses occurring throughout the basin, which have resulted in aggradation and loss of summer surface flows in Westside streams, like Shackleford Creek (QVIR 2011). Fine sediment levels in lower Etna Creek are considered fair, although this decrease in fine sediment may be the effect of the sediment sampling location not being in a depositional reach, rather than a true reduction in sediment supply. Assessments of specific stream channels and riparian habitats have been undertaken along Etna Creek, to design effective watercourse and lake protection zones (Sommarstrom 2007, Farber and Whitaker 2010).

Adverse Hatchery-Related Effects

A small egg collecting station operated on Shackleford Creek from 1925 to 1940 (Leitritz 1970). No hatcheries or artificial propagation occur in the Scott River basin, but Iron Gate Hatchery is about 50 miles (80.5 km) upstream of the mouth of the Scott River, within the Klamath River basin. Juvenile fish often outmigrate from the Scott River into the Klamath River when they are still undersized, to escape rising water temperatures during the spring. These juvenile outmigrants encounter large numbers of released Iron Gate hatchery fish also utilizing cold water refugia along the mainstem Klamath River and experience competition for prey resources and exposure to disease. A limited survey of Scott River spawning grounds occurred in 2004, 2005, 2008, 2009, and 2010; in most years, no hatchery fish were observed (Quigley 2005, 2006, Walsh 2008, Franklin 2012, Yokel 2011, 2013). Adverse hatchery-related effects pose a medium risk to all life stages, due to the presence of Iron Gate Hatchery and Trinity River Hatchery in the Klamath basin (Appendix B)

Increased Disease/Predation/Competition

Increases in disease, predation, and competition present a high stress for juveniles and smolts, a medium stress for fry and adults, and a low stress for eggs,. This stress increases as coho salmon health is reduced by elevated water temperatures during the spring and summer. Warm water temperatures make fish more susceptible to diseases, and decrease fitness levels and the ability to fend off predators and competitors, including non-native piscivorous fish. Elevated mainstem temperatures force juvenile fish into the remaining cold water refugia (e.g., portions of the so-called “thermal reach” from the USGS Scott River gage to Townsend Gulch) where increased competition occurs for limited resources. If juvenile fish are forced into the Klamath River, they are exposed to disease and are vulnerable to other wildlife.

Juvenile fish are exposed to a variety of pathogens including *Ceratonova shasta,* which leads to ceratomyxosis, *Flavobacterium columnare* (columnaris), aeromonid bacteria *Nanophyetus salmonicola*, and the kidney myxosporean *Parvicapsula minibicornis* (Federal Energy Regulatory Commission 2007). Actinospore concentrations of both *C. shasta* and *P. minibicornis* in the mainstem Klamath River are often above the threshold necessary to induce infection and disease (Stocking et al. 2006, Nichols and True 2007) and have been shown to infect juveniles inhabiting the mainstem river in this area. By late spring and summer, both diseased hatchery and wild juveniles are seen dead or moribund in Klamath River screw traps.

Barriers

Barriers present a high stress for juvenile coho salmon, and a low stress for fry, smolt and adult life stages. Diversion dams, small impoundments, and road/stream crossings pose partial or complete barriers to high IP in the Scott River basin. Big Mill Creek, a tributary to the East Fork Scott River, has a complete fish passage barrier caused by down cutting at a road culvert outfall. The Big Mill Creek site can be corrected by returning Big Mill flow to its original channel, but this has been delayed until the landowner can be assured necessary access to private property across Big Mill Creek. Rail Creek, another tributary to the East Fork Scott River, poses a complete fish passage barrier and impoundment, caused by an irrigation pond levee. A project to provide fish passage at Rail Creek has been developed, but its implementation has been postponed while an analysis is done to determine if the 0.7 mile of upstream habitat to be regained justifies the project's expected cost. The Scott Valley Irrigation District's Youngs Dam has been outfitted with a fishway that needs correction to ensure fish passage in varying flow conditions. The City of Etna's municipal water diversion dam on Etna Creek effectively blocked fish passage into upper Etna Creek, but this dam was retrofitted with a volitional fishway in 2010. Work has been done recently to convert seasonal gravel push up dams to boulder weirs and the evaluation and upgrading of previously constructed boulder vortex weirs is ongoing. There are currently three known vortex weirs within SONCC coho salmon critical habitat in Shackleford and French creeks that require treatment to ensure complete fish passage.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

36.6 Threats

Table 36-6. Severity of threats affecting each life stage of coho salmon in the Scott River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Agricultural Practices[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Dams/Diversions[1]	Medium	Very High	Very High[1]	Very High	Very High	Very High
3	Channelization/Diking	Very High	Very High	Very High	High	High	Very High
4	Climate Change	Medium	Medium	Medium	Medium	Medium	Medium
5	Roads	High	High	High	High	High	High
6	High Severity Fire	High	High	Medium	Medium	Medium	High
7	Hatcheries	Medium	Medium	Medium	Medium	Medium	Medium
8	Mining/Gravel Extraction	Medium	Medium	Medium	Medium	Medium	Medium
9	Urban/Residential/Industrial Dev.	Medium	Medium	Medium	Medium	Medium	Medium
10	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
11	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
12	Fishing/Collecting	-	-	Low	Low	Medium	Low

[1] Key limiting threats and limited life stage.
[2] Invasive Non-Native/Alien Species is not considered a threat to this population

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are agricultural practices and dams/diversions.

Agricultural Practices

Current agricultural practices are a very high threat to all life stages, and therefore have a very high overall threat. Sub-basins of the Scott Valley where pasture/hay and cultivated crops comprise more than 10 percent of the landscape include Clark Creek, lower Johnson Creek, lower Patterson Creek, lower Kidder Creek, Rattlesnake Creek, and lower Shackleford /Mill creeks. These sub-basins have become altered by the high percentage of agricultural land occurring within them. Grazing and other ranching activities are pervasive throughout the lower portions of the Scott Valley. Approximately 20 percent of all pastures/fields adjacent to stream channels have no exclusionary fencing or unmaintained fencing (Black 2011), which then contributes to increased bank erosion, degradation of riparian vegetation, and alteration of instream habitat characteristics.

Agriculture and related activities have been, and continue to be the major land use within the Scott Valley (Van Kirk and Naman 2008). Agricultural land use currently consists of approximately 29,000 acres of irrigated land with an estimated annual irrigation withdrawal of approximately 83,500 acre feet per year (Van Kirk and Naman 2008). There has been an increase in irrigation withdrawals in the Scott Valley of 115 percent between 1953 and the period 1988 to 2001, though the amount of irrigated farmland has not changed significantly (CDWR 2003). A progressive shift from irrigation of grain crops to alfalfa during this period did increase irrigation withdrawals (Harter and Hines 2008). Another important shift in the recent past was the change from flood to sprinkler irrigation, which increased efficiency and reduced return flows to the Scott River (Van Kirk and Naman 2008).

Currently, a large proportion (50 percent or more) of water used for irrigation comes from ground water (Van Kirk and Naman 2008). Because of the recognized interconnection between surface and groundwater (California State Water Resources Control Board 1980), quantification and modeling of groundwater dynamics has begun for the entire Scott Valley via a community groundwater study plan (Harter and Hines 2008, Foglia et al. 2013), which is documenting interactions between groundwater use and water availability in adjacent riparian habitat. In most years, low flows in the Scott River basin from June to November have become more pronounced with enhanced agricultural use of water (Van Kirk and Naman 2008), but with annual maximum groundwater levels remaining fairly constant (Harter and Hines 2008). Low surface flows, due in part to accumulation of less snow at lower elevations (Van Kirk and Naman 2008), result in elevated water temperature and loss of connectivity to side-channel and off-channel habitat areas.

During the summer, and especially during critically dry years, large portions of the mainstem Scott River become completely dry, leaving only isolated pools (SRWC 1997). Dry mainstem cuts off access to summer rearing habitat in many tributaries and high IP areas. In some years, many thousands of juvenile salmon and steelhead are stranded and killed in the Scott River basin (SRWC 1997) when stream flows go subsurface in the lower reaches of Etna, Patterson, Kidder (including Big Slough), and Shackleford Creeks each summer through early fall. This drying is believed to be a natural event (Siskiyou County Historical Society 1978), but it has become exacerbated by water withdrawal in the form of seasonal agricultural diversions, groundwater pumping, and by aggradation in low gradient tributary reaches. The end result is the dewatering of miles of instream habitat, lack of access to and from rearing habitat, and poor water quality, all of which yield stressful and sometimes lethal water temperatures for rearing coho salmon. Scott Valley eastside tributaries tend to flow only during high flow events (Mack 1958), but their confluences with the mainstem Scott River have high IP, which could provide enhanced over-summering habitat to juvenile fish with improved/enhanced wetland habitat along the Scott River channel via interconnected groundwater or hyporheic flow (Figure 36-1). Unless market factors bring about changes in cropping or amount of land in production, current agricultural activities and associated water use are expected to continue, and the associated stresses discussed above will continue to be a problem for the Scott River coho salmon population.

Dams/Diversions

Dams and diversions are a medium threat to the egg life stage, and a very high threat to fry, juvenile, smolt and adult life stages. Dams and diversions occur throughout the basin and are usually associated with agricultural practices and other ranching and grazing activities. Multiple water diversions currently hasten surface flow disconnection in the mainstem Scott River each summer, resulting in the reduction of available rearing habitat, increases in water temperatures, fish stranding, and death. Additionally, the impoundment of water behind dams and the diversion of stream flows affect juvenile and smolt life stages by decreasing instream flows, increasing water temperatures, blocking passage to and from vital rearing habitat, and causing stranding during peak diversion times. Although virtually all diversions within SONCC coho salmon habitat have been outfitted with fish exclusion screens, there is no consistent screen monitoring and maintenance to ensure that bypass flows around these screens is sufficient to sustain rearing juvenile coho salmon and their habitat downstream.

Van Kirk and Naman (2008) found that late summer baseflows in the Scott River were 60 percent lower (6.541 Mm^3 versus 10.96 Mm^3) in the recent past (1977 to 2005) than in the historic period (1942 to 1976). Climate change was found to be responsible for approximately 39 percent of this decline in late summer base flow. The minimum baseflow of 30 cfs during the summer months was determined necessary for the survival of salmon and steelhead stocks within the 1980 Scott River Adjudication. Gaging records at Fort Jones show summer discharge frequently falling below 30 cfs, and often fell below 10 cfs in critically dry water years. Flows failed to meet the USFS water right of 30 cfs in at least nine years since 1977 (QVIR 2011). At this level of discharge, the Scott River and portions of lower tributaries become a series of stagnant pools inhospitable to salmonids. Water diversions for agricultural practices, groundwater extraction, cattle grazing, residential/domestic water use, and flood control have diminished surface flows and greatly reduced or eliminated access to and use of historical coho salmon habitat in the Scott Valley. Agricultural surface water diversion continues to exacerbate channel drying and dewatering of the Scott River and its tributaries each spring/early summer. Juvenile salmonid strandings in isolated pools continues to occur. When coho salmon are stranded, they are often rescued and relocated to unoccupied cool water oversummering habitat.

Until diversion operations are remediated, demands are decreased, and dams are removed, this threat will continue to impact the Scott River coho salmon population. Work has begun in many areas of the watershed to begin to diminish the impacts from this threat. At Youngs Dam, efforts continue to improve/increase the range of flows at which the fishway, constructed in 2006, ensures consistent fish passage at the dam. Rail Creek, a tributary to the East Fork Scott River, has a complete fish passage barrier and impoundment caused by an irrigation pond levee. A project to provide fish passage at Rail Creek has been developed, but its implementation has been postponed while an analysis is done to determine if the 0.7 mile of upstream habitat to be regained justifies the project's expected cost. There are currently three known vortex weirs in French and Shackleford Creeks that require treatment to ensure complete fish passage. All Scott Valley agricultural water diversions within the known range of Chinook and coho salmon have been outfitted with fish exclusion screens. Approximately 15 diversion dams in tributaries to the Scott River continue to block salmonid passage. Priorities have been set to progressively address these remaining barriers through projects to both improve passage and properly screen all diversions within the range of anadromy.

Channelization/Diking

The channelization and diking of the Scott River mainstem and tributaries poses a very high threat to egg and fry life history stages, and a high threat to juvenile, smolt and adult life stages. Floodplain connectivity is poor (non-functional) in South Fork Scott River, Wildcat Creek, Sugar Creek, French/Miners Creeks, and Etna Creek watersheds, due to past hydrologic mining and conversion of beaver-occupied wetlands to drained agricultural lands. Floodplain connectivity is fair in the East Fork Scott River and the Scott River Canyon. In the 1930s, the US Army Corps of Engineers, at the request of Siskiyou County, removed the remaining vegetation through the middle of the valley and built levees for flood control (SRWC 1997), in turn altering the hydrology and morphology of the mainstem river and tributaries downstream. The construction and maintenance of levees disconnects floodplain habitat, alters the hydrograph throughout the system, decreases riparian vegetation success by lowering and disconnecting the water table, and increases flows during storm events. Since the construction of the first levees in the 1930s, much of the remaining mainstem Scott River has also been channelized in a continuing effort to control flood impacts and maximize acreage of agricultural lands adjacent to the river. This has destroyed low velocity margin and side channel habitat, making winter rearing habitat a significant limiting factor to juvenile coho salmon survival.

Climate Change

Climate change poses a medium threat to this population. The impacts of climate change in this region will have the greatest impact on the early fresh water life stages. Climate change will likely decrease summer base flow, reduce summer rearing habitat, and increase irrigation demand in the Scott River basin. The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 2.7 °C in the summer and by 1.3 °C in the winter. Snowpack in upper elevations of the basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009). The vulnerability of the Klamath estuary to sea level rise is low to moderate and therefore does not pose a significant threat to estuarine rearing habitat downstream. Juvenile rearing and migratory habitat in the Scott River and mainstem Klamath is most at risk to climate change. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, all populations in the ESU will be negatively impacted by ocean acidification, rising sea surface temperatures and stratification, and loss of calcareous shell-forming species, which will affect prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Roads

Roads are a high threat across all life stages, and a significant overall threat for coho salmon in the Scott River population. Roads posing the highest threats to coho salmon are virtually all unpaved forest roads that, unless receiving a high level of use, receive minimal routine maintenance. High road density in watersheds concentrates and channelizes surface runoff, resulting in slope failures and landslides, which can mobilize sediment to stream channels, increase substrate embeddedness, smother eggs in redds, and fill in pools. Road density is high in the following tributary sub-basins, where high IP reaches predominate: South Fork Scott

River, upper East Fork Scott River, French/Miners creeks, Johnson Creek, Patterson Creek, Kidder Creek, Moffett Creek, McAdams Creek, Shackleford/Mill creeks, Boulder Creek, and Scott Bar Mill Creek. In the Scott River basin, human-related land sliding averages 36 tons/mi^2 per year, which significantly exceeds natural background land sliding in other neighboring watersheds (NCRWQCB 2006a). Road construction in upland areas has stabilized since the mid-1990s, providing opportunities to storm proof priority use roads and to decommission redundant roads. Currently, there are ongoing Klamath National Forest and private projects to upgrade, storm proof, and decommission roads in priority areas of the Scott River basin (USFS 2011a). While road related sediment issues remain a high threat across the basin, continuation and further funding of these efforts will likely decrease the magnitude of this threat in the future.

High Severity Fire

High severity fire, and the associated riparian forest habitat destruction and surface erosion to streams it causes is a high threat to both egg and fry and a medium threat to juvenile, smolt and adult life history stages. Because of past timber harvest practices, coupled with the fire-suppression efforts over the past century, understory forest fuel loads have become excessive. A wildland fire resulting from these excessive forest fuel loads occurred in the Scott River Canyon portion of the watershed in 1987 (USFS 2000d). Such fire mobilize sediment downslope to streams when they do occur, and can smother eggs in redds, decrease pool volume and habitat complexity, and create alluvial sills in tributary mouths (Maria 2002). High severity fire risk is expected to continue into the future, until current understory fuels reduction actions have strategically treated upland areas, and a more natural fire regime is reestablished throughout the basin.

Hatcheries

Hatcheries pose a medium threat to all life stages in the Scott River basin. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Mining/Gravel Extraction

Mining activities and gravel extraction are a medium threat to all life stages. Effects from historic mining activities have created a legacy of impacts throughout the basin, with tailing piles and constrained active channels highlighting the altered structure of floodplains. Placer and hard rock mining continue today (USFS 2006), and are concentrated in the canyon reach of the mainstem Scott River. Currently, suction dredging is prohibited in California.

Current gravel extraction is incrementally removing a portion of historic tailings piles along the mainstem Scott River near Callahan, which may aid in the restoration of floodplain and channel connections and potentially restore a more natural hydrograph in areas downstream of the channelized reach (USFS 2006). Gravel extraction also has the potential to improve surface flow connection between the mainstem Scott River and tributaries that have been disconnected by alluvial sills, incised channels, and a lowered water table. This gravel can be relocated to nearby river reaches that currently require substrate enhancement for improved spawning habitat conditions (Cramer Fish Sciences et al. 2010).

Urban/Residential/Industrial Development

Urban/residential/industrial development is a medium threat to all life stages. The human population of the Scott Valley has grown from 2,900 in 1930 to nearly 8,000 in 2000 (SRWC 2005), which represents 1,800 acre feet of annual water use, at 200 gallons per person per day. In contrast, current irrigated agriculture/pasture annually uses approximately 81,070 acre feet of water for 29,000 acres (Van Kirk and Naman 2008). This agricultural usage is expected to continue without major change for the foreseeable future, due to the Scott Valley's relative isolation. The Scott Valley Area Plan and Environmental Impact Report (SRWC 2005) projected the Scott Valley population to reach 18,000 by 2010, but the actual population size at this time is less than half of this estimate. While human population growth is currently stable or even decreasing in the Scott Valley, establishment of center pivot irrigation systems using groundwater, and development of small ranches are increasing demand for water. Much of this demand is met through shallow groundwater wells, or through exercise of adjudicated in-stream diversions, which can markedly reduce stream flows during summer low-flow periods. Water use associated with rural residential development along tributaries to the Scott River may result in pronounced reductions in tributary summer surface flows. The number of domestic wells increased from 108 to 913 between 1970 and 2002, respectively (Shasta Scott Recovery Team 2003), and this growth in groundwater use is likely to continue into the future, representing a continued threat to the Scott River coho salmon population.

Timber Harvest

Timber harvest poses a medium threat to the Scott River population. High (25 to 35 percent of watershed harvested) and very high (>35 percent of watershed harvested) rates of timber harvest have occurred in the following tributary sub-basins: Noyes Valley Creek, Mule Creek, Wildcat Creek, French/Miners creeks, Etna Creek, Moffett Creek, McAdams Creek, and lower Scott River (upper Canyon Reach). These formerly high rates of timber harvest, though reduced since the mid-1990s, still contribute to the altered sediment supply, impaired water quality, degraded riparian forest conditions and impaired mainstem function stresses that are occurring in the Scott River basin. The steeper and erodible western and northwestern drainages of the basin had been extensively logged (USDA 2000) and then suffered a major fire prior to a December 1955 flood (Sommarstrom et al. 1990), when sediment and debris mobilized by the flood contributed to aggradation of alluvial fans at the foothill-valley floor interface for some of these tributary streams. These impacts have caused decreased pool volumes, poor water quality, disconnection of floodplain and off-channel habitat, and simplification of instream habitats. While Timber harvest activities continue in the Westside and Scott River Canyon areas, timber harvest has decreased in the last 15 years and upland riparian forest areas are in early stages of recovery. This recovery is expected to proceed as clear cutting is replaced by density-dependent thinning and understory fuels reduction, which are intended to reduce wildland fire risk and attendant sediment mobilization. Stormproofing and decommissioning of roads used for forest stand management and timber harvest have also stabilized road prisms and are reducing sediment mobilization downslope.

Road-stream Crossing Barriers

Road-related barriers are a low threat to all life history stages, with the exception of the egg stage which is not affected by such barriers. Available information in the Passage Assessment Database on the Calfish.org website and on the 5 Counties website indicate several road/stream crossings that require fish passage evaluation to determine necessary follow-up treatment (Table 36-7). The Hwy 3/Big Mill Creek road/stream crossing is a Caltrans facility located within SONCC coho salmon critical habitat, and is a high priority for treatment. Remediation of this barrier can be accomplished by returning Big Mill Creek flow to its original channel, but this has been delayed until the landowner can be assured necessary access to property across Big Mill Creek. There are currently no passage barriers within coho salmon critical habitat located on the U.S. Forest Service roads system in the Scott River basin.

Table 36-7. Road/stream crossing barriers in the Scott River basin.

IP priority	Stream Name	Road Name	Sub-basin	Miles of upstream habitat
1	Big Mill Creek	State Hwy 3	East Fork Scott River	1.5
1	Meamber Creek	Scott River Road	Lower Scott River	1.0
1	Sniktaw Creek	Big Meadows Road	Lower Scott River	2.0
1	Little Jackson Creek	Forest Service Road	South Fork Scott River	
1	West Boulder Creek	Forest Service Road	South Fork Scott River	
2	Kangaroo Creek	Forest Service Road	East Fork Scott River	
2	Tiger Fork	Forest Service Road	Sugar Creek	
2	Duzel Creek #1	Duzel Creek Road	Moffett	
2	Soap Creek	Hwy 3	Moffett Creek	

The number and kind of passage barriers associated with road-stream crossings on private land in the Scott River basin are unknown but potentially significant, given that many private roads cross high-IP reaches on the valley floor (e.g., lower Scott Bar Mill Creek-road crossing). Access to private land to inventory these crossings remains limited.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

36.7 Recovery Strategy

Sustained efforts to restore aquatic habitat condition and function have been occurring on the Scott Valley floor and in upland areas since the 1970s (USFS 2000d, SRWC 2005). Coho salmon in the Scott River basin, including the relatively productive 2010 brood year, are depressed in abundance, with a restricted distribution. Unless agricultural water use efficiency increases, water use is reduced, floodplain and channel structure is reestablished, and riparian habitat is restored, instream flows and riparian ecosystem functions are expected to remain in degraded condition. Fenced stream reaches on the Scott Valley floor and along its tributaries are in an early seral stage of recovery, although riparian canopy, large wood recruitment processes, and complex stream habitat will take decades to recover. Sediment loads resulting from agriculture-related channel alteration, degraded roads and compacted surfaces continue to impair salmon habitat. Residential development in the valley and lower tributary reaches of the watershed, many miles of untreated private roads, and ongoing stream channelization and straightening will continue to present a threat from sediment inputs into stream channels.

Recovery activities in the watershed should continue to be aimed towards increasing spatial distribution, productivity and abundance. Where possible, activities should occur watershed-wide, with a focus on those tributaries with consistent coho occupancy and high IP values. Recovery activities that enhance and extend surface flow connectivity to ensure sufficient instream flows should be given priority, along with efforts to increase summer and winter rearing habitat, and reduce lethal stream temperatures and fine sediment mobilization. Many of these activities are ongoing and are being undertaken by the Siskiyou RCD (NCRWQCB 2009) and Scott River Watershed Council, in coordination with the US Fish and Wildlife Service (Sommarstrom 2009), Natural Resources Conservation Service, California Department of Fish and Wildlife, and NMFS. The following recovery actions build upon these current, ongoing efforts. Specific goals for each stress are listed in the recovery actions that follow. These goals identify activities that are expected to reduce the stresses currently affecting the Scott River SONCC coho salmon population. The effects of fishing on this population’s ability to meet its viability criteria should be evaluated.

Table 36-8 on the following page lists the recovery actions for the Scott River population.

Table 36-8. Recovery action implementation schedule for the Scott River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ScoR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	1
SONCC-ScoR.3.1.7.1	*Identify and help reduce obstacles associated with voluntarily transferring water rights to instream flow through the CA Water Code Section 1707 process. Seek expanded use of CA Water Code Section 1707 transfers where appropriate*					
SONCC-ScoR.3.1.7.2	*Use groundwater modeling to identify areas of interconnected water and undertake improved water use management to increase flows and improve flow timing*					
SONCC-ScoR.1.2.46	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary	1
SONCC-ScoR.1.2.46.1	*Implement recovery actions for Lower Klamath River population that address the target "Estuary", including the creation/restoration of off-channel rearing habitat throughout the lower Klamath River*					
SONCC-ScoR.30.1.69	Disease, Predation, Competition	No	Reduce disease	Disrupt the disease cycle between salmon, myxospore, polychaetes, and actinospore stages.	Population wide	1
SONCC-ScoR.30.1.69.1	*Assess all means possible to disrupt disease cycle and develop a plan to do so*					
SONCC-ScoR.30.1.69.2	*Disrupt the disease cycle, guided by assessment results*					
SONCC-ScoR.10.1.14	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase flow	Mouth of Shackleford/Mill crk system, Sugar Crk, South Fork Scott River, Patterson Crk, Upper Kidder Crk, Noyes Valley Crk, Meadow Gulch, candidate pond sites in McConnaughy Gulch, mtn catchments out of wilderness areas, and where coho benefit immediately	1
SONCC-ScoR.10.1.14.1	*Conduct flow studies at key sites in priority watersheds to determine necessary minimum instream flows that will ensure survival and recovery of all relevant coho salmon life stages*					
SONCC-ScoR.10.1.14.2	*Implement plan to increase minimum instream flows in priority watersheds, using flow study information to guide priority flow augmentation projects*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ScoR.10.1.15	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Restore surface flow	Tributaries to mainstem Scott River, including Kidder Creek, Patterson Creek, Moffett Creek, all streams where coho salmon would benefit immediately	1
SONCC-ScoR.10.1.15.2	*Secure enhanced instream flows*					
SONCC-ScoR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve irrigation practices	All areas where coho salmon would benefit immediately	2c
SONCC-ScoR.3.1.5.1	*Apply a variety of techniques (e.g., Farm Irrigation Rating Index Model) to make irrigation system water use efficiency comparisons, and implement water use efficiency improvements*					
SONCC-ScoR.3.1.5.2	*Evaluate irrigation water fees/pricing in the Scott Valley, and recommend revenue neutral changes that encourage water use efficiency and/or dedications to instream flows*					
SONCC-ScoR.3.1.5.3	*Line or pipe surface irrigation ditch systems to increase efficiency (e.g. ditch lining/piping techniques)*					
SONCC-ScoR.3.1.81	Hydrology	Yes	Improve flow timing or volume	Improve irrigation practices	Population wide	2d
SONCC-ScoR.3.1.81.1	*Apply a variety of techniques (e.g., Farm Irrigation Rating Index Model) to make irrigation system water use efficiency comparisons, and implement water use efficiency improvements*					
SONCC-ScoR.3.1.81.2	*Evaluate irrigation water fees/pricing in the Scott Valley, and recommend revenue neutral changes that encourage water use efficiency and/or dedications to instream flows*					
SONCC-ScoR.3.1.81.3	*Line or pipe surface irrigation ditch systems to increase efficiency (e.g. ditch lining/piping techniques)*					
SONCC-ScoR.3.1.1	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2c
SONCC-ScoR.3.1.1.1	*Identify, map, and quantify all surface water diversions*					
SONCC-ScoR.3.1.1.2	*Secure dedicated unused water diversion rights and ensure use to increase instream flows*					
SONCC-ScoR.3.1.1.3	*Verify permitted water diversions and ensure water is allocated according to established water rights through watermaster program*					
SONCC-ScoR.3.1.3	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2c
SONCC-ScoR.3.1.3.1	*Water master all irrigation water diversions, compliant with applicable water law*					
SONCC-ScoR.3.1.79	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-ScoR.3.1.79.1	*Identify, map, and quantify all surface water diversions*					
SONCC-ScoR.3.1.79.2	*Secure dedicated unused water diversion rights and ensure use to increase instream flows*					
SONCC-ScoR.3.1.79.3	*Verify permitted water diversions and ensure water is allocated according to established water rights through watermaster program*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ScoR.3.1.2	Hydrology	Yes	Improve flow timing or volume	Monitor flow for compliance	Population wide	2c
SONCC-ScoR.3.1.2.1	*Install flow measuring devices*					
SONCC-ScoR.3.1.2.2	*Maintain all flow measuring devices*					
SONCC-ScoR.3.1.2.3	*Install head gates and NMFS compliant fish exclusion screens on all water diversions in coho salmon habitat*					
SONCC-ScoR.3.1.42	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	Population wide	2c
SONCC-ScoR.3.1.42.1	*Continue to identify priority reaches for improved flows beneficial to coho salmon, and those diversions and water rights that can provide significant instream flow benefits. Work with willing participants to develop and implement flow solutions (short-term or long-term).*					
SONCC-ScoR.3.1.42.2	*Support the collection and use of relevant hydrologic data to help guide and monitor instream flow actions. Support the continued water lease/dedication efforts of the Scott River Water Trust, to improve streamflow in priority habitat reaches through voluntary leases and dedications*					
SONCC-ScoR.3.2.10	Hydrology	Yes	Increase water storage	Increase water retention	All areas where coho salmon would benefit immediately	2c
SONCC-ScoR.3.2.10.1	*Develop water storage and recharge plans that help recharge groundwater, increase summer base flows, and extend surface connectivity in tributaries to Scott River*					
SONCC-ScoR.3.2.10.2	*Implement projects identified in water storage and recharge plan*					
SONCC-ScoR.3.2.10.3	*Maintain water storage structures*					
SONCC-ScoR.3.2.83	Hydrology	Yes	Increase water storage	Increase water retention	Population wide	2d
SONCC-ScoR.3.2.83.1	*Develop water storage and recharge plans that help recharge groundwater, increase summer base flows, and extend surface connectivity in tributaries to Scott River*					
SONCC-ScoR.3.2.83.2	*Implement projects identified in water storage and recharge plan*					
SONCC-ScoR.3.2.83.3	*Maintain water storage structures*					
SONCC-ScoR.3.1.65	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2c
SONCC-ScoR.3.1.65.1	*Identify and cease unauthorized water diversions*					
SONCC-ScoR.3.1.67	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2c
SONCC-ScoR.3.1.67.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-ScoR.3.1.67.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-ScoR.3.1.82	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-ScoR.3.1.82.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-ScoR.3.1.82.2	*Reduce diversions using a combination of incentives and enforcement measures*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ScoR.3.1.68	Hydrology	No	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	2c
SONCC-ScoR.3.1.68.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-ScoR.3.1.68.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-ScoR.3.1.68.3	*Implement coho salmon instream flow needs plan.*					
SONCC-ScoR.2.1.48	Floodplain and Channel Structure	No	Increase channel complexity	Improve regulatory mechanisms	Population wide	2c
SONCC-ScoR.2.1.48.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-ScoR.2.1.25	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	All areas where coho salmon would benefit immediately	2c
SONCC-ScoR.2.1.25.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-ScoR.2.1.25.2	*Place instream structures, guided by assessment results*					
SONCC-ScoR.2.1.74	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-ScoR.2.1.74.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-ScoR.2.1.74.2	*Place instream structures, guided by assessment results*					
SONCC-ScoR.2.2.20	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2c
SONCC-ScoR.2.2.20.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-ScoR.2.2.20.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-ScoR.2.2.75	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-ScoR.2.2.75.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-ScoR.2.2.75.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-ScoR.2.2.22	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	All streams where coho salmon would benefit immediately	2c
SONCC-ScoR.2.2.22.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-ScoR.2.2.22.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-ScoR.2.2.22.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ScoR.2.2.77	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2d
SONCC-ScoR.2.2.77.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-ScoR.2.2.77.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-ScoR.2.2.77.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-ScoR.2.2.24	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	All areas where coho salmon would benefit immediately	2c
SONCC-ScoR.2.2.24.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-ScoR.2.2.24.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-ScoR.2.2.78	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Population wide	2d
SONCC-ScoR.2.2.78.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-ScoR.2.2.78.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-ScoR.2.2.21	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Restore natural channel form and function	Scott River including Westside Channel and Wolford Slough areas, and all streams where coho salmon would benefit immediately	2c
SONCC-ScoR.2.2.21.1	*Identify and prioritize mining reaches, developing a plan to restore the floodplain and channel by removing tailing piles and reconstructing the channel*					
SONCC-ScoR.2.2.21.2	*Remove tailing piles and reconstruct the channel, guided by the restoration plan*					
SONCC-ScoR.2.2.76	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Restore natural channel form and function	Population wide	2d
SONCC-ScoR.2.2.76.1	*Identify and prioritize mining reaches, developing a plan to restore the floodplain and channel by removing tailing piles and reconstructing the channel*					
SONCC-ScoR.2.2.76.2	*Remove tailing piles and reconstruct the channel, guided by the restoration plan*					
SONCC-ScoR.30.1.70	Disease, Predation, Competition	No	Reduce disease	Conduct monitoring and research actions as described in the Klamath River Fish Disease Research Plan	Population wide	2c
SONCC-ScoR.30.1.70.1	*Develop monitoring plan and research actions as described in the Klamath River Fish Disease Research Plan*					
SONCC-ScoR.30.1.70.2	*Implement Klamath River Fish Disease Research Plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ScoR.26.1.66	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2d
SONCC-ScoR.26.1.66.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-ScoR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	All areas where coho salmon would benefit immediately	3c
SONCC-ScoR.3.1.4.1	*Develop integrated water management plan and water budget, including identifying the relationship between groundwater and surface flow*					
SONCC-ScoR.3.1.4.2	*Improve water use efficiency through the investigation and implementation of alternative agricultural crops and practices (e.g., grass fed beef, winter wheat, alternative pasture crops)*					
SONCC-ScoR.3.1.4.3	*Upgrade and expand alternative stock watering systems to increase instream flows*					
SONCC-ScoR.3.1.4.4	*Develop and disseminate an on-farm water use efficiency monitoring system*					
SONCC-ScoR.3.1.4.5	*If current water use/management is determined to be inconsistent with coho salmon recovery, modify management accordingly*					
SONCC-ScoR.3.1.80	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	Population wide	3d
SONCC-ScoR.3.1.80.1	*Develop integrated water management plan and water budget, including identifying the relationship between groundwater and surface flow*					
SONCC-ScoR.3.1.80.2	*Improve water use efficiency through the investigation and implementation of alternative agricultural crops and practices (e.g., grass fed beef, winter wheat, alternative pasture crops)*					
SONCC-ScoR.3.1.80.3	*Upgrade and expand alternative stock watering systems to increase instream flows*					
SONCC-ScoR.3.1.80.4	*Develop and disseminate an on-farm water use efficiency monitoring system*					
SONCC-ScoR.3.1.80.5	*If current water use/management is determined to be inconsistent with coho salmon recovery, modify management accordingly*					
SONCC-ScoR.7.1.18	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Low gradient private lands, all areas where coho salmon would benefit immediately	3c
SONCC-ScoR.7.1.18.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-ScoR.7.1.18.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-ScoR.7.1.18.3	*Plant vegetation to stabilize stream bank*					
SONCC-ScoR.7.1.18.4	*Maintain fencing or fence livestock out of riparian zones*					
SONCC-ScoR.7.1.18.5	*Manage livestock watering sources to reduce impacts to coho salmon*					
SONCC-ScoR.7.1.87	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-ScoR.7.1.87.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-ScoR.7.1.87.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-ScoR.7.1.87.3	*Plant vegetation to stabilize stream bank*					
SONCC-ScoR.7.1.87.4	*Maintain fencing or fence livestock out of riparian zones*					
SONCC-ScoR.7.1.87.5	*Manage livestock watering sources to reduce impacts to coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ScoR.5.1.12	Passage	No	Improve access	Provide artificial passage	French Creek, East Fork Scott River, mainstem Scott River upstream of Fay Lane, and all streams where coho salmon would benefit immediately	3c
SONCC-ScoR.5.1.12.1		*Identify and prioritize all barriers at diversions (rock weirs) and develop plan to provide short- and long-term passage*				
SONCC-ScoR.5.1.12.2		*Provide passage for all life stages, guided by plan*				
SONCC-ScoR.5.1.85	Passage	No	Improve access	Provide artificial passage	Population wide	3d
SONCC-ScoR.5.1.85.1		*Identify and prioritize all barriers at diversions (rock weirs) and develop plan to provide short- and long-term passage*				
SONCC-ScoR.5.1.85.2		*Provide passage for all life stages, guided by plan*				
SONCC-ScoR.5.1.13	Passage	No	Improve access	Reduce sediment barriers	All streams where coho salmon would benefit immediately	3c
SONCC-ScoR.5.1.13.1		*Inventory and prioritize barriers formed by alluvial deposits*				
SONCC-ScoR.5.1.13.2		*Using reach-based fluvial geomorphology information, remove alluvial deposits, construct low flow channels through alluvial reaches, or reduce stream gradient to provide fish passage for all life stages*				
SONCC-ScoR.5.1.86	Passage	No	Improve access	Reduce sediment barriers	Population wide	3d
SONCC-ScoR.5.1.86.1		*Inventory and prioritize barriers formed by alluvial deposits*				
SONCC-ScoR.5.1.86.2		*Using reach-based fluvial geomorphology information, remove alluvial deposits, construct low flow channels through alluvial reaches, or reduce stream gradient to provide fish passage for all life stages*				
SONCC-ScoR.5.1.11	Passage	No	Improve access	Remove structural barriers	Big Mill Creek, Rail Creek, Youngs Dam, improperly functioning diversion weirs, and all areas where coho salmon would benefit immediately	3c
SONCC-ScoR.5.1.11.1		*Assess barriers and prioritize for removal*				
SONCC-ScoR.5.1.11.2		*Remove all barriers guided by assessment results*				
SONCC-ScoR.5.1.84	Passage	No	Improve access	Remove structural barriers	Population wide	3d
SONCC-ScoR.5.1.84.1		*Assess barriers and prioritize for removal*				
SONCC-ScoR.5.1.84.2		*Remove all barriers guided by assessment results*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ScoR.7.1.58	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve food availability	In watersheds that are natal habitat and/or provide thermal refugia, and all areas where coho salmon would benefit immediately	3c
SONCC-ScoR.7.1.58.1		*Assess need for salmonid carcass enhancement (with intestines and kidneys removed) to increase food for juvenile coho salmon, using excess hatchery*				
SONCC-ScoR.7.1.58.2		*Develop a plan for salmonid carcass enhancement to benefit rearing juvenile coho salmon, one that does not vector diseases*				
SONCC-ScoR.7.1.58.3		*Implement and monitor plan for salmonid carcass enhancement to benefit rearing juvenile coho salmon, and that does not vector diseases*				
SONCC-ScoR.7.1.88	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve food availability	Population wide	3d
SONCC-ScoR.7.1.88.1		*Assess need for salmonid carcass enhancement (with intestines and kidneys removed) to increase food for juvenile coho salmon, using excess hatchery*				
SONCC-ScoR.7.1.88.2		*Develop a plan for salmonid carcass enhancement to benefit rearing juvenile coho salmon, one that does not vector diseases*				
SONCC-ScoR.7.1.88.3		*Implement and monitor plan for salmonid carcass enhancement to benefit rearing juvenile coho salmon, and that does not vector diseases*				
SONCC-ScoR.8.2.26	Sediment	No	Increase spawning gravel	Enhance spawning substrate	Sugar Creek, South Fork Scott River, Shackelford Creek, French Creek, Scott River, Patterson Creek, Etna Creek, Kidder Creek, and all streams where coho salmon would benefit immediately	3c
SONCC-ScoR.8.2.26.1		*Continue to develop a spawning substrate management plan that identifies quantity, quality, location, and timing of gravel supplements*				
SONCC-ScoR.8.2.26.2		*Supplement gravel, guided by the plan*				
SONCC-ScoR.8.2.90	Sediment	No	Increase spawning gravel	Enhance spawning substrate	Population wide	3d
SONCC-ScoR.8.2.90.1		*Continue to develop a spawning substrate management plan that identifies quantity, quality, location, and timing of gravel supplements*				
SONCC-ScoR.8.2.90.2		*Supplement gravel, guided by the plan*				
SONCC-ScoR.8.1.44	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	South Fork Scott River, upper East Fork Scott River, French/Miners, Johnson, Patterson, Kidder, Moffett , McAdams, Shackleford/Mill, Boulder, Scott Bar Mill creeks, and all areas where coho salmon would benefit immediately	3c
SONCC-ScoR.8.1.44.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-ScoR.8.1.44.2		*Decommission roads, guided by assessment*				
SONCC-ScoR.8.1.44.3		*Upgrade roads, guided by assessment*				
SONCC-ScoR.8.1.44.4		*Maintain roads, guided by assessment*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ScoR.8.1.89	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-ScoR.8.1.89.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-ScoR.8.1.89.2	*Decommission roads, guided by assessment*					
SONCC-ScoR.8.1.89.3	*Upgrade roads, guided by assessment*					
SONCC-ScoR.8.1.89.4	*Maintain roads, guided by assessment*					
SONCC-ScoR.10.2.49	Water Quality	No	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	3c
SONCC-ScoR.10.2.49.1	*Develop a pesticide management plan*					
SONCC-ScoR.10.2.49.2	*Implement pesticide management plan and technical assistance program*					
SONCC-ScoR.10.2.72	Water Quality	No	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-ScoR.10.2.72.1	*Develop a pesticide management plan*					
SONCC-ScoR.10.2.72.2	*Implement pesticide management plan and technical assistance program*					
SONCC-ScoR.10.1.16	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Reduce warm water inputs	All streams where coho salmon would benefit immediately	3c
SONCC-ScoR.10.1.16.1	*Develop a program that identifies, designs, and constructs projects that will reduce warm tailwater inputs*					
SONCC-ScoR.10.1.16.2	*Implement tailwater reduction program*					
SONCC-ScoR.10.1.71	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Reduce warm water inputs	Population wide	3d
SONCC-ScoR.10.1.71.1	*Develop a program that identifies, designs, and constructs projects that will reduce warm tailwater inputs*					
SONCC-ScoR.10.1.71.2	*Implement tailwater reduction program*					
SONCC-ScoR.10.7.64	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-ScoR.10.7.64.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-ScoR.10.7.64.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-ScoR.10.7.73	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-ScoR.10.7.73.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-ScoR.10.7.73.2	*Supply marine-derived nutrients to streams guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ScoR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	3d
SONCC-ScoR.3.1.6.1	*Develop and implement an educational program addressing water conservation programs, instream leasing and water dedication programs, and improved connectivity at water diversions in tributaries to Scott River*					
SONCC-ScoR.3.1.6.2	*Create voluntary programs for Scott Valley agricultural water users to implement water conservation and instream transfer activities*					
SONCC-ScoR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-ScoR.3.1.8.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-ScoR.3.1.9	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-ScoR.3.1.9.1	*Conduct a comprehensive inventory of current groundwater wells and well usage within Scott River Basin, completed by a surface-groundwater integrated model, that together can evaluate the relative merit of water management alternatives*					
SONCC-ScoR.3.1.9.2	*Establish a comprehensive groundwater permit process*					
SONCC-ScoR.7.1.43	Riparian	Yes	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Population wide, guided by assessment priorities (particularly USFS WCF 2011, in uplands on the Westside and in the Scott River Canyon)	3d
SONCC-ScoR.7.1.43.1	*Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime*					
SONCC-ScoR.7.1.43.2	*Carry out fuel reduction or modification projects such as thinning, prescribed burning, and piling, guided by the plan*					
SONCC-ScoR.7.1.59	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Population wide guided by recent assessment priorities (USFS, WCF 2011)	3d
SONCC-ScoR.7.1.59.1	*Reduce stand densities in watersheds where stands are over dense, to create fire resilient landscapes*					
SONCC-ScoR.7.1.59.2	*Reduce the occurrence of high severity fire through strategic fuels treatments that allow future fires to be managed for multiple objectives*					
SONCC-ScoR.16.1.28	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ScoR.16.1.28.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-ScoR.16.1.28.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-ScoR.16.1.61	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-ScoR.16.1.61.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-ScoR.16.1.61.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ScoR.16.1.62	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-ScoR.16.1.62.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-ScoR.16.1.62.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-ScoR.16.1.29	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ScoR.16.1.29.1	*Determine actual fishing impacts*					
SONCC-ScoR.16.1.29.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-ScoR.16.1.63	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-ScoR.16.1.63.1	*Determine actual fishing impacts*					
SONCC-ScoR.16.1.63.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-ScoR.16.2.30	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ScoR.16.2.30.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-ScoR.16.2.30.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-ScoR.16.2.31	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ScoR.16.2.31.1	*Determine actual impacts of scientific collection*					
SONCC-ScoR.16.2.31.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-ScoR.10.2.17	Water Quality	No	Reduce pollutants	Set standard	Population wide	3d
SONCC-ScoR.10.2.17.1	*Continue implementation of TMDLs for water bodies listed under Clean Water Act Section 303(d)*					

37. Shasta River Population

Interior Klamath Stratum

Core, Functionally Independent Population

High Risk of Extinction

Population likely below depensation threshold

4,700 Spawners Required for ESU Viability

793 mi^2 watershed (27% Federal ownership)

144 IP-km (90 IP-mi) (80% high)

Dominant Land Uses are Agricultural and moderate Timber Harvest

Key Limiting Stresses are 'Impaired Water Quality' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Agricultural Practices' and 'Dams/Diversions'

Highest Priority Recovery Actions

• Increase instream flows by securing unused water rights and establishing a water trust to benefit salmon • Develop a plan to increase flows out of Greenhorn Dam to enhance coho salmon rearing habitat • Increase cold water in the Upper Shasta basin	• Reduce water temperature, increase dissolved oxygen • Increase instream flows by improving the Grenada Irrigation District ditch diversion to decrease impacts on coho salmon • Reduce warm tailwater inputs into the stream

37.1 History of Habitat and Land Use

The Shasta Valley is situated on the western side of the Cascade Range in far northern California. The Shasta River basin is uniquely located at the boundary between two of California's principal geomorphic provinces: the Klamath Mountains province and the Cascade Range province. The Klamath Mountains province includes the western portions of the Shasta River watershed, where varied bedrock geologic conditions comprised principally of Paleozoic sedimentary and metamorphic rocks give rise to the Scott and Siskiyou Mountains. These contiguous mountain ranges intercept moist air originating over the Pacific Ocean, creating a pronounced rain shadow over the Shasta River basin. Due to this rain shadow, precipitation is low (i.e., 12-18 inches/year) and diminish considerably to the north and east. The majority of this precipitation falls as rain and snow between October and March, producing snowmelt and rainfall runoff along easterly draining and headwater tributaries to the Shasta River. The eastern portions of the Shasta Valley are contained within the Cascade Range geomorphic province, an area underlain by Tertiary and Quaternary volcanic and debris flows, including a large Pleistocene debris avalanche. Westerly-draining tributaries to the Shasta River originate in these Cascadian volcanic rocks along the southern and eastern watershed boundaries. Flows in these tributaries are dominated by discharge from numerous groundwater springs sourced principally from high elevation snowmelt percolation through the porous volcanic rocks. Differences in underlying lithological conditions throughout the Shasta River basin generate spatial differences in hydrological conditions and dependent geomorphic conditions. Shasta Basin geology continues to be influenced by Cascadian volcanism, particularly a massive lahar from Mt. Shasta that covered much of the southern portion of the Shasta Valley approximately 350,000 years ago (USFS 2012).

Hydrologic and dependent geomorphic conditions in the Shasta River downstream from Big Springs Creek are largely defined by spring flow from Big Springs Creek and other small springs and spring-fed tributaries. These freshwater springs provide continuous flow of cool water originating primarily from glaciers on Mt. Shasta, and this keeps the Shasta River watered throughout the year (Snyder 1931). The hydrology of the Shasta River has been and continues to be affected by Dwinnell Dam, surface water diversions, and interconnected groundwater pumping. The construction of Dwinnell Dam and the Parks Creek diversion by the Montague Water Conservation District (MWCD) in about 1926 has altered the natural flow and sediment transport regime in both the upper Shasta River and lower Parks Creek and also blocked access to about 22 percent of the available fish habitat for anadromous salmonids (National Research Council [NRC] 2004). A reduction in the frequency of large flood flows along with the elimination of sediment transport processes downstream of Dwinnell Dam have resulted in coarsening of the bed and reduction in habitat diversity immediately downstream. The loss of woody debris, pools, side channels, springs, and accessible wetlands from land use conversions, have also contributed to reduced summer and winter rearing capacity for juvenile coho salmon. Further alterations to stream channel function from agricultural practices includes a reduction in the number of beaver ponds, which provide important habitat attractive to rearing coho salmon.

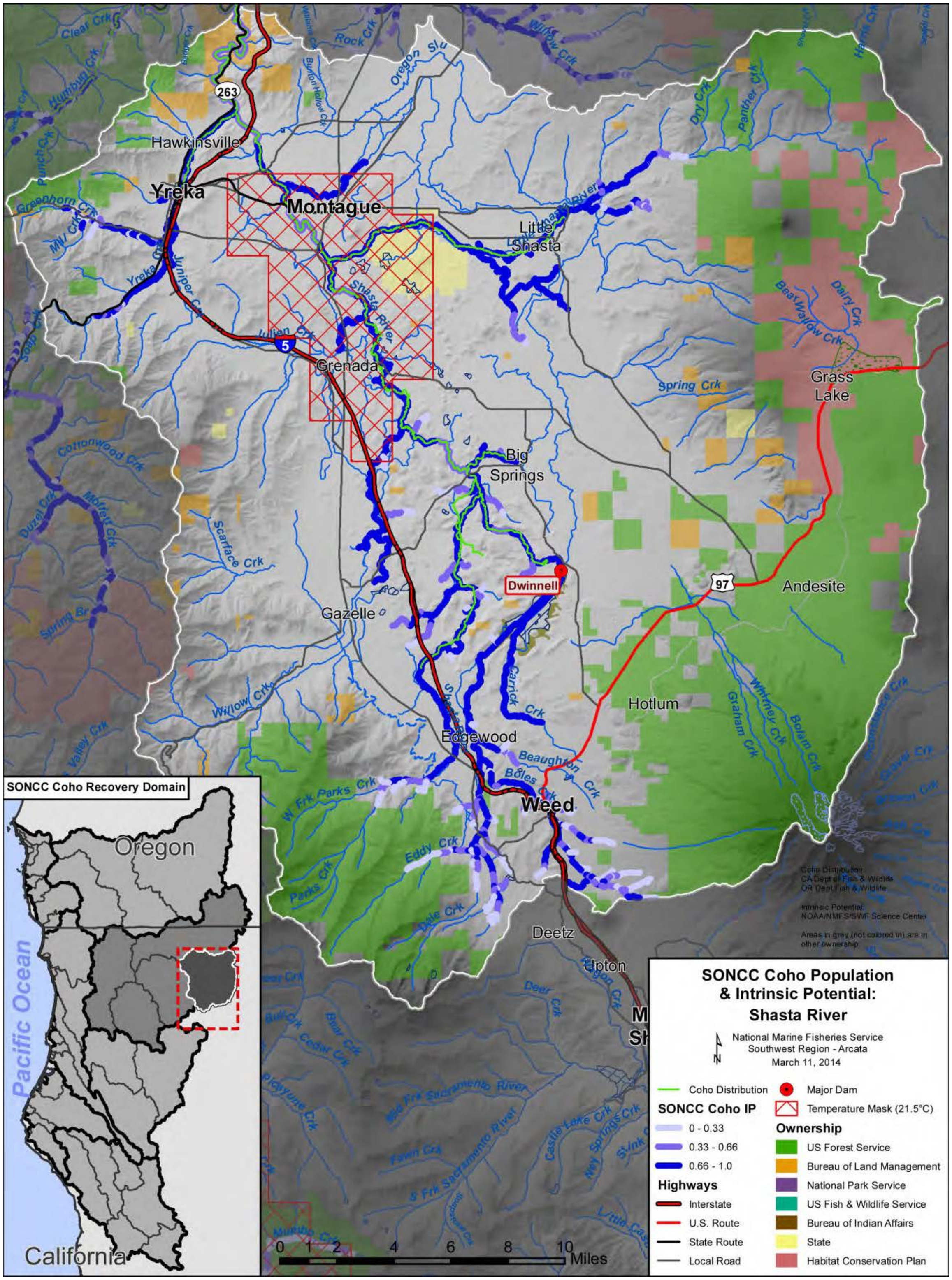

Figure 37-1. The geographic boundaries of the Shasta River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Klamath River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

Historic gold mining along Yreka Creek and the lower seven miles of the Shasta River occurred from the 1850s through the 1930s. Early mining activities were dependent on the development of water diversion systems to meet mining needs and gravel extraction was focused along the mainstem Shasta River. Large dredge mining activities ended around 1950 in the Shasta River basin, including Yreka Creek, but riparian areas remain poorly vegetated and erodible in these sites (Shasta Valley Resource Conservation District 2005). These past operations continue to be a threat for coho salmon along the west side of the Shasta River basin through legacy effects of remnant tailing piles, altered channel morphology, and potential remaining gold mining-associated pollution inputs.

Intensive timber harvest of the region surrounding the Shasta River watershed began in the 1850s, reached a peak in the 1950s (Klamath River Basin Fisheries Task Force 1991) and is currently occurring at a much reduced harvest rate and intensity. Extensive road networks were built to facilitate the intensive timber harvest, and many of them are on steep, naturally fragile terrain. Increased sediment loads resulting from these roads and upslope timber harvesting (e.g., Parks Creek drainage) have accumulated in the Shasta Valley. This, along with hydraulic conditions characterized by unvarying spring-fed base flows, have resulted in the covering of substrate, decreased availability of spawning gravel, and simplified pool and riffle habitats. This sediment has not been thoroughly flushed since construction of the Dwinnell Dam in 1926 and continues to be a threat to the Shasta River coho salmon population.

Wildland fire risk has increased in the Shasta River during the recent past due to fire suppression activities that have resulted in a buildup of understory fuels. These understory fuels were historically reduced by low-intensity fires that occurred every 12 to 19 years (Taylor and Skinner 1998). Fire suppression activities over the past 50 years have inadvertently created a new fire regime around the margins of the Shasta Basin, which can be characterized by frequent high severity, stand replacing fires.

37.2 Historical Fish Distribution and Abundance

Information suggests that coho salmon abundance is depressed relative to historical population numbers. Until recently, coho salmon abundance could not be accurately estimated. Coho salmon runs in the Shasta Valley probably averaged a little more than 1,000 fish annually in the late 1950s (CDFG 1959), which already suggests a depressed population. In the early 1960s, the runs were estimated to average 600 fish (CDFG 1979). More recently, data suggest (Figure 37-2) the 2004 adult returning brood year class is the strongest, although still lower than historical numbers. Returns for the 2002 and 2003 brood classes have been extremely depressed.

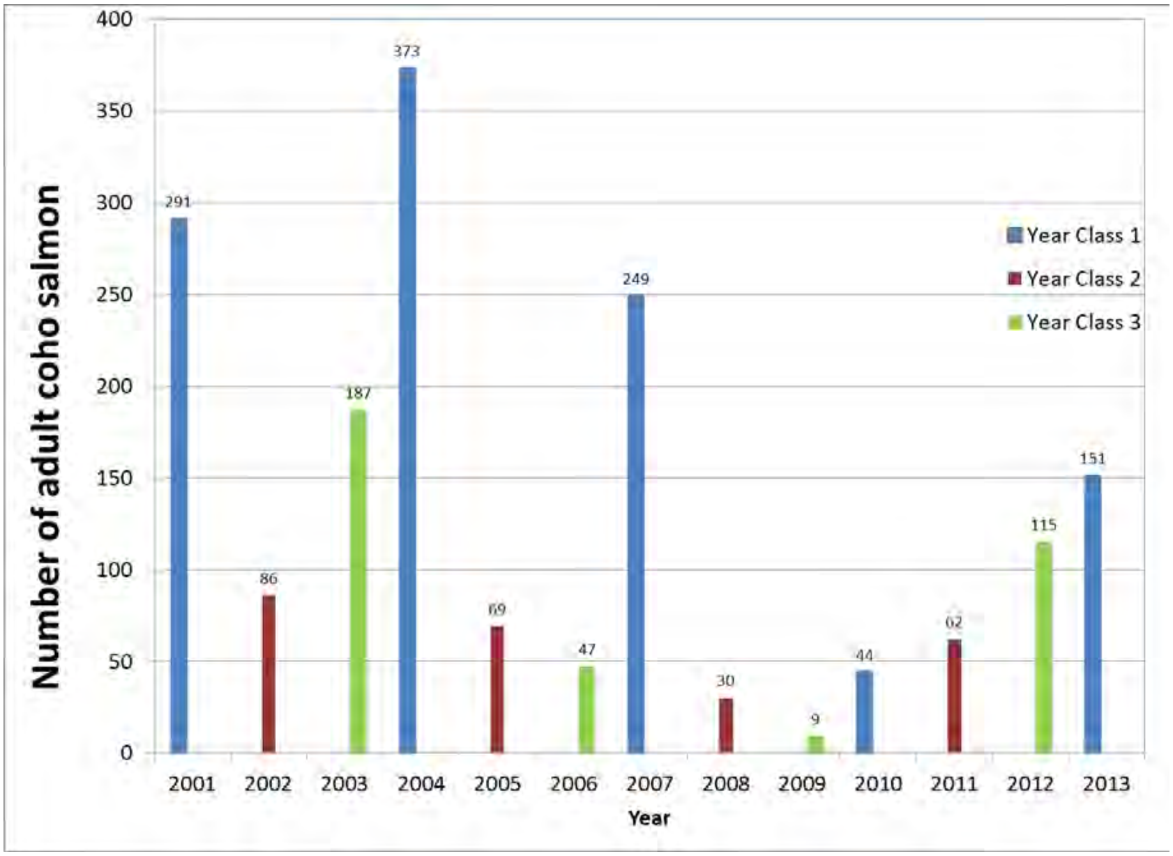

Figure 37-2. Estimates of adult coho salmon in the Shasta River from 2001 to 2013 (Knechtle 2014).

Adult coho salmon have been observed spawning in the Shasta River Canyon, lower Yreka Creek, throughout the Big Springs Complex area, and in lower Parks Creek. Juvenile coho salmon have been observed rearing in these same areas, continuing further upstream (Mount et al. 2008), and in the upper Little Shasta River. Potential coho salmon habitat is distributed throughout the Shasta River basin and IP model shows the highest values (IP > 0.66) are throughout the Shasta Valley, in low gradient reaches, and near cool spring fed tributaries to the Shasta River and Parks Creek.

Table 37-1. Tributaries in the Shasta River with high IP reaches (IP > 0.66) (Williams et al. 2006).

Stream Name	Stream Name
Shasta River[1]	Yreka Creek[1]
Big Springs Creek[1]	Little Shasta River[1]
Parks Creek[1]	Willow Creek[1]
Oregon Slough	Juniper Creek
Dale Creek	Boles Creek
[1] Denotes a “Key Stream” as identified in the State of California’s Coho Recovery Strategy	

37.3 Status of Shasta River Coho Salmon

Spatial Structure and Diversity

The diversity and complexity of the physical and environmental conditions found within the Shasta River basin created unique life history strategies and diverse coho salmon habitat. The Shasta River population is considered a Functionally Independent population within the SONCC coho salmon ESU (Williams et al. 2006). Historical instream river conditions, fostered by unique cold spring complexes, created abundant summer rearing and off channel overwintering habitat that were favorable for production of coho salmon in the Shasta River basin.

The current distribution of coho salmon spawners is concentrated in the mainstem Shasta River from river mile 32 to about river mile 36, Big Springs Creek, lower Parks Creek, and in the Shasta River Canyon (river mile 0 to 7). Juvenile rearing is also occurring in these same areas, and occasionally in lower Yreka Creek ((Garwood 2012) and the upper Little Shasta River (Whelan, J., pers. comm. 2006). Coho salmon have also been observed utilizing aquatic macrophyte habitat in the Big Springs Creek area that is both complex and productive. This distribution is both a small fragment of the current Shasta River stream network and of the modeled IP in the basin..

Another important consideration in regards to SONCC coho salmon ESU diversity, spatial structure, and productivity is how coho salmon populations from tributaries, such as the Shasta River, are affected by straying of hatchery fish. The average annual percentage of hatchery coho salmon in the Shasta River from 2001 to 2010 was 23, with a high of 73 in 2008 (Chesney and Knechtle 2013, Ackerman et al. 2006). A high number of hatchery strays has the potential to reduce the reproductive success of the natural population (Chilcote 2003, Mclean et al. 2003, Araki et al. 2007, Chilcote et al. 2011) and negatively affect the diversity of the interior Klamath populations via outbreeding depression (Reisenbichler and Rubin 1999, HSRG 2004). However, recent preliminary findings by NMFS Southwest Fisheries Science Center suggest that hatchery and natural fish have already interbred in the upper Klamath Basin tributaries near Iron Gate Hatchery (CDFW 2013a). The total impacts of hatchery strays on Klamath River populations are not well understood. However, known straying data and preliminary genetic typing indicate that hatchery releases have negatively impacted natural populations, particularly in the upper basin.

Negative effects potentially increase over time due to climate change. For example, freshwater habitat availability for juvenile coho salmon rearing and migration is expected to decrease in the future due to climate warming (Mote et al. 2003, Battin et al. 2007); therefore, competition for limited thermal refuge areas will increase. Bartholow (2005) found a warming trend of 0.5 °C/decade in the Klamath River and a decrease in average length of river with temperatures below 15 °C (8.2 km/decade), underscoring the importance of thermal refugia areas. However, hatchery releases are expected to remain constant during this period of shrinking freshwater habitat availability, which makes the detrimental impact from density-dependent mechanisms in the freshwater environment to naturally produced coho salmon populations increase through time under a climate warming scenario. In this way, hatcheries likely continue to have an adverse impact in the effective use of habitats by naturally produced coho salmon in the future, if shared use of these habitats by natural and hatchery stocks exceed capacity limitations and food supplies. Although there are risks to Klamath coho salmon populations from continued releases of coho salmon smolts from the Iron Gate Hatchery, due to the significantly depressed status of the Upper Klamath, Scott, and Shasta populations, releases of coho salmon could continue to contribute towards coho salmon abundance, one of the VSP criteria (NMFS and USFWS 2013).

Population Size and Productivity

The number of spawners in all three year classes is low, well below the depensation threshold. Productivity may also be impaired. Recent comparisons of estimated Shasta River yearling coho salmon production to returning adult Shasta River coho salmon have ranged from 4.4 to 46.6 (Chesney and Knechtle 2013, Table 37-2). By brood year, the number of yearlings produced per returning adult has been trending downwards, suggesting that in-river conditions have not improved sufficiently to initiate recovery of the Shasta River coho salmon population. The number of yearlings produced per adult will continue to be tracked, as it is a useful measure to infer habitat condition and trend between years, for coho salmon in the Shasta Basin when redd and juvenile abundance is below carrying capacity (Knechtle and Chesney 2013).

Adult spawning surveys and fish counting weir information started in 1934, and are conducted by the California Department of Fish and Wildlife (formerly California Department of Fish and Game [CDFG]). These weir counts indicate that the minimum number of adult spawning coho salmon have varied between 0 to 400 for most years, with a high of approximately 900 returning adults in 1978 (Chesney and Knechtle 2013; note: These data may not account for entire adult coho salmon brood year numbers, as weirs were sometimes removed [due to high flows] before all coho salmon spawners had entered the Shasta River). These brood year population estimates are low, and have not trended upward over time. Therefore, the Shasta River coho salmon population is at high risk of extinction given the unstable and low population size and presumed negative population growth rate.

Table 37-2 Adult coho salmon estimates. Yearling coho salmon production point estimates, and ratio of yearling coho salmon produced per adult return for the Shasta River population, brood years 2001-2008 (Chesney and Knechtle 2013)

Adult Brood Year	Adult Estimate	Yearling Year	Yearling Point Estimate	Yearlings Produced Per Adult
2001	291	2003	11,052	38
2002	86	2004	1,799	20.9
2003	187	2005	2,054	11
2004	373	2006	10,833	29
2005	69	2007	1,178	17.1
2006	47	2008	208	4.4
2007	255	2009	5,396	21.2
2008	31	2010	169	5.6
2009	9	2011	19	2.1
2010	44	2012	2049	46.6
Average				**19.62**

Extinction Risk

The Shasta River population is at high risk of extinction because the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in the watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Shasta River population is a core, Functionally Independent population within the Interior Klamath River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Shasta River core population should have at least 4,700 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Shasta River population may serve as a source of spawner strays for nearby coastal populations. At present, the capacity of the Shasta River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from the nearby Scott River and Upper Klamath River may enhance recovery of the Shasta River population.

37.4 Plans and Assessments

Shasta Valley Resource Conservation District

The Shasta Valley Resource Conservation District was formed in July of 1953 and reached its present boundaries in 1957. The Shasta Valley RCD manages soil, water, and fish and wildlife resources for conservation purposes. Currently, the District manages 44 open funding contracts and employs 5 permanent staff members. In addition to permanent staff, the Shasta Valley RCD also employs 2 temporary staff members. Additional information about the Shasta Valley RCD is available on their web site, http://svrcd.org/wordpress/.

> *Study Plan to Assess Shasta River Salmon and Steelhead Recovery Needs* (Shasta Valley RCD and McBain & Trush 2013)

This Study Plan focuses on fish ecology, geomorphology, hydrology, water quality (including temperature), and the habitat needs for salmonid life history stages. The plan emphasizes coordination of basin-wide research and monitoring, to guide and enhance the Shasta Valley RCD's ability to assist the recovery of Shasta Basin salmonid populations. Developing the Study Plan required: review of relevant Shasta Basin documents and information; characterization of historical streamflow and habitat conditions in the Shasta Basin, to help guide recovery planning efforts; description of the geographical distribution of different life stages of

salmonids (migration, spawning, rearing, etc.) to form life history tactics and the physical and biological constraints each life stage experiences; anticipation of key restoration and management issues that will foster rapid salmonid population recovery; and evaluation of modeling, monitoring, and planning efforts to help synchronize future data collection for model input, calibration, and testing.
http://www.fws.gov/arcata/fisheries/reports/dataSeries/SVRCD%20Shasta%20River%20Final%20Study%20Plan.pdf

Shasta Valley Coordinated Resources Management and Planning

The decline in anadromous salmon populations, particularly fall-run Chinook salmon, by the late 1980s, prompted ranchers and other water users in the Shasta Valley to form the Shasta River Coordinated Resources Management and Planning committee in 1991. Their desire was to examine and understand the local factors that might be responsible for declines in anadromous fish which could then lead to identification of effective ways to reverse those declines. Since that time, the Shasta Coordinated Resources Management and Planning committee has been working on a variety of approaches to improving survival of salmon and steelhead in the Shasta River.

With support provided by the Shasta Valley RCD, the Coordinated Resources Management and Planning committee began monitoring Shasta River water temperature, air temperature, and flow in the mid-1990s, and dissolved oxygen in the late 1990s. The Shasta Valley RCD has recently begun stream flow monitoring in support of the nascent Shasta Water Trust managed by The Nature Conservancy. The Shasta Valley RCD began a groundwater study in 2004, completed Phase One in 2007, and is continuing with Phase Two. The Shasta Valley RCD continues its streambank protection program, has revived its riparian planting program, and is implementing prioritized irrigation tailwater reduction strategies. The Shasta Valley RCD continues to support efforts to fund the lease/purchase of cold water for dedication to the Shasta River and Parks Creek. Efforts are also underway to expand accessible coho salmon habitat, especially in the Big Springs Complex area, Little Shasta River, and Upper Parks Creek. Approximately six miles of habitat is being restored along Big Springs Creek and the adjacent reach of the Shasta River. This restored area is already being used by coho salmon and other salmonids. The Shasta River Coho Salmon Working Group is exploring alternatives to supplement the coho salmon population in the Shasta River Basin, working with a wide range of stakeholders and agencies.

Montague Water Conservation District (MWCD)

The MWCD is an irrigation district located within the Shasta River watershed, (for history see: http://freepages.genealogy.rootsweb.ancestry.com/~npmelton/sismont.htm). MWCD operates three points of diversion in the Shasta River, including at Lake Shastina. MWCD has been working with local, state and federal agencies to improve habitat and to better understand existing conditions and opportunities to improve conditions for coho salmon and other species in the Shasta River watershed. In recent years the MWCD has worked collaboratively with fishery managers to provide pulse flows that assist juvenile salmon to either relocate to better rearing habitat or to out migrate towards the Pacific Ocean. In December 2013, the MWCD agreed to settle a lawsuit that would result in 2,250 to 11,000 acre-feet of environmental water released from Dwinnell Dam for fish benefits each year. MWCD will have to develop a long-term flow plan and habitat restoration measures that will be subject to a formal Endangered Species Act process.

The Nature Conservancy

The Nature Conservancy (TNC) purchased two large ranches along the upper Shasta River (the Nelson Ranch) and Big Springs Creek (the Busk Ranch) between 2005 and 2008. These properties, currently referred to as the Shasta Big Springs Ranch, contain 4,534 acres and include 3 miles along the upper Shasta River and another 2.2 miles of Big Springs Creek. The TNC, along with various local, state and federal partners, has already implemented several restoration actions including, but not limited to, construction of riparian fencing, riparian plantings, instream water dedications, and improved water management actions. Restoration of riverine habitats throughout this reach have already resulted in improvements to instream flow and water temperature benefitting anadromous salmonids. TNC staff have also assisted in the establishment of the Shasta River Water Trust, which leases surface water and undertakes permanent water transfers to improve instream flows in the Shasta River. For more information describing TNC's restoration of salmonid habitat in the Shasta Big Springs Ranch, please refer to their web site:

http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/california/explore/shasta-big-springs-ranch-protected.xml

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon (CDFG 2004b) was adopted by the California Fish and Game Commission in February 2004 and is a guide for recovering coho salmon on the north and central coasts of California, including the Shasta River. The Recovery Strategy emphasizes cooperation and collaboration at many levels, and recognizes the need for funding, public and private support for restorative actions, and maintaining a balance between regulatory and voluntary efforts. The Strategy includes improved water management/water use efficiency, water augmentation, improved habitat management, protection, assessment and monitoring, and outreach and education.

Shasta River TMDL
http://www.swrcb.ca.gov/northcoast/

Clean Water Act Section 303(d) requires each state to develop a list of impaired waters where pollution controls are not sufficient to attain or maintain applicable water quality standards and a total maximum daily load (TMDL) for each pollutant of concern in each of the listed impaired waters. In June 2006, a Total Maximum Daily Load (TMDL) was established for water temperature and dissolved oxygen in the Shasta River watershed, along with an action plan to implement it. The TMDL and Action Plan set load allocations and assigned implementation responsibilities. In September 2011, the Shasta Valley RCD provided the NCRWQCB with a five-year Shasta Valley TMDL Progress Report.

Natural Resources Conservation Service

Klamath Basin Adaptive Management Plan (NRCS2002)

The primary goal of the adaptive management plan in the Shasta Valley RCD service area is to achieve a reliable water supply for agriculture. The core objectives are to: decrease water demand, increase water storage, improve water quality, and develop fish and wildlife habitat. Planning, design, and implementation of on-farm projects within the Shasta River basin are ongoing, and include assistance from a variety of NRCS programs.

U. S. Fish and Wildlife Service

Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program
http://www.krisweb.com/biblio/gen_usfws_kierassoc_1991_lrp.pdf

In 1986, the Klamath River Basin Fishery Resources Restoration Act was enacted (Public Law 99-552) which authorized a 20-year long Klamath River Basin Conservation Area Restoration Program to help rebuild anadromous fish populations in the basin. The "Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program" was produced by Klamath River Basin Fisheries Task Force (1991) with assistance from Kier Associates. This program includes work through the Jobs in the Woods Program, the Fish Passage Program, and the Partners for Fish and Wildlife Program. The Partners program is funded through the US Fish and Wildlife Service and provides funding for fish habitat restoration activities, planning and implementation, project monitoring, and education/outreach in the Klamath basin.

37.5 Stresses

Table 37-3. Severity of stresses affecting each life stage of coho salmon in the Shasta River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Impaired Water Quality[1]	Medium	Very High	Very High[1]	Very High	Medium	Very High
3	Altered Hydrologic Function[1]	Medium	Very High	Very High[1]	Very High	Medium	Very High
2	Impaired Estuary/Mainstem Function	-	Low	High	High	Low	High
4	Increased Disease/Predation/Competition	Low	Medium	Very High	Very High	Medium	Very High
5	Lack of Floodplain and Channel Structure	High	High	High	High	High	High
6	Adverse Hatchery-Related Effects	Very High	Very High	Very High	Very High	Very High	Very High
7	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
8	Altered Sediment Supply	Medium	Medium	Medium	Low	Medium	Medium
9	Barriers	-	Medium	High	High	Medium	High
10	Adverse Fishery and Collection-Related Effects	-	-	Low	Low	Medium	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The Shasta River coho salmon population evolved with areas of large spring complexes, which provided sustained sources of cold, clean, high quality water, and abundant areas for rearing during hot, dry summer months. With the expansion of large-scale water diversions to serve agricultural needs, the amount and extent of cold water springs accessible to coho salmon have diminished. Data indicate that impaired water quality and altered hydrologic function are the limiting stresses for the Shasta River coho salmon population, and that juveniles are the limiting life stage for the population due to poor water quality and stressful conditions encountered during hot, dry summer months.

The most vital habitat in the Shasta River basin are its cold springs, which create cold water refugia for juvenile coho salmon, decrease overall water temperatures throughout the basin, and allow for successful summer rearing of individuals in natal and non-natal creeks and mainstem areas. Yreka Creek, Julian Creek, Willow Creek, Parks Creek, Dale Creek, Eddy Creek and the Shasta River upstream from Lake Shastina receive runoff from west side mountains. Boles Creek, Carrick Creek, Beaughton Creek and Big Springs Creek are all spring creeks originating from snowmelt percolating from Mt. Shasta. Recent UC Davis investigations have indicated the high potential productivity and capability of the Big Springs Creek to support large salmonid populations (Mount et al. 2009). Known cool water refugia are listed in Table 37-4. They are all located in reaches with high IP values.

Table 37-4. Potential refugia areas within the geographic boundaries of the Shasta River population.

Sub-basin	Stream Name	Stream Name
Shasta River	Big Springs Complex: Big Springs Creek, Little Springs Creek, Hole in the Ground Springs and Creek, Clear Springs, and other unnamed springs downstream from Dwinnell Dam	Mainstem Shasta River, river mile 32 to 38
Shasta River	upper Little Shasta River	upper Yreka Creek
Shasta River	Parks Creek, and springs flowing into the lower reaches of Parks Creek: Shasta Springs, Kettle Springs and Creek, and Bridge Field/Black Meadow Springs and Bridge Field Creek	upper Greenhorn Creek (N.B. upstream from Greenhorn Dam)

Impaired Water Quality

Impaired water quality is a very high stress for most coho salmon life stages. Reduced quantity of instream flows creates extremely stressful water quality conditions for rearing juveniles, and decreases the cold water input from vital cold spring complexes throughout the basin. This is primarily the result of agricultural diversion of surface water. The hydrology in the Shasta River is dominated by a large spring complex that provides the majority of the water for the Shasta River, particularly during the summer. The water that emerges from the springs is very cold, high in nutrients, and provides for exceptionally high primary and secondary productivity. The flow of the river is enhanced by snow melt from Mt. Shasta that historically maintained a consistent cold water flow of at least 103 cubic feet per second (cfs) to the Klamath River during the summer (Mack 1958). This spring-fed system was noted for producing large runs of both spring-run and fall-run Chinook salmon, coho salmon, and steelhead (Snyder 1931).

The diversion of surface water has resulted in stream temperatures for summer rearing that are poor throughout the mainstem Shasta River from its mouth to the Big Springs area, and in Parks Creek further upstream. At times, water temperatures become lethal to anadromous fish (Gwynne 1993, North Coast Regional Water Quality Control Board [NCRWQCB] 2006). During summer months dissolved oxygen concentrations in the Shasta River follow a distinct diurnal pattern, with high concentrations (near or above saturation) during daylight hours and lower concentrations (near or below saturation) at night. This dissolved oxygen pattern is typical of productive river systems experiencing high photosynthesis and respiration rates of aquatic plants. During summer months, Shasta River dissolved oxygen concentrations are above the Basin Plan objective of 7.0 mg/L during daylight hours, and fall below 7.0 mg/L during nighttime and early morning hours of the day (NCRWQCB 2011). These conditions (high water temperatures, high pH, and large fluctuations in DO) are exacerbated by low stream flows, large biomass of aquatic vegetation, high level of biological oxygen demand in sediments via organic decay, decrease in riparian cover, and increasing ambient temperatures from climate change. Impaired water quality creates a very high stress for all life stages of coho salmon, and decreases survival and fitness of juveniles throughout the Shasta River watershed.

Since 2009, livestock have been excluded from Big Springs Creek, the source of approximately 80% of the summer stream flow in the Shasta River (Jeffres et al. 2010). Livestock exclusion has facilitated a dramatic increase in submerged and emergent aquatic vegetation biomass, resulting in concomitant increases in channel depths (through increased resistance) and shade (from the vegetation canopy). Increases in shade and depth have reduced rates of heating throughout Big Springs Creek, making much of the creek thermally suitable as over-summering coho salmon rearing habitat.

Altered Hydrologic Function

Altered hydrologic function presents a very high stress to fry, juvenile, and smolt life stages, and a medium stress to the egg and adult stages. Dwinnell Dam and over 100 other adjudicated irrigation diversions either store or divert from the Shasta River from April 1 to October 1, providing irrigation for approximately 52,000 acres of land (about 10 percent of the watershed) during the growing season. Water diversions have been estimated to exceed 110 cfs (NRC 2004) and consumptive use of irrigation water is approximately 150,000 acre feet per year (KRBFTF 1991).

Shasta River surface water is over-appropriated during the irrigation season, leaving inadequate summer instream flows of approximately 15 to 20 cfs in the lower Shasta River, sometimes dropping to 5 cfs in dry years (Hampton 2009; CDWR 2014). In response, the Shasta TMDL Implementation Plan set a target summer flow of 45 cfs of water cool enough to sustain salmonids at the DWR Montague gage (NCRWQCB 2011). Water quantity/flow regime is generally good (fully functional) in the southern portion of the Shasta Valley including upper Parks Creek, the upper Shasta River, and tributaries originating from the flanks of Mt. Shasta: Dale, Boles, Broughton and Carrick creeks, but poor in other key areas from over appropriated water diversions and Dwinnell Dam.

Hydrologic function is severely altered by a rapid decrease in flows beginning with the onset of the irrigation season, when large numbers of Shasta Valley irrigators begin diverting water simultaneously. The reduced discharge along the mainstem Shasta River, Parks Creek, and tributaries to the Shasta River forces rearing juvenile coho salmon to move either upstream towards spring-fed habitat, or downstream to the Klamath River. Reduced flows during the spring often result in decreases in summer rearing habitat and reduced opportunities for juvenile fish movement within the basin.

In undertaking annual Shasta River downstream migrant trapping studies, CDFW observed a relationship between reduced base flows, increasing water temperatures, and early outmigration of young-of-the-year (YOY) coho salmon (Chesney and Yokel 2003). In years when spring base flows were reduced early due to drought conditions and the onset of agricultural water deliveries, YOY coho salmon outmigration to the mainstem Klamath River occurred earlier than in years when Shasta River base flows were sustained at a higher level through the spring (Chesney and Yokel 2003). This suggests that juvenile coho salmon, while known to naturally exhibit non-natal rearing in the Klamath River, are prematurely forced to redistribute within the basin in response to diminishing spring flows. Note that the mainstem Klamath River below Iron Gate Dam is impaired by elevated nutrient levels, organic enrichment/low dissolved oxygen levels, elevated water temperatures (NCRWQCB 2010), and fish diseases (Stocking et al. 2006, Nichols and True 2007). Thermal impairment of lower Shasta River water in late summer/early fall can also result in morbidity and mortality of in-migrating adult coho salmon. This impairment therefore reduces the health and survival of both out-migrating and in-migrating Shasta River coho salmon.

Impaired Estuary/Mainstem Function

This stress refers to the estuary and mainstem conditions in the Klamath River since this population is part of a larger basin containing multiple populations. Conditions in the Klamath River mainstem and estuary are important to this population since all salmon and steelhead that originate from the Shasta River migrate to and from the ocean through the mainstem Klamath River and the Klamath River estuary. The Klamath River estuary plays an important role in providing holding habitat, foraging and refuge opportunities for outmigrating juvenile coho salmon from the Shasta River. Previous studies have shown that naturally produced yearling coho salmon can have extended estuarine residence times, up to several weeks (Miller and Sadro 2003). Although the estuary is short and small compared to the large size of the watershed, it does provide numerous habitat types and vital rearing habitat for juvenile and smolting coho salmon (Wallace 1995). The degraded conditions that exist throughout the Klamath Basin today may mean that the estuary plays an even more important role for all Klamath populations by providing the opportunity for juvenile and smolt growth and refugia prior to entering the ocean. The estuary, although relatively intact, suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain (Hiner 2006). Levees along the Lower Klamath and development on the floodplain have led to the loss and degradation of habitat in the estuary.

Mainstem conditions in the Shasta and Klamath Rivers are stressful because of poor water quality, sedimentation, and degraded habitat. Because of the distance that this population must travel to and from the ocean, and the time spent in the mainstem Klamath River, this stress is especially significant for the Shasta River population. Juveniles, fry, and smolts transitioning through estuarine and mainstem habitat are stressed by the degraded conditions in these migratory habitats and suffer from the lost opportunity for increased growth and consequently a lower survival rate. The loss and degradation of estuarine and mainstem habitat is considered a high stress for the population, with the most affected life stages being juveniles and smolts due to the degradation of rearing and migratory habitat.

Increased Disease/Predation/Competition

Disease, predation, and competition present a very high stress for juveniles and smolts, a medium stress for adults and fry, and a low stress for eggs. Disease does become a significant stress to Shasta River coho salmon when they enter the Klamath River, where pathogens become pervasive during the late spring and summer. Pathogens that have caused diseases in juvenile fish include *Ceratonova shasta* (resulting in ceratomyxosis), *Flavobacterium columnare* (columnaris), aeromonid bacteria *Nanophyetus salmonicola*, and the kidney myxosporean *Parvicapsula minibicornis* (Federal Energy Regulatory Commission 2007). Actinospore concentrations of both *C. shasta* and *P. minibicornis* in the mainstem Klamath River are often above the threshold necessary to induce infection and disease (Stocking et al. 2006, Nichols and True 2007). By late spring and summer, both diseased hatchery and natural-stock juveniles are seen dead or moribund in Klamath River screw traps. In addition to disease, competition can occur when numerous, larger-sized hatchery fish displace wild juveniles in refugia along the Klamath River, take available prey, or eat undersized wild juvenile fish. Non-native piscivorous fish and amphibians also prey on juvenile coho salmon originating from the Shasta River population (Knechtle 2011).

Lack of Floodplain and Channel Structure

Lack of floodplain and channel structure presents a high stress for all life stages. Agricultural practices occurring adjacent to the mainstem Shasta River and several important tributaries has led to degradation and loss of rearing habitat, refugia, wetlands, and other off-channel habitats. Loss of riparian vegetation cover throughout the Shasta Valley has caused the loss of large perennial riparian vegetation recruitment, channel margin degradation, and excessive sediment, decreasing available rearing summer and winter rearing habitat, pool depth, and instream cover. These impacts collectively limit the development of complex stream habitat necessary to sustain spawning and rearing throughout much of the high IP areas of the Shasta Valley.

Adverse Hatchery-Related Effects

While there are no hatcheries nor does artificial propagation currently occur in the Shasta River basin, there is a fish hatchery on the Klamath River at the base of Iron Gate Dam, approximately 13 miles (21 km) upstream of the mouth of the Shasta River. Approximately 75,000 coho salmon yearlings, along with 6,000,000 fall Chinook salmon and 200,000 steelhead yearlings are released from Iron Gate Hatchery each year. These hatchery steelhead yearlings compete with out-migrating coho salmon for mainstem Klamath River habitat, and may also prey upon them. As adults, some of these hatchery coho salmon stray into the Shasta River basin when migrating back upstream, and can breed with natural origin Shasta River coho salmon. Hatchery coho salmon can simplify natural coho salmon population’s genetics and decrease the productivity of natural coho salmon populations over time. On average, 16 percent of adult carcasses recovered in the Shasta River basin in 2001, 2003, and 2004 were of hatchery origin (Ackerman and Cramer 2006; note: fish carcass recruitment into interior basins is considered a natural and beneficial nutrient addition to riparian chemistry and productivity). Hatchery origin coho salmon returns to the Shasta River fish counting facility from 2007 to 2012 (Chesney and Knechtle 2013), averaged 43 percent. The impacts from such straying of hatchery coho salmon increase as naturally produced Shasta River populations decline. Therefore, adverse hatchery-related effects pose a very high stress to all life stages because hatchery origin adults generally make up greater than 30 percent of the total number of adults (Appendix B).

In January 2013, NMFS received an application from the California Department of Fish and Wildlife and PacifiCorp for a permit to enhance the propagation and survival of SONCC coho salmon. This application included a Hatchery and Genetic Management Plan (HGMP) for coho salmon produced at the hatchery. The HGMP specifies methods for the operation of the Iron Gate Hatchery coho salmon program that are intended to reduce adverse hatchery-related genetic impacts on the natural coho salmon populations, including the Shasta River population. The HGMP shifts the coho salmon program from a mitigation program to an integrated program with natural populations and incorporates artificial propagation, monitoring, and evaluation activities, both within the hatchery and major tributary streams in the Upper Klamath River Population Unit. NMFS anticipates making a final decision on whether to issue the permit and approve the HGMP in 2014.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions pose a medium stress to adults, and a high stress to fry, juvenile, and smolt life stages. Stream corridor vegetation and cover is considered very good (fully functional) in the southern portion of the Shasta Valley including upper Parks Creek, Eddy Creek, and the upper tributaries of the Shasta River (Dale, Boles, Broughton and Carrick creeks) while the upper Little Shasta River has fair, partially functional stream corridor cover. However, the loss of riparian cover in other areas of the basin has left portions of the mainstem Shasta River and tributary riparian areas downstream of Dwinnell Dam exposed, degraded, and unable to sustain productive biotic communities. Riparian assessments of the Shasta River on the Nelson Ranch (Mount et al. 2008) and the Shasta Big Springs Ranch (Mount et al. 2009) indicate that highly productive riparian habitat can be sustained and restored along portions of the Shasta River watershed, but natural recruitment of woody perennials is inconsistent, due to soil chemistry, current agricultural practices, and other anthropogenic changes in land use.

Altered Sediment Supply

Altered sediment supply presents a medium stress for the juvenile life stage, and a low stress for all other life stages. The Shasta Valley is geologically young and relatively stable (CH2M HILL 1985), and sediment that is delivered to the Shasta River derives from unstable sloughing stream banks, unpaved upland roads, and residential development. Alterations in sediment can simplify and fill in pool habitat, preclude the establishment and maintenance of riparian vegetation cover, cause embeddedness of gravels in spawning areas, and alter channel morphology. Since juvenile coho salmon rear for an extended period in freshwater environments, changes such as these can be detrimental to their fitness and ability to survive.

Barriers

Barriers present a high stress for juvenile and smolt life stages and a medium stress for fry and adult life stages. There are two permanent dams that act as barriers in the Shasta River. Dwinnell Dam blocks about 22 percent of Shasta River anadromous fish habitat (NRC 2004). Greenhorn Dam was built in the 1950s in Greenhorn Creek, a tributary to Yreka Creek, for municipal and industrial water storage. Greenhorn Dam blocks access to upstream areas in Greenhorn Creek, blocks the movement of gravel down Yreka Creek, and alters the hydrology in Yreka Creek. Multiple diversion dams, small impoundments, one small micro-hydro installation at the entrance to the Shasta River canyon (Klamath River Basin Fisheries Task Force 1991) and road/stream crossings also cause partial or complete barriers to high IP habitat in several Shasta River basin locations. Diversion dams reduce instream flows and allow impounded water to reach lethal temperatures during the summer, while the larger Dwinnell Dam changes channel morphology, impedes coarse sediment input, alters the hydrologic function of the mainstem Shasta River (Knechtle 2010). Diversion dams also create a pond-like environment, rich in nutrients, where algae bloom in abundance. Of the six flashboard summer irrigation dams on the mainstem Shasta River, five have been removed, locally improving the function and condition of the mainstem river. Several flashboard dams also continue to operate on the Little Shasta River.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

37.6 Threats

Table 37-5. Severity of threats affecting each life stage of coho salmon in the Shasta River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Agricultural Practices[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Dams/Diversions[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
3	Channelization/Diking	High	High	High	High	High	High
4	Roads	High	High	High	High	High	High
5	Hatcheries	Very High	Very High	Very High	Very High	Very High	Very High
6	Climate Change	Low	Low	Medium	Medium	Medium	Medium
7	Timber Harvest	Low	Low	Low	Low	Low	Low
8	High Severity Fire	Medium	Medium	Medium	Medium	Medium	Medium
9	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
10	Urban/Residential/Industrial Dev.	Medium	Medium	Medium	Medium	Medium	Medium
11	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
12	Fishing and Collecting	-	-	Low	Low	Medium	Low

[1] Key limiting threats and limited life stage
[2] Invasive Non-Native/Alien Species is not considered a threat to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are agricultural practices and dams/diversions.

Agricultural Practices

Current agricultural practices are a very high threat to all life stages of coho salmon. Many sub-basins of the Shasta Valley have pasture/hay and cultivated crops, which together account for more than 10 percent of the land area. Agricultural areas adjacent to coho salmon habitat occur along the mainstem Shasta River downstream from Dwinnell Dam to the Shasta River canyon entrance, the Little Shasta River, Parks Creek, Yreka Creek, and Big Springs Creek. Excessive fine sediment, low flows, and warm-water inputs damage spawning and rearing habitat and hinder migration. Erosion from agricultural practices can contribute fine sediment to the river. Livestock along the Shasta River can compound these problems by damaging stream banks and riparian vegetation, and by adding nutrients to the stream, thereby reducing dissolved oxygen levels. Beyond these basin-wide impacts, there is considerable risk of trampling of redds in the upper portions of the Shasta Valley (Parks Creek and the upper Shasta River), where areas suitable for salmon spawning are also frequently preferred by livestock for crossings and in-channel grazing. Livestock exclusion fencing now precludes these impacts in most of the Shasta Valley, with remaining unfenced reaches located along both the upper Shasta River near Dwinnell Dam and upper Parks Creek.

Water diversions and warm irrigation tailwater returns in scarce cool-water areas severely limits habitat values in critical refuge spawning and rearing areas. Even in areas where water temperatures are generally good, intermittent pulses of warm tailwater can overwhelm available cold water, forcing fish to relocate or killing them outright. The Shasta Valley RCD's Agricultural Water and Tailwater Management Program is improving on-farm management, beginning in high priority areas in the Big Springs Complex, including river miles 32 to 38 of the Shasta River and river mile 4 to 6 of Parks Creek, to reduce tailwater creation and to implement projects that contain, store, cool, and reuse agricultural tailwater.

The onset of the irrigation season in the Shasta River watershed has a dramatic impact on instream flows when large numbers of irrigators begin taking water simultaneously. This results in a rapid decrease in flows below the diversions, stranding coho salmon as channel margin and side channel habitat disappears (CDFG 1997a). Low stream flows can limit access to rearing areas and decrease rearing habitat for juvenile coho salmon. Diversion of surface water has limited the quantity of cold water from the spring complexes within the basin, causing water temperatures to rise above the lethal level of the 25.6 ºC for salmon (Carter 2005). Low dissolved oxygen levels also occur along the Shasta River, adversely affecting salmonids. Though much diminished since 1991, livestock access to the Shasta River contributes to these problems, by damaging stream banks and riparian vegetation that provide shade and cover, and by also adding excessive nutrients to the stream, contributing further to reduced dissolved oxygen levels. Warm, nutrient-rich tailwater entering cool-water reaches of the Shasta River severely degrade habitat quality in adjacent spawning and rearing areas that are already scarce.

Dams/Diversions

Dams, diversions, and associated reductions in water availability downstream, as well as the timing of that availability, are a very high threat to all life stages of coho salmon. In 1926, the Shasta River was dammed at river mile 37 to form Dwinnell Reservoir (Lake Shastina). Dwinnell Dam blocks about 22 percent of salmon habitat in the Shasta River basin (NRC 2004), though the condition of this habitat in 1926 was not documented. In 1955, the capacity of the dam was increased, bringing the total storage capacity to 50,000 acre-feet. For decades, there were no or minimal instream flow releases (i.e., for priority water right holders downstream of Dwinnell Dam) from Dwinnell Dam, which further diminished Shasta River flows during the summer irrigation season. In December 2013, the MWCD agreed to settle a lawsuit that would result in 2,250 to 11,000 acre-feet of water released from Dwinnell Dam for fisheries benefits each year. During the winter, Lake Shastina's capture of peak winter flows significantly reduces the ability of the Shasta River to flush fine sediment from spawning gravels and recruit spawning gravel, and changes the hydrology downstream. However, Dwinnell Dam's presence does appear to influence neighboring groundwater and related springs that provide cold over-summering habitat for juvenile coho salmon and other salmonids. The Dwinnell Dam infrastructure is also used by MWCD in collaboration with fishery managers to provide pulse flows that assist juvenile salmon to either relocate to better rearing habitat or to out migrate towards the Pacific Ocean.

In addition to Dwinnell Dam, another permanent dam was placed in Greenhorn Creek, a tributary to Yreka Creek, in the 1950s for municipal and industrial water storage. Greenhorn Dam blocks access to upstream areas in Greenhorn Creek, blocks the movement of gravel down Yreka Creek, and alters the Yreka Creek hydrograph. The City of Yreka does not routinely release water from this reservoir during the summer, and such releases could help maintain sufficient flow in Yreka Creek for coho salmon holding and rearing there.

Irrigation diversions block stream channels, reduce flows and often create riverine impoundments. These impoundments warm water to lethal temperatures during the summer, become rich in nutrients, and foster algae blooms. Additionally, if not screened, irrigation diversions can trap fish and create passage problems for juveniles looking for refugia. Diverted irrigation water becomes warmed and nutrient rich before it drains back into the river as tailwater. Pervasive diversion of irrigation water results in diminished peak flows that historically inundated the valley and expanded juvenile rearing habitat. One flashboard diversion dam remains on the Shasta River, and continues to create passage problems for juvenile and smolt coho salmon. There is also several smaller diversion dams listed in the California Fish Passage Assessment Database (CalFish 2009), most of which are seasonal barriers located in high IP areas. Dams and diversions which pose significant barriers to fish passage, including upstream juvenile migration, are listed in Table 37-6.

Other barriers associated with small water diversion have been observed in lower Parks Creek, an area with several small, cold water springs that are critically important for the survival of juvenile coho salmon. Adult radio tagging information since 2004 confirms that many coho salmon tracked in the upper Shasta River ultimately spawned in lower Parks Creek (CDFG 2008b), the southwest portion of the Big Springs Complex.

Table 37-6. List of dams/diversion barriers in the Shasta River basin (Elfgen 2013).

IP priority	Stream Name	Dam/Diversion Name	Miles of habitat blocked habitat (partial* or full)
1	Shasta River	Dwinnell Dam (Shasta River Dam & diversion)	26
1	Yreka Creek	Greenhorn Dam	4
1	Shasta River	Novy/Rice Dam	28*
1	Parks Creek	Cardoza Diversion Dam	9*
2	Shasta River	USGS gage near Montague, CA	31*
2	Little Shasta River	Hart Diversion Dam	4*
2	Little Shasta River	Blair Smith / Musgrave Dam (diversion)	3*

Channelization/Diking

Channelization and diking pose a high threat to all life stages of coho salmon, and occur primarily along many reaches of Parks Creek, Willow Creek, the Little Shasta River, and the urban reach of Yreka Creek. Channelization and diking of rivers and streams has been shown to decrease the quantity and quality of winter rearing habitat by eliminating the availability of low flow energy, off channel habitats: habitat which is already lacking in the Shasta River basin. This channel alteration has resulted in the conversion of beaver-occupied wetlands to drained agricultural lands. In contrast, natural channel form and floodplain connectivity remain good (fully functional) in portions of the upper Shasta River and its tributaries.

Roads

Roads are a high threat to all life stages of coho salmon in the Shasta River population. Road density is very high (>3 miles of roads/sq. mile) in the following tributary sub-basins, where high IP reaches predominate: upper Shasta River, upper Little Shasta River, Yreka Creek; and upstream of Dwinnell Dam/Reservoir in Boles Creek. Road density is high (2.5 to 3.0 miles of roads/sq. mile) in Eddy Creek, upper Parks Creek, Willow Creek, upper Juniper Creek; and upstream of Dwinnell Dam/Reservoir in Carrick Creek. Mobilization of sediments from roads and road related erosion sources upstream of Dwinnell Dam are currently captured in the reservoir. Road density improves downstream and is considered a medium to low threat throughout most of the Shasta Valley. Erosion potential from unmaintained roads is greatest in the upper portions of sub-basins where heavy rain, and rain on snow occur in areas containing roads from past timber harvest activities. The associated increases in fine sediment from these conditions have been shown to suffocate redds, degrade pool quality, and decrease pool depth (Newcombe and Jensen 1996, Suttle et al 2004). Residential development in the Shasta Valley, and the increasing number of un-engineered private roads mobilize sediment to stream channels, thereby further increasing impacts to juvenile coho salmon rearing in adjacent streams.

Hatcheries

Hatcheries pose a very high threat to all life stages. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

Climate Change

Climate change poses an overall medium threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 to 100 years (see Appendix B for modeling methods). Average temperature could increase by up to 3^{o} C in the summer and by 1.3^{o} C in the winter. Annual precipitation in the Shasta Valley is already less than 20 inches, and is likely to trend downward over the same time period. Snowpack in upper elevations of the basin will decrease with changes in temperature and precipitation (Howat et al. 2007, California Natural Resources Agency 2009). Changes will impact water yield of natural springs, which is one of the most important components of the hydrologic regime of the Shasta River, and this will impact summer rearing habitat. The vulnerability of the Klamath estuary to sea level rise is low to moderate and therefore does not pose a significant threat to estuarine rearing habitat downstream. Juvenile and smolt rearing and migratory habitat in the Shasta River and Klamath mainstem is most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Overall, the range and degree of variability in temperature and precipitation are likely to increase. Adults will also be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007). Sustained monitoring of ocean conditions will be needed to detect possible correlation(s) with future trends in Klamath Basin salmonid population survival and productivity (see Chapter 3).

Timber Harvest

The volume of timber harvested on national forest land diminished in the early 1990s, and has remained low since the implementation of the Klamath National Forest and Shasta Trinity National Forest Land and Resource Management Plan in 1994 (USFS 1994b). General Forest Management Areas available for timber harvest in the Shasta River basin are small and are confined to the western slopes of the Cascade Range, and portions of upper Parks and Eddy Creeks west of Weed, California. Small scale projects involving understory fuels reduction, hazard tree removal, and small commercial thinning projects are expected to continue at current rates into the future. The Shasta Trinity National Forest has identified the Parks and Eddy Creek watersheds as priorities for restoration (see: Shasta-Trinity National Forest 2013).

High Severity Fire

High severity fire, and the riparian habitat destruction and surface erosion it causes, is a medium threat to all life stages of coho salmon. Because of past timber harvest practices and fire-suppression efforts over the past century, understory forest fuel loads have become excessive and have severely altered the fire regime in the region. High severity fires result from these excessive forest fuel loads and could occur in the uplands of the Shasta River watershed, creating erosion/sedimentation problems, large areas of bare, unstable soil, and degrading riparian vegetation along stream banks. In addition, fire suppression activities could lead to impacts to coho salmon from misapplication of fire retardant, increased water withdrawals in summer months, and mobilization of sediment through the creation of fire lines and other fire prevention methods.

Mining/Gravel Extraction

Mining and gravel extraction are low threats to all life stages of coho salmon. Currently, neither gold nor gravel mining commonly occur in the Shasta River basin, and are not expected to change in the near future. The legacy impacts of historic gold mining along Yreka Creek and the lower seven miles of the Shasta River continue to degrade habitat, through alterations in floodplain connectivity, changes in channel morphology, and continuing impacts from the historic removal of gravel. Gravel recruitment has been reduced in the Shasta River downstream from Dwinnell Dam and in the depositional portions of many tributaries. Tailing piles and fill occupy large historic floodplains along Yreka and Greenhorn creeks, where riparian areas remain poorly vegetated and erodible (Shasta Valley Resource Conservation District 2005). Associated legacy effects are sometimes long lasting and need to be addressed to decrease the threat to Shasta River coho salmon. A spawning gravel evaluation and enhancement plan for the Shasta River has been completed by McBain and Trush (2010), and can be used to inform and prioritize spawning gravel enhancement efforts in the basin.

Urban/Residential/Industrial Development

Urban, residential, and industrial development is a medium threat to all life stages. Within the Shasta Valley, modest densities of residences and urban development are located near Yreka, Weed, Montague, Little Shasta, Big Springs, Grenada, and Gazelle. Overall, this threat is not expected to change in the foreseeable future, as population growth is currently stable in this area.

Road-Stream Crossing Barriers

Road related barriers are a low threat to all juvenile and adult life stages of coho salmon. Readily available information from CalFish (2009) and Five Counties Salmonid Conservation Program (2008) indicate road/stream crossings that require further evaluation for improved fish passage.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

37.7 Recovery Strategy

Coho salmon in the Shasta River are depressed in abundance with a restricted distribution. Recovery activities in the watershed should continue to promote increased spatial distribution as well as increased productivity and abundance. Activities should occur throughout the watershed, with a focus on mainstem and tributary reaches with high IP values. Recovery actions that reduce stream temperatures, increase dissolved oxygen concentrations, and achieve sufficient instream flow targets through the summer should be a priority in the watershed. Addressing the limiting factor of inadequate summer rearing habitat for juveniles should be a top priority, and multi-faceted, long term solutions should be sought. Winter rearing and spawning habitat improvement is also a priority, and should include beaver/beaver habitat enhancement, large/complex woody debris recruitment, and spawning substrate enhancement. Additionally, collaborative efforts with interested parties and stakeholders, working to restore mainstem and estuary conditions in the Klamath River, must expand, to assure that the Shasta River coho salmon population has the necessary habitat requirements for all freshwater life stages. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 37-7. Recovery action implementation schedule for the Shasta River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ShaR.3.1.1	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide, including upstream from Dwinnell Dam	1
SONCC-ShaR.3.1.1.1	*Identify, map, and quantify all surface water diversions*					
SONCC-ShaR.3.1.1.2	*Assess water diversions, prioritize, and adjust management to benefit life history requirements of coho, attaining at least a 55 cfs target summer base flow, or baseflow sufficient for recovery of all affected life stages of coho salmon, at the DWR Montague water gage*					
SONCC-ShaR.3.1.1.3	*Secure dedicated unused water diversion rights*					
SONCC-ShaR.3.1.1.4	*Verify permitted water diversions*					
SONCC-ShaR.3.1.1.5	*Establish a water trust to sustain and re-establish flow connectivity*					
SONCC-ShaR.3.1.1.6	*Use real time flow, precipitation, snowpack, groundwater, and climate information to guide Water Trust work to augment surface flows at priority locations for coho, via water leases and dedications*					
SONCC-ShaR.10.1.18	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cold water	Big Springs Lake Dam, Parks Creek, Kettle Springs, Bridge Field Springs Complex, Little Shasta River, and the upper Shasta River	1
SONCC-ShaR.10.1.18.1	*Evaluate quantity and quality of refugia habitat*					
SONCC-ShaR.10.1.18.2	*Conduct water rights assessment at spring complexes*					
SONCC-ShaR.10.1.18.3	*Dedicate cold water*					
SONCC-ShaR.10.1.19	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cold water	Dwinnell Dam, mainstem Shasta River and its downstream tributaries and springs, and upstream from Dwinnell Dam	1
SONCC-ShaR.10.1.19.1	*Investigate feasibility of changing drawdown location on Dwinnell Dam to maximize cold water and dissolved oxygen*					
SONCC-ShaR.10.1.19.2	*Investigate alternative sources of cold water (e.g., springs) for instream flow dedication, evaluate feasibility, and then dedicate cold water to provide instream flow benefits, guided by evaluation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ShaR.10.1.16	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase flow	Population wide, especially Big Springs Lake, Parks Creek, Kettle Springs, Bridge Field Springs Complex, and the upper Shasta River	1
SONCC-ShaR.10.1.16.1	*Conduct flow studies at key sites in priority watersheds to determine necessary minimum instream flows that will ensure survival and recovery of all relevant coho salmon life stages*					
SONCC-ShaR.10.1.16.2	*Implement plan to increase minimum instream flows in priority watersheds, using flow study information to guide priority flow augmentation projects*					
SONCC-ShaR.1.2.48	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary	1
SONCC-ShaR.1.2.48.1	*Implement recovery actions for Lower Klamath River population that address the target "Estuary", including the creation/restoration of off-channel rearing habitat throughout the lower Klamath River*					
SONCC-ShaR.30.1.70	Disease, Predation, Competition	No	Reduce disease	Disrupt the disease cycle between salmon, myxospore, polychaetes, and actinospore stages.	Population wide	1
SONCC-ShaR.30.1.70.1	*Assess all means possible to disrupt disease cycle and develop a plan to do so*					
SONCC-ShaR.30.1.70.2	*Disrupt the disease cycle, guided by assessment results*					
SONCC-ShaR.12.1.22	Agricultural Practices	Yes	Improve agricultural practices	Improve grazing practices	All areas where coho salmon would benefit immediately	2a
SONCC-ShaR.12.1.22.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-ShaR.12.1.22.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-ShaR.12.1.22.3	*Plant vegetation to stabilize stream bank*					
SONCC-ShaR.12.1.22.4	*Maintain fencing or fence livestock out of riparian zones*					
SONCC-ShaR.12.1.22.5	*Remove livestock watering sources away from riparian areas, including springs*					
SONCC-ShaR.12.1.74	Agricultural Practices	Yes	Improve agricultural practices	Improve grazing practices	Population wide	2b
SONCC-ShaR.12.1.74.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-ShaR.12.1.74.2	*Develop grazing management plans to improve water quality and coho salmon habitat*					
SONCC-ShaR.12.1.74.3	*Plant vegetation to stabilize stream bank*					
SONCC-ShaR.12.1.74.4	*Maintain fencing or fence livestock out of riparian zones*					
SONCC-ShaR.12.1.74.5	*Remove livestock watering sources away from riparian areas, including springs*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ShaR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	GID Ditch diversion, Dwinnell Dam diversion	2a
SONCC-ShaR.3.1.4.1	*Reduce impacts to coho salmon from the GID ditch diversion*					
SONCC-ShaR.3.1.4.2	*Assess the effects of relocating or redesigning the diversion point to Dwinnell Dam Reservoir to decrease the impacts to coho salmon*					
SONCC-ShaR.3.1.4.3	*Relocate or redesign the diversion structure to Dwinnell Dam Reservoir guided by assessment results*					
SONCC-ShaR.3.1.4.4	*Improve infrastructure at the Parks Creek "cross canal" diversion, to both increase bypass flows for downstream fishes and to eliminate fish impingement/entrainment*					
SONCC-ShaR.10.1.20	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Reduce warm water inputs	Bridge Field Springs Complex, Kettle Springs, Upper Shasta River, and Parks Creek	2a
SONCC-ShaR.10.1.20.1	*Develop a program that identifies, designs, and constructs projects that will reduce warm tailwater input to streams*					
SONCC-ShaR.10.1.20.2	*Implement tailwater reduction program*					
SONCC-ShaR.3.1.66	Hydrology	No	Improve flow timing or volume	Increase instream flows	All areas where coho salmon would benefit immediately	2a
SONCC-ShaR.3.1.66.1	*Identify and cease unauthorized water diversions*					
SONCC-ShaR.3.1.68	Hydrology	No	Improve flow timing or volume	Increase instream flows	All areas where coho salmon would benefit immediately	2a
SONCC-ShaR.3.1.68.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-ShaR.3.1.68.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-ShaR.3.1.80	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-ShaR.3.1.80.1	*Identify and cease unauthorized water diversions*					
SONCC-ShaR.3.1.81	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-ShaR.3.1.81.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-ShaR.3.1.81.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-ShaR.3.1.69	Hydrology	No	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	2a
SONCC-ShaR.3.1.69.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-ShaR.3.1.69.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-ShaR.3.1.69.3	*Implement coho salmon instream flow needs plan.*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ShaR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Improve irrigation practices	All areas where coho salmon would benefit immediately	2b
SONCC-ShaR.3.1.6.1		*Apply a variety of techniques (e.g., Farm Irrigation Rating Index Model) to make irrigation system water use efficiency comparisons, and implement efficiency improvements*				
SONCC-ShaR.3.1.6.2		*Implement improved irrigation techniques and monitor associated flow and water quality enhancements*				
SONCC-ShaR.3.1.6.3		*Design an irrigation schedule to maximize cold water influence/extension from Clear Springs and other cold water sources*				
SONCC-ShaR.3.1.79	Hydrology	Yes	Improve flow timing or volume	Improve irrigation practices	Population wide	2c
SONCC-ShaR.3.1.79.1		*Apply a variety of techniques (e.g., Farm Irrigation Rating Index Model) to make irrigation system water use efficiency comparisons, and implement efficiency improvements*				
SONCC-ShaR.3.1.79.2		*Implement improved irrigation techniques and monitor associated flow and water quality enhancements*				
SONCC-ShaR.3.1.79.3		*Design an irrigation schedule to maximize cold water influence/extension from Clear Springs and other cold water sources*				
SONCC-ShaR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	All areas where coho salmon would benefit immediately	2b
SONCC-ShaR.3.1.5.1		*Develop integrated water management plan and water budget, including groundwater surface flow dynamics, and drought year emergency contingencies*				
SONCC-ShaR.3.1.5.2		*Improve water use efficiency through the investigation and implementation of alternative agricultural crops and practices (e.g., grass fed beef, winter wheat, alternative pasture crops)*				
SONCC-ShaR.3.1.5.3		*Upgrade and expand alternative off-channel stock watering systems to increase instream flows*				
SONCC-ShaR.3.1.5.4		*Develop and disseminate an on-farm water use efficiency monitoring system*				
SONCC-ShaR.3.1.5.5		*If current water use/management is determined to be inconsistent with coho salmon recovery, modify management accordingly*				
SONCC-ShaR.3.1.78	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	Population wide	2c
SONCC-ShaR.3.1.78.1		*Develop integrated water management plan and water budget, including groundwater surface flow dynamics, and drought year emergency contingencies*				
SONCC-ShaR.3.1.78.2		*Improve water use efficiency through the investigation and implementation of alternative agricultural crops and practices (e.g., grass fed beef, winter wheat, alternative pasture crops)*				
SONCC-ShaR.3.1.78.3		*Upgrade and expand alternative off-channel stock watering systems to increase instream flows*				
SONCC-ShaR.3.1.78.4		*Develop and disseminate an on-farm water use efficiency monitoring system*				
SONCC-ShaR.3.1.78.5		*If current water use/management is determined to be inconsistent with coho salmon recovery, modify management accordingly*				
SONCC-ShaR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Yreka Creek, Little Shasta River, Parks Creek, upstream from Dwinnell Dam, and all streams where coho salmon would benefit immediately	2b
SONCC-ShaR.3.1.7.1		*Develop plans to detain stormwater runoff, increase infiltration, enhance floodplains, and deliver sub-surface flows*				
SONCC-ShaR.3.1.7.2		*Implement plans that increase groundwater recharge and connectivity*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ShaR.3.1.82	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2c
SONCC-ShaR.3.1.82.1	*Develop plans to detain stormwater runoff, increase infiltration, enhance floodplains, and deliver sub-surface flows*					
SONCC-ShaR.3.1.82.2	*Implement plans that increase groundwater recharge and connectivity*					
SONCC-ShaR.10.1.12	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Improve quality of water released from Dwinnell Reservoir	Dwinnell Dam and vicinity	2b
SONCC-ShaR.10.1.12.1	*Develop plan that includes range of alternatives to improve quality of water released from Dwinnell Reservoir to upper Shasta River*					
SONCC-ShaR.10.1.12.2	*Implement water quality improvement plan*					
SONCC-ShaR.5.1.13	Passage	No	Improve access	Reduce sediment barriers	Kettle Springs and Bridgefield Springs Complex, and all areas where coho salmon would benefit immediately	2b
SONCC-ShaR.5.1.13.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-ShaR.5.1.13.2	*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*					
SONCC-ShaR.5.1.83	Passage	No	Improve access	Reduce sediment barriers	Population wide	2d
SONCC-ShaR.5.1.83.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-ShaR.5.1.83.2	*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*					
SONCC-ShaR.5.1.15	Passage	No	Improve access	Remove barriers	Greenhorn Dam, Cardoza Diversion, mainstem Shasta River, Big Springs Water Wheel, and all streams where coho salmon would benefit immediately	2b
SONCC-ShaR.5.1.15.1	*Identify and prioritize all barriers and diversions, and develop a plan to provide short- and long-term passage which may include use of artificial passage designs*					
SONCC-ShaR.5.1.15.2	*Provide passage for all life stages, guided by plan*					
SONCC-ShaR.5.1.85	Passage	No	Improve access	Remove barriers	Population wide	2d
SONCC-ShaR.5.1.85.1	*Identify and prioritize all barriers and diversions, and develop a plan to provide short- and long-term passage which may include use of artificial passage designs*					
SONCC-ShaR.5.1.85.2	*Provide passage for all life stages, guided by plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ShaR.7.1.23	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve protection and shading of spring complexes	All areas where coho salmon would benefit immediately	2b
SONCC-ShaR.7.1.23.1		*Identify and prioritize locations for planting and thinning*				
SONCC-ShaR.7.1.86	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve protection and shading of spring complexes	Population wide	2d
SONCC-ShaR.7.1.86.1		*Identify and prioritize locations for planting and thinning*				
SONCC-ShaR.7.1.24	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide, unvegetated areas	2b
SONCC-ShaR.7.1.24.1		*Plant riparian vegetation to increase shade/cover and habitat complexity, guided by the plan*				
SONCC-ShaR.7.1.24.2		*Thin, or release conifers, guided by the plan*				
SONCC-ShaR.26.1.25	Low Population Dynamics	No	Increase population abundance	Implement an enhancement program	Population wide	2b
SONCC-ShaR.26.1.25.1		*Assess impacts and benefits associated with different enhancement programs such as captive broodstock, rescue rearing, supplementation, and conservation hatcheries*				
SONCC-ShaR.26.1.25.2		*Obtain a permit and develop a facility to rear fish*				
SONCC-ShaR.26.1.25.3		*Operate enhancement program as a temporary strategy to increase population abundance*				
SONCC-ShaR.26.1.25.4		*Monitor fish populations at all life stages including juvenile snorkel counts, downstream migrant counts, spawning surveys, and Passive Integrated Transponder (PIT) tagging*				
SONCC-ShaR.26.1.67	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-ShaR.26.1.67.1		*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*				
SONCC-ShaR.8.2.29	Sediment	No	Increase spawning gravel	Enhance spawning substrate	Downstream of Dwinnell Dam, Parks Creek, and other tributary drainages where coho salmon would benefit immediately	2b
SONCC-ShaR.8.2.29.1		*Review the McBain and Trush (2010) spawning gravel plan that identifies quantity, quality, location, and timing of gravel supplements*				
SONCC-ShaR.8.2.29.2		*Supplement gravel, guided by the McBain and Trush (2010) spawning gravel plan for the Shasta River*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ShaR.8.2.89	Sediment	No	Increase spawning gravel	Enhance spawning substrate	Population wide	2d
SONCC-ShaR.8.2.89.1	*Review the McBain and Trush (2010) spawning gravel plan that identifies quantity, quality, location, and timing of gravel supplements*					
SONCC-ShaR.8.2.89.2	*Supplement gravel, guided by the McBain and Trush (2010) spawning gravel plan for the Shasta River*					
SONCC-ShaR.2.2.27	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All areas where coho salmon would benefit immediately, including upstream from Dwinnell Dam	2b
SONCC-ShaR.2.2.27.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-ShaR.2.2.27.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-ShaR.2.2.75	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-ShaR.2.2.75.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-ShaR.2.2.75.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-ShaR.2.2.46	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	All areas where coho salmon would benefit immediately, including upstream from Dwinnell Dam	2b
SONCC-ShaR.2.2.46.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-ShaR.2.2.46.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-ShaR.2.2.46.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-ShaR.2.2.77	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	2d
SONCC-ShaR.2.2.77.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-ShaR.2.2.77.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-ShaR.2.2.77.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-ShaR.2.2.28	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Restore natural channel form and function	All areas where coho salmon would benefit immediately	2b
SONCC-ShaR.2.2.28.1	*Identify and prioritize mining reaches, developing a plan to restore the floodplain and channel by removing tailing piles and reconstructing the channel*					
SONCC-ShaR.2.2.28.2	*Remove tailing piles and reconstruct the channel, guided by the restoration plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ShaR.2.2.76	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Restore natural channel form and function	Population wide	2d
SONCC-ShaR.2.2.76.1	*Identify and prioritize mining reaches, developing a plan to restore the floodplain and channel by removing tailing piles and reconstructing the channel*					
SONCC-ShaR.2.2.76.2	*Remove tailing piles and reconstruct the channel, guided by the restoration plan*					
SONCC-ShaR.30.1.71	Disease, Predation, Competition	No	Reduce disease	Conduct monitoring and research actions as described in the Klamath River Fish Disease Research Plan	Population wide	2b
SONCC-ShaR.30.1.71.1	*Develop monitoring plan and research actions as described in the Klamath River Fish Disease Research Plan*					
SONCC-ShaR.30.1.71.2	*Implement Klamath River Fish Disease Research Plan*					
SONCC-ShaR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	2d
SONCC-ShaR.3.1.8.1	*Develop an educational program addressing water conservation programs, instream leasing and water dedication programs, and water diversion/screen hardware maintenance extension support information*					
SONCC-ShaR.3.1.3	Hydrology	Yes	Improve flow timing or volume	Manage flow	Population wide	2d
SONCC-ShaR.3.1.3.1	*Continue watermaster program to ensure water is allocated according to established water rights*					
SONCC-ShaR.3.1.2	Hydrology	Yes	Improve flow timing or volume	Monitor flow for compliance	Population wide	2d
SONCC-ShaR.3.1.2.1	*Install flow measuring devices*					
SONCC-ShaR.3.1.2.2	*Maintain all flow measuring devices*					
SONCC-ShaR.3.1.2.3	*Install head gates and NMFS compliant fish exclusion screens on all water diversions in coho salmon habitat*					
SONCC-ShaR.26.1.26	Low Population Dynamics	No	Increase population abundance	Reduce take of coho salmon	Population wide	2d
SONCC-ShaR.26.1.26.1	*Develop programs providing incidental take coverage for specified, legal agricultural activities, while simultaneously aiding SONCC coho salmon recovery*					
SONCC-ShaR.26.1.26.2	*Implement programs providing incidental take coverage for specified, legal agricultural activities, while simultaneously aiding SONCC coho salmon*					
SONCC-ShaR.10.2.21	Water Quality	Yes	Reduce pollutants	Set standard	Population wide	3b
SONCC-ShaR.10.2.21.1	*Continue implementation of TMDLs for water bodies listed under Clean Water Act Section 303(d)*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ShaR.8.1.31	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately, including both upslope and valley floor roads	3b
SONCC-ShaR.8.1.31.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-ShaR.8.1.31.2		*Decommission roads, guided by assessment*				
SONCC-ShaR.8.1.31.3		*Upgrade roads, guided by assessment*				
SONCC-ShaR.8.1.31.4		*Maintain roads, guided by assessment*				
SONCC-ShaR.8.1.88	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-ShaR.8.1.88.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-ShaR.8.1.88.2		*Decommission roads, guided by assessment*				
SONCC-ShaR.8.1.88.3		*Upgrade roads, guided by assessment*				
SONCC-ShaR.8.1.88.4		*Maintain roads, guided by assessment*				
SONCC-ShaR.10.2.51	Water Quality	Yes	Reduce pollutants	Reduce pesticides	All areas where coho salmon would benefit immediately	3c
SONCC-ShaR.10.2.51.1		*Develop a pesticide management plan*				
SONCC-ShaR.10.2.51.2		*Implement pesticide management plan and technical assistance program*				
SONCC-ShaR.10.2.72	Water Quality	Yes	Reduce pollutants	Reduce pesticides	Population wide	3d
SONCC-ShaR.10.2.72.1		*Develop a pesticide management plan*				
SONCC-ShaR.10.2.72.2		*Implement pesticide management plan and technical assistance program*				
SONCC-ShaR.8.1.30	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	All areas where coho salmon would benefit immediately	3c
SONCC-ShaR.8.1.30.1		*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*				
SONCC-ShaR.8.1.30.2		*Implement plan to stabilize slopes and revegetate exposed areas including agricultural lands*				
SONCC-ShaR.8.1.87	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-ShaR.8.1.87.1		*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*				
SONCC-ShaR.8.1.87.2		*Implement plan to stabilize slopes and revegetate exposed areas including agricultural lands*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ShaR.10.7.65	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All areas where coho salmon would benefit immediately	3c
SONCC-ShaR.10.7.65.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-ShaR.10.7.65.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-ShaR.10.7.73	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-ShaR.10.7.73.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-ShaR.10.7.73.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-ShaR.3.1.9	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide, including upstream from Dwinnell Dam	3d
SONCC-ShaR.3.1.9.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-ShaR.3.1.9.2	*Implement water dedications to increase instream flows using the streamlined process*					
SONCC-ShaR.3.1.10	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-ShaR.3.1.10.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-ShaR.3.1.11	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-ShaR.3.1.11.1	*Conduct a comprehensive inventory of current groundwater wells and well usage within Shasta River Basin, completed by a surface-groundwater integrated model, that together can evaluate the relative merit of water management alternatives*					
SONCC-ShaR.3.1.11.2	*Establish a comprehensive groundwater permit process*					
SONCC-ShaR.10.1.17	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase flow	Emmerson Ranch Properties	3d
SONCC-ShaR.10.1.17.1	*Develop emergency action ranch management plan for Emmerson Ranch*					
SONCC-ShaR.10.1.17.2	*Create an irrigation diversion and water use operations manual that conserves and assists recovery of coho salmon*					
SONCC-ShaR.7.1.45	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Population wide, guided by recent assessment priorities (USFS WCF 2011)	3d
SONCC-ShaR.7.1.45.1	*Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime*					
SONCC-ShaR.7.1.45.2	*Carry out fuel reduction or modification projects such as thinning, prescribed burning, and piling, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-ShaR.2.1.50	Floodplain and Channel Structure	No	Increase channel complexity	Improve regulatory mechanisms	Population wide	3d
SONCC-ShaR.2.1.50.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-ShaR.16.1.33	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ShaR.16.1.33.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-ShaR.16.1.33.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-ShaR.16.1.63	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-ShaR.16.1.63.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-ShaR.16.1.63.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-ShaR.16.1.34	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ShaR.16.1.34.1	*Determine actual fishing impacts*					
SONCC-ShaR.16.1.34.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-ShaR.16.1.64	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-ShaR.16.1.64.1	*Determine actual fishing impacts*					
SONCC-ShaR.16.1.64.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-ShaR.16.2.35	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ShaR.16.2.35.1		*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*				
SONCC-ShaR.16.2.35.2		*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*				
SONCC-ShaR.16.2.36	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-ShaR.16.2.36.1		*Determine actual impacts of scientific collection*				
SONCC-ShaR.16.2.36.2		*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*				

38. Lower Trinity River Population

Interior Trinity River Stratum

Core Population

High Extinction Risk

Population likely below depensation threshold

3,600 Spawners Required for ESU Viability

746 mi^2 watershed (91% Federal ownership)

112 IP-km (63 IP-mi) (1% High)

Dominant Land Uses are Forestry and Agriculture

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Channelization/Diking' and 'Hatcheries'

Highest Priority Recovery Actions

• Prioritize and provide incentives for use of CA Water Code Section 1707 • Streamline process for water leasing under CA Water Code Section 1707 for instream purposes • Establish a comprehensive groundwater permit process	• Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows • Implement a hatchery and genetic management plan • Remove, set back, or reconfigure levees and dikes

38.1 History of Habitat and Land Use

Prior to 1944, the Lower Trinity River was occupied by Native Americans and turn-of-the century miners (U.S. Forest Service (USFS) 2000d). Their use of these lands probably had relatively minor impacts. Forest Service road construction and timber harvest did not begin until the 1950s (USFS 2000e). Land use activities in the Lower Trinity River watershed today include mining, timber harvesting, agriculture, road construction, recreation and a limited degree of residential development (U.S. Environmental Protection Agency [USEPA] 2001). The construction of Trinity and Lewiston dams in the early 1960s and water diversion to the Sacramento Valley has had major impacts on the flow and function of the Trinity River (USEPA 2001, USFS 2000e). Effects to coho salmon habitat in the Lower Trinity River include degradation of spawning and rearing habitat, lack of deep pools, sedimentation, channelization and channel confinement, and high water temperatures. Some streams with moderate intrinsic potential (IP) value are relatively intact with regards to their historic condition and a few have federally designated Wilderness protection.

Fish habitat, especially anadromous fish habitat, was greatly degraded in the 1964 flood, which affected the Lower Trinity River and most anadromous habitat in northern California (USFS 2000e). Substantial habitat recovery has occurred since the 1964 flood, but wild anadromous fish populations and salmon habitat have generally not recovered in the Klamath basin (USFS 2000e). Fire has also been a source of catastrophic disturbance. Several high severity fires have burned through the lower Trinity River since fire suppression activities on USFS land began in the mid-1900s.

For instance, the 1999 Megram Fire burned 125,000 acres and the Big Bar Complex burned close to 80,000 acres (53 percent) of the New River watershed in August 1999. Both impacted the riparian communities of some streams and accelerated the delivery of sediment to several streams in the Lower Trinity River drainage (USFS 2000e).

Timber harvest practices and developments on floodplains within the Trinity River watershed have also contributed significantly to habitat degradation (U.S. Department of the Interior 1981). A total of 28 percent of the Lower Trinity was harvested between 1940 and 1990 (USEPA 2001) as a result of large-scale timber harvesting occurring on private land (especially Willow Creek and Sharber Creek) (USFS 2003b). Clearcutting promoted increased sediment loading; removal of streamside vegetation increased water temperatures; and log jams at the mouths of tributaries (USDOI 1981). In addition, timber harvest within the sub-basin has necessitated the construction of hundreds of miles of unpaved timber management roads (USDOI 1981). Road networks in the Lower Trinity and many other areas of the Pacific Northwest are the most significant source of anthropogenic sediment input to anadromous fish habitats, often exceeding all other combined sources from forest activities (USFS 2003b). Roads have led to decreased hydrologic function and increased sediment loading. The resulting increased yield of sediment in the mainstem Trinity River and its tributaries has reduced the biological productivity and fish carrying capacity of the river (USDOI 1981).

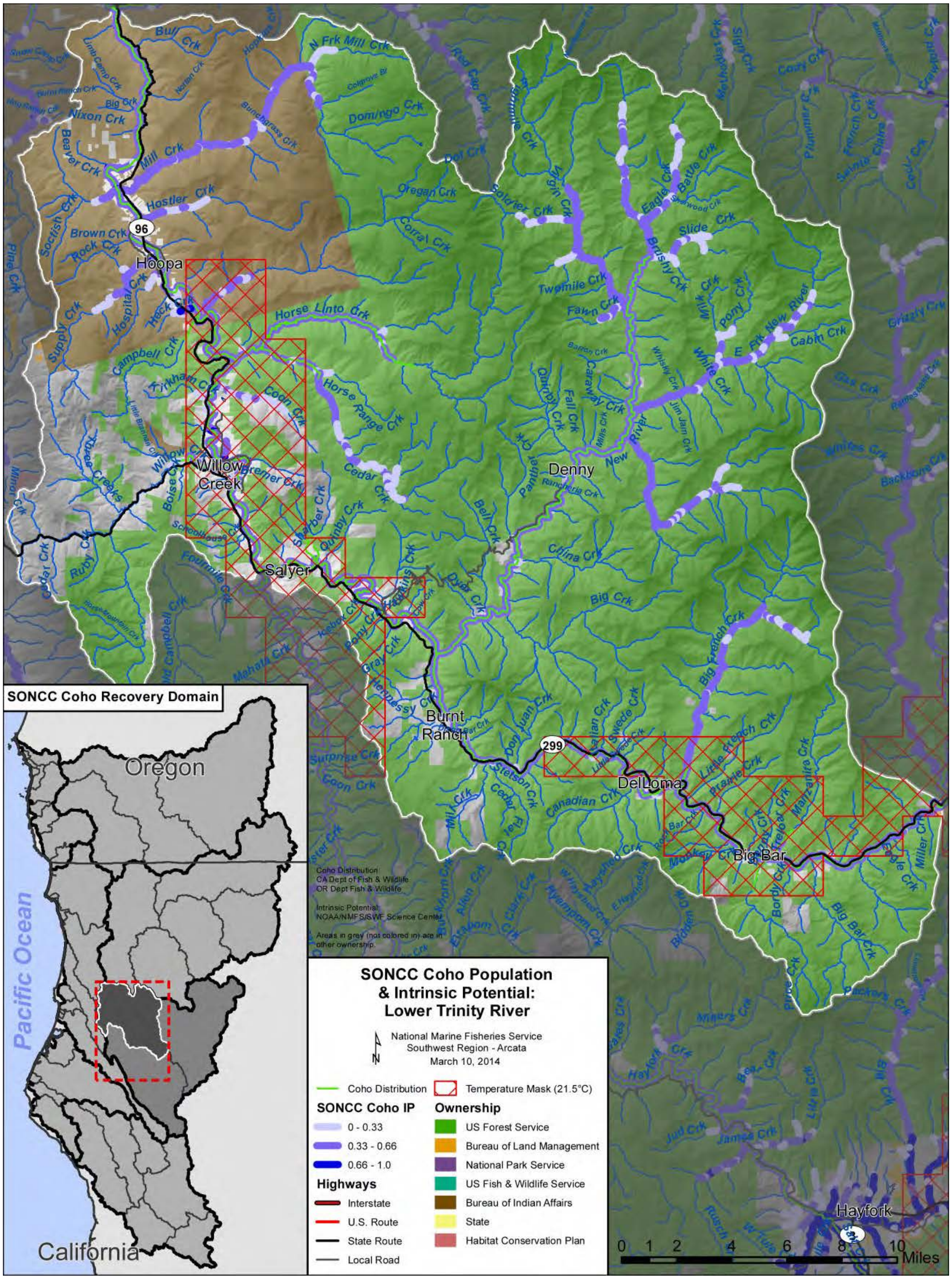

Figure 38-1. The geographic boundaries of the Lower Trinity River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Trinity River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

Much of the mainstem Trinity River and virtually all tributaries have been subjected to hydraulic mining activities (U.S. Fish and Wildlife Service [USFWS] and Hoopa Valley Tribe [HVT] 1999, USEPA 2001). Hydraulic mining destabilized streambanks, changed the channel structure, and caused large amounts of sediment to be washed into tributary streams. However, the form and function of the streams in areas where hydraulic mining has occurred seem to have persisted despite this disturbance (USFWS and HVT 1999, USEPA 2001).

It is likely that many watersheds within the Burnt Ranch and New River hydrologic subarea (HSA) are properly functioning with regard to aquatic habitat and watershed conditions. These streams have a large portion of their watersheds in the Trinity Alps Wilderness and remain in a relatively undisturbed state. Most of these streams remain accessible to coho salmon. Although these streams currently support small populations of anadromous steelhead and some coho salmon, they may not have historically supported robust populations of coho salmon because of their high gradient.

38.2 Historic Fish Distribution and Abundance

There is little information on the historic abundance of coho salmon in the lower Trinity River. USFWS and California Department of Fish and Game (CDFG) (1956) noted that "Silver [coho] salmon enter most lower Trinity River tributaries to spawn." Similarly, Moffet and Smith (1950) stated that "silver [coho] salmon enter the lower Trinity River to spawn" and reported that coho salmon were usually observed in the Hoopa Valley by October. In 1969 and 1970, CDFG estimated the coho salmon run size for the Trinity River to be 3,222 and 5,245, respectively (Smith 1975, Rogers 1973). Since 1978, coho salmon escapement estimates above Willow Creek has ranged from 558 to 32,373 (USFWS and HVT 1999). These returns have largely been comprised of hatchery fish since Trinity River Hatchery (TRH) was built. An estimated 90 percent of coho salmon spawning between Willow Creek and Lewiston Dam are of hatchery origin (USFWS and HVT 1999). The estimated escapement of naturally produced coho salmon adults and jacks upstream of the Willow Creek weir from 1997 to 2010 ranged from 539 to 9,055, with an average of 2,028. Unknown is the proportion of these coho salmon that spawn in the lower Trinity River, as many are likely migrating to the Upper Trinity River. Spawning surveys by the USFS in the mid to late 1990s have found scattered use of tributaries in the Lower Trinity by coho salmon with between 0 and 100 spawners found during any given year in the few surveyed streams (USFS 2003b).

TRH first began releasing coho salmon in 1960. Although substantial efforts were made to trap and haul coho salmon above the dam during the construction of Trinity Dam, adult returns fell to essentially zero during the 1962-63 run (zero females, seven males, nine jacks). Transfer of coho salmon eggs from outside of the Trinity basin often occurred, which imported coho salmon that were likely not as well adapted to the Trinity basin's habitat conditions as were the original stocks. The TRH facility originally used Trinity River fish for broodstock, though coho salmon from Eel River (1965), Cascade River (1966, 1967, and 1969), Alsea River (1970), and Noyo River (1970) have also been reared and released at the hatchery as well as elsewhere in the Trinity River basin (NMFS 2003). Actual production averaged 496,813 from 1987 to 1991, decreased to 385,369 from 1992 to 1996, then increased again to 527,715 fish from 1997 to 2002. During the period 1991–2001, an average of 3,814 adult coho salmon were trapped and 562 females were spawned at TRH (NMFS 2003).

Given that several tributary streams in Lower Trinity River provide spawning habitat, it can be inferred that coho salmon were historically widely distributed throughout the Lower Trinity River sub-basin. Historically, it was probably rare for coho salmon to spawn in the mainstem Lower Trinity River. The steep nature of the surrounding terrain likely limited the amount of high quality habitat available to coho salmon and the majority of IP habitat is of moderate value (0.33- 0.66). There exist only a few scattered kilometers of high IP habitat (>0.66). The relatively steep nature of the area and the consequent lack of high IP habitat (<2 percent high IP) suggest this population never supported large runs of coho salmon but may have supported a moderately-sized population that was spread throughout most major tributaries (e.g., Big French Cr., New River, Willow Cr., Horse Linto Cr., Tish Tang Cr., Mill Cr., and Cedar Cr.)

38.3 Status of Lower Trinity River Coho Salmon

Spatial Structure and Diversity

Good spawning habitat exists in a few tributaries in the Lower Trinity. The Burnt Ranch and New River HSAs have some of the best known spawning habitat in the population area. Tributaries known to support coho salmon spawning and/or rearing include Mill Creek, Horse Linto Creek, Tish Tang Creek, and Sharber-Peckham Creek. The presence of juvenile coho salmon has also been confirmed within relatively recent years in Manzanita Creek, Big French Creek, East Fork New River, Cedar, Supply, Campbell, and Hostler creeks, as well as in Willow Creek as far upstream as the Boise Creek confluence (Boberg 2008, Everest 2008). Sharber-Peckham Creek likely supports the highest number of spawning coho salmon (USFS 2001; Boberg 2008). The Six Rivers National Forest indicated that populations in the lower portions of Mill and Horse Linto creeks are extremely low, particularly in Horse Linto Creek since 1995 (USFS 2001). The USFS (2000f) reported that coho salmon are rarely found in the New River although this is one of the largest watersheds with the potential for coho salmon production based on the availability of IP habitat in the sub-basin. Based on this current distribution of coho salmon in the Lower Trinity, most of the historic habitat of the Lower Trinity River remains accessible to coho salmon, though many of the streams are unoccupied, or sporadically occupied.

Although not well documented, there appears to be some diversity of life history strategies in the Lower Trinity River. Data on run timing and outmigration indicate that there is some variation in the life history characteristics of the population. Coho salmon enter the Trinity River between September and November and spawning in the river continues into December (CDFG 2009b). Also, both young-of-the-year and yearling coho salmon are captured at downstream migrant traps located in the Trinity River near Willow Creek (Pinnix et al. 2007). Redistribution of age 0+ coho occurs over a large time period between March and September as does outmigration of age 1+ (Pinnix et al. 2007).

Hatchery influences on the genetic diversity of the population are substantial in the Lower Trinity River sub-basin. Each year, TRH releases approximately 500,000 coho salmon smolts. Currently, coho salmon returns to the Trinity River are dominated by hatchery fish (USFWS and HVT 1999). From 1997 to 2005, over 85 percent of adults returning to the Trinity River (as estimated at Willow Creek) were of hatchery origin (CDFG 2009b). Trinity River hatchery coho salmon stray into many of the tributaries on the Six Rivers National Forest, such as Horse Linto Creek (Cyr 2008). Straying of hatchery fish into tributaries of the Trinity River presents a particular threat to the diversity viability parameter, as hatchery fish may reduce the reproductive success of the overall population (Mclean et al. 2003) through outbreeding depression (Reisenbichler and Rubin 1999). In 1985, Jong and Mills (1992) found that 35.8 percent of adult coho salmon returning to the South Fork Trinity River were of hatchery origin. In other years, few or no hatchery coho salmon were trapped on the South Fork Trinity River (Jong and Mills 1992). We assume that in years of high adult returns of hatchery coho salmon (>10,000), the proportion of hatchery coho salmon adult returns to tributaries in the Lower Trinity River is similar to that found in the South Fork, or greater, because hatchery coho salmon are migrating to Trinity River Hatchery through the Lower Trinity River.

Table 38-1. Estimated run sizes of adult and jack coho salmon based on observations at Willow Creek weir (CDFW 2013c). Hatchery-origin fish were identified by a right maxillary clip.

Year	Number Unmarked	Number Marked	% Hatchery	% Natural
1997	651	7,284	92%	8%
1998	1,132	11,348	90%	10%
1999	586	4,959	89%	11%
2000	539	14,993	97%	3%
2001	3,373	28,768	90%	10%
2002	596	15,420	96%	4%
2003	4,093	24,059	86%	14%
2004	9,055	29,827	77%	23%
2005	2,740	28,679	92%	8%
2006	1,624	18,454	92%	8%
2007	1,199	4,551	79%	21%
2008	1,312	8,671	87%	13%
2009	642	5,753	90%	10%
2010	861	7,085	89%	11%

Population Size and Productivity

Williams et al. (2008) determined at least 112 spawners are needed each year in the Lower Trinity River to avoid problems associated with low spawner density such as the failure to find mates leading to a reduced probability of fertilization, and the failure to saturate predator populations (Liermann and Hilborn 2001, Williams et al. 2008). Williams et al. (2008) also determined that there should be a spawner density of at least 35 coho salmon per IP-km of habitat in the Lower Trinity River sub-basin, resulting in a total of 3,900 individuals to meet the low risk spawner threshold.

Limited presence/absence and spawning survey data are available from the U.S. Forest Service. Based on spawner surveys by the USFS run sizes in Sharber Creek between 1996 and 2001 ranged from 0 fish in 1999 to almost 150 fish in 2001 (USFS 2003b). The average run size during this time was 56 fish (and 27 redds). No coho salmon were found during spawning surveys in Willow Creek between 1991-2000 although juveniles have been found during outmigrating trapping (USFS 2003b). Surveys of coho salmon in streams with IP on USFS land suggest that coho salmon have declined since the 1990s and are only occasionally seen at extremely low abundance levels (Collins 2012). However, no live coho salmon were observed in

2011 and there were only a couple of potential redds observed in 2011 (Collins 2012). Captures of yearling coho salmon in the Trinity River during outmigrant trapping have been consistent, but numbers are generally low (CDFG 2009b).

Coho salmon on the Hoopa Valley Indian Reservation (HVIR) are rare and seemingly missing cohorts based on monitoring conducted by the Hoopa Valley Tribe HVT (Table 38-2, Figure 38-2 and Figure 38-3). From 2005 to 2010, the total expanded net catch for the HVIR ranged from 744 to 2 coho salmon (Figure 38-2 and Figure 38-3). Because so few were captured in these years, population estimates were not possible (HVT 2012). However, dividing the yearly total Chinook salmon expanded net catch by the yearly Chinook salmon population estimates provides an approximation, albeit rough, of the percentage of the Chinook salmon population that was captured in the downstream migrant traps. From 2005 to 2010, the expanded Chinook salmon catch accounted for 8 to 19 percent of the estimated Chinook salmon population (HVT 2012). Assuming this same proportion of the coho salmon population was captured in the downstream migrant traps (expanded catch) yields an approximation of the population of coho salmon juveniles on streams on the HVIR. From 2005 to 2010, roughly 9,036 to 14 coho salmon were present in the seven streams monitored by HVT (Table 38-3) using this method. NMFS acknowledges there are limitations to using this population proxy, including, but not limited to, potentially unequal capture probabilities of juvenile coho salmon and Chinook salmon. However, the calculations do provide an understanding of the magnitude of what could be expected of coho salmon juvenile population estimates on the HVIR, if estimates were available.

The expanded catch of coho salmon, as well as the population approximations, show marked declines after 2005. This leads NMFS to conclude that since 2005, there have been no more than a couple spawning pairs of coho salmon in all of the tributaries on the HVIR combined, assuming that none of the juveniles captured in HVIR tributaries were rearing in non-natal streams. If these few fish were actually non-natal rearing SONCC coho salmon juveniles, which is equally probable, then no adult coho salmon would have spawned in HVIR streams since 2005.

Table 38-2. Present (X) and missing (blank) coho salmon brood years in anadromous HVIR streams in the action area, 2005-2010 (HVT 2012). Pine Creek is a tributary to the Klamath River.

	Hostler	Mill	Pine	Soctish	Supply	Tish Tang
2005						
2006	X		X	X	X	X
2007	X			X	X	
2008	X			X		X
2009	X				X	
2010		X	X	X	X	X

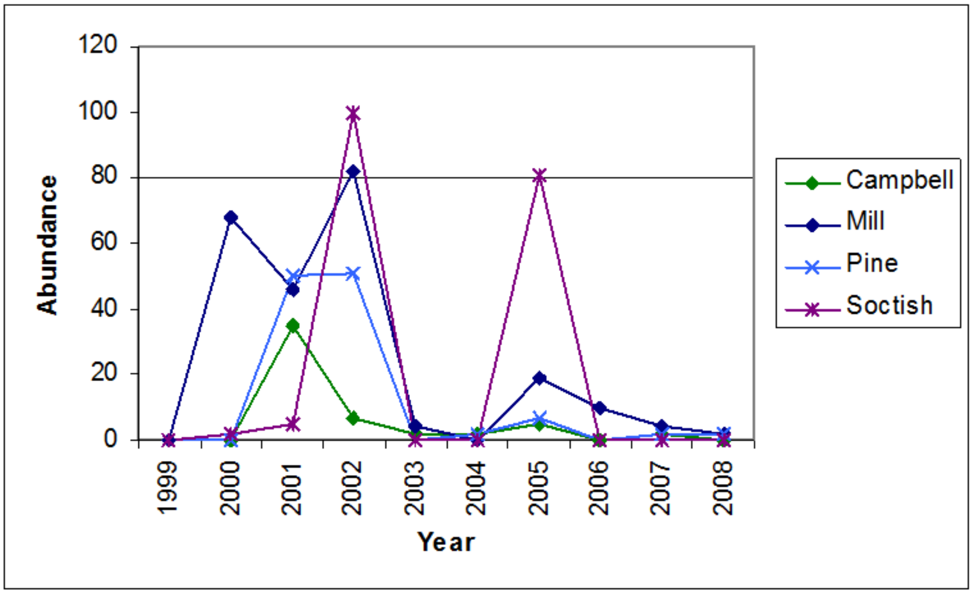

Figure 38-2. Juvenile coho salmon trapped in Campbell, Mill, Pine, and Soctish Creeks from 1999-2008 (HVT 2012).

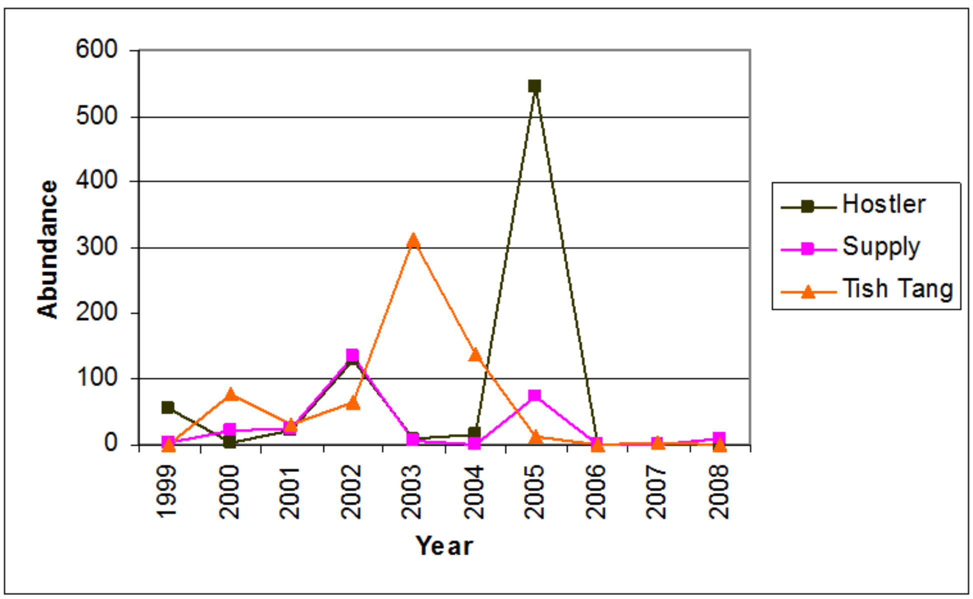

Figure 38-3. Juvenile coho salmon trapped in Hostler, Supply, and Tish Tang Creeks from 1999-2008 (HVT 2012).

Table 38-3. Number coho salmon captured, and population estimation, for seven streams on the HVIR (Campbell, Hostler, Mill, Pine, Soctish, Supply, and Tish Tang creeks) (HVT 2012).

Year	Expanded coho salmon catch	Coho salmon population approximation
2005	744	9,036
2006	10	81
2007	9	93
2008	12	121
2009	7	36
2010	2	14

In years such as 2001 and 2004 that were exceptionally strong brood years for coho salmon throughout northern California, with smolt-to-adult returns (SAR) for TRH hatchery coho salmon exceeding 6 percent and population estimates over 25,000 (CDFG 2008c), tributaries of the HVIR likely hosted numerous strays of both hatchery and wild origin. Strays in the early 2000s could have accounted for a significant proportion of the juvenile coho salmon production on the HVIR. Undoubtedly, a factor in the decline in coho salmon abundance on the HVIR is low marine survival, as evidenced by SAR rates on the order of 1 percent since 2005 for TRH coho salmon (CDFG unpublished data). Given the low number of coho salmon in the HVIR tributaries, a 1 percent SAR appears to have yielded numbers of coho salmon in the tributaries so small that they are likely not viable or self-sustaining. The inability of the coho salmon population on the HVIR to remain viable during years of low marine survival leads NMFS to believe that tributaries of the HVIR currently do not support a population of self-sustaining coho salmon and likely rely on strays to periodically produce juvenile coho salmon.

The limited data available from the USFS and the HVT for the Lower Trinity River population suggests that much of the IP habitat in the Lower Trinity River is currently unoccupied or only sporadically occupied. Brood year cohorts may be missing and the adult coho salmon population is likely less than the depensation threshold of 112 adults. The population growth rate in Lower Trinity River sub-basin has not been quantified. Recent data indicate that the amount of recruits produced per female spawner in the Trinity River is substantially less than two, meaning the population is failing to replace itself (Table 39-3). The population growth rate for the Lower Trinity River is likely to be negative, and the population relies on the heavy influence of hatchery fish to maintain current abundance levels.

Extinction Risk

The Lower Trinity population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role of Population in SONCC Coho Salmon ESU Viability

The Lower Trinity River population is a core, Potentially Independent population within the Interior Trinity River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, but strongly influenced by immigration from other populations such that they did not exhibit independent dynamics (Williams et al. 2006). To contribute to stratum and ESU viability, the Lower Trinity River core population should have at least 3,600 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Lower Trinity River population may serve as a source of spawner strays for nearby coastal populations. At present, the capacity of the Lower Trinity River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from other populations in the Klamath River basin may enhance recovery of the Lower Trinity River population.

38.4 Plans and Assessments

Hoopa Valley Tribal Fisheries and Hoopa Valley Environmental Program

http://www.hoopa-nsn.gov

Monitoring activities include fish tagging, weir operations, juvenile outmigrant trapping, screw trap monitoring, creel census, and net harvest monitoring. Much of the data gathered through these monitoring activities is used to estimate future anadromous runs in order to determine allocation between the ocean fishery, Tribal fisheries, and the sports fishery. Along with the monitoring and reporting, Hoopa Tribal Fisheries takes several measures to ensure optimal spawning habitat and rearing grounds in the seven major tributaries located within the Hoopa Reservation. Through habitat typing, channel morphology characterization, and sediment loading analysis, Tribal Fisheries is able to assess local stream habitat and address shortcomings through restoration activities.

Hoopa Tribal Environmental Protection Agency offers a multitude of services to the Hoopa Valley Tribe in environmental protection, public outreach and education, air quality monitoring, water quality planning, solid waste management, hazardous waste protection, and environmental compliance. www.hoopa-nsn.gov.

Yurok Tribal Fisheries Program and Yurok Tribal Environmental Program

http://www.yuroktribe.org/departments/fisheries/
http://www.yuroktribe.org/departments/ytep/

The Yurok Tribe has several reports and assessments available for the Trinity River basin on salmon populations, salmon habitat, and water quality. The Yurok Tribe is an active participant in the Trinity River Restoration Program, performing fisheries research, salmon population monitoring such as redd and carcass surveys and habitat restoration. The Yurok Tribe also monitors and reports on water quality in the Trinity River.

U.S. Forest Service- Shasta-Trinity and Six Rivers National Forests

http://www.fs.fed.us/r5/shastatrinity/

The U.S. Forest Service (USFS) has a variety reports and assessments available for the Trinity Basin. USFS has programs benefitting salmon and steelhead habitat in the Trinity River basin. USFS maintains an active road decommissioning and sediment abatement program that aims to minimize fine sediment delivery to streams. Fuels reductions programs implemented by the USFS are activities that help reduce the risk of catastrophic forest fires and subsequent erosion. The USFS is an active participant in the Trinity River Restoration Program and performs salmon and steelhead monitoring, restoration, and habitat assessments.

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The specific restorative recommendations developed by the Coho Recovery Team and CDFG for the Upper Trinity River have been considered and incorporated into the table of population-specific recovery actions.

North Coast Regional Water Quality Control Board (NCRWQCB)

www.waterboards.ca.gov/northcoast

The NCRWQCB has identified the Trinity River as impaired under Clean Water Act (CWA) 303(d) due to elevated sedimentation. The NCRWQCB is required to develop the measures which will result in implementation of the TMDLs in accordance with the requirements of 40 CFR 130.6. The North Coast Basin Plan identifies both numeric and narrative water quality objectives for the Trinity River.

Five Counties Salmonid Conservation Program

http://www.5counties.org/

The Five Counties Salmonid Conservation Program (5C) has reports and plans available on sediment reduction, barriers to migration and fish habitat in the Trinity River basin. The 5C promotes improved understanding and support for road-related conservation and restoration efforts by providing roads, salmon, and water quality workshops, fish passage engineering training, and planning and policy meetings for County and other agency staff. Among other goals, the 5C seeks to:

- Improve County policies and road maintenance practices with a strong emphasis on training.
- Identify potential restoration opportunities through inventories of fish passage barriers and potential sediment sources on County maintained roads.
- Increase the amount of salmonid habitat by replacing stream crossings that are barriers to migration with structures that provide for passage.
- Improve water quality by treating identified sources of road related sediment.

38.5 Stresses

Table 38-4. Severity of stresses affecting each life stage of coho salmon in the Lower Trinity River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Adverse Hatchery-Related Effects	Very High	Very High	Very High	Very High	Very High	Very High
2	Lack of Floodplain and Channel Structure[1]	Medium	Very High	Very High[1]	Medium	Medium	Very High
3	Altered Hydrologic Function[1]	Medium	Medium	High[1]	High	High	High
4	Altered Sediment Supply	High	High	High	Medium	Medium	High
5	Impaired Water Quality	Low	Low	High	Low	Medium	Medium
6	Degraded Riparian Forest Conditions	-	Medium	Medium	Low	Medium	Medium
7	Barriers	-	Low	Medium	Medium	Medium	Medium
8	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
9	Increased Disease/Predation/Competition	Low	Low	Medium	Medium	Low	Medium
10	Impaired Estuary/Mainstem Function	-	Low	Medium	Medium	Low	Medium

[1]Key limiting stresses and limited life stage

Key Limiting Stresses, Life Stages, and Habitat

Several factors limit the viability of the Lower Trinity population. The most dominant of these factors stem from negative impacts of the altered hydrologic function and altered floodplain and channel structure. The juvenile life stage is the most limited and quality summer and winter rearing habitat is lacking for the population. Overall, the capacity of the Lower Trinity to support juveniles and other life stages of coho salmon has been reduced by these impacts. In order to improve the viability of this population it will be imperative to address the issues related to the hatchery and to improve habitat conditions for juveniles and adults. Addressing other stresses and threats and improving habitat for all life stages and life history strategies will also be an important component of recovery.

Lack of floodplain and channel structure impacts also have a major impact on the productivity of this population. Rearing opportunities and capacity are low due to disconnection of the floodplain, a lack of LWD inputs, poor riparian conditions, and sediment accretion. Low-lying areas of streams such as Supply, Mill, and Willow Creek have been channelized, diked, and disconnected from the floodplain. There exists very little off-channel habitat that can be used for rearing and refugia. Many tributaries in low-gradient areas of the Lower Trinity experience similar habitat characteristics due to development of the floodplain, sedimentation and changes in flow. The mainstem river also lacks side channel, backwater, and wetland habitat where juvenile coho salmon could find habitat in the winter. A lack of floodplain and channel structure impacts winter rearing because high flow events can displace juveniles from streams and there exists very little low-velocity rearing habitat. Lack of complex habitat also impacts summer rearing due to the loss of predatory refugia, low-flow refugia, and foraging habitat.

Given the number of diversions and the potential amount of water withdrawn from the mainstem Trinity River and its tributaries, a lack of hydrologic function could also be potentially limiting coho salmon production in the Lower Trinity population. Many tributaries likely experience unnatural seasonal low flow conditions that prohibit their use during the summer. Thermal refugia on the mainstem may also be impacted by reduced flows through a reduction in the extent, duration, or quality of refugia areas. Given the importance of tributary rearing habitat and thermal refugia on the mainstem a loss of hydrologic function could have a major impact on juvenile coho.

Lack of Floodplain and Channel Structure

The lack of floodplain and channel structure presents a moderate to high stress across life stages. Data on instream large woody debris (LWD) is limited, but it is assumed to be low given the extent of timber harvest in the areas and current lack of late seral riparian forest (e.g., Willow Creek and Sharber Creek; USFS 2003b). Lack of LWD has resulted in loss of pool habitat and a reduction in overall habitat and hydraulic complexity in coho salmon streams (CDFG 2002). Sediment loading in many streams has led to the filling of pools, disconnection from the floodplain, and the overall loss of stream complexity. Diking and channelization in many streams has reduced habitat complexity, connectivity with the floodplain, and increased water velocity, leading to lower survival of the egg, fry, and juvenile life stages. Historic floodplains in the area have been disconnected from tributary streams and converted to agricultural, grazing, or residential lands. This has further limited a relatively scarce yet important habitat type that is used for rearing of coho salmon fry and juveniles. Examples of floodplains that have been diked and simplified are the lower portions of Supply and Mill creeks on the Hoopa Valley Tribe Reservation. Complex floodplain habitats are crucial for overwintering survival and growth of juvenile coho salmon.

Altered Hydrologic Function

Altered hydrologic function is a medium to high stress for all life stages. There were 381 diversions listed in CDFG’s Fish Passage Assessment Database (CalFish 2009), and this does not included unpermitted or illegal diversions or groundwater use. The towns of Willow Creek and Hoopa both get drinking water from the Lower Trinity River sub-basin through city water systems. Denny and Burnt Ranch also get water from tributaries in the Lower Trinity. Even when a stream is not fish bearing (e.g., McDonald Creek in Burnt Ranch) it will create vitally important thermal refugia for coho salmon where the creek meets the Trinity River. By reducing the summer stream flow in streams like McDonald Creek that are not fish bearing, water diversion can still have an impact on juvenile rearing by decreasing the size of thermal refugia within the mainstem Trinity River. Other smaller domestic wells also utilize ground water, but the cumulative impact from these various residential uses on surface flows is not well documented. Overall diversions likely impact flow in many tributaries, especially during summer and early fall low flow periods. Sharber Creek, an important stream for coho salmon production in the Lower Trinity, has limited flow during the summer and can go dry in some areas. In addition to water diversion for human uses, the hydrologic regime in the Lower Trinity has been affected by the road system and fire regime. Many streams in the Lower Trinity population unit are impacted by illegal diversions and water use for marijuana cultivation, which is a growing and substantial impact to streamflow in the area. Roads affect subsurface water flow, concentrate flow, and divert or reroute water from paths it would otherwise take (Gucinski et al. 2001, USFS 2003b). The high density of roads mean that many streams experience changes in their hydrology as a result of roads. Less frequent fire in tributary watersheds has reduced or eliminated peak flow responses to the removal of duff, understory vegetation, and overstory vegetation by fire.

Adverse Hatchery-Related Effects

There are no hatcheries in the Lower Trinity River population area, but Trinity River Hatchery is upstream on the Trinity River. Trinity River Hatchery currently releases 4.3 million juvenile and yearling Chinook salmon, 500,000 yearling coho salmon, and 800,000 yearling steelhead. Hatchery-origin coho salmon make up most of the spawning run to the Trinity River each year. On average, only three percent of in-river spawners were not reared in a hatchery (USFWS and HVT 1999). Between 1997 and 2002, hatchery fish constituted between 85 percent and 97 percent of the fish (adults plus jacks) returning to the Willow Creek weir in the Lower Trinity River (CDFG 2009b). Spawning surveys in 1998-99 found a high proportion of hatchery strays (60-100 percent) in all Lower Trinity streams where coho salmon where found (Dutra and Thomas 1999). Adverse hatchery-related effects pose a very high risk to all life stages, because more than thirty percent of adults are of hatchery origin (Appendix B) and there is significant potential for ecological interactions.

Altered Sediment Supply

Water quality of the Trinity River is listed as impaired for sediment throughout its length by California State Water Resources Control Board under Section 303 (d) of the Federal Clean Water Act. Increased sediment loading is thought to have filled pools, widened channels, and simplified stream habitat used for rearing and altered sediment supply presents a moderate to high stress for coho salmon in this population. In many reaches, aggradation has reduced surface stream flows, limiting tributary and habitat access to migrating juveniles. In the Willow Creek and Hoopa HSAs, sediment loading is especially high and likely limits the potential for spawning and rearing in these areas. Campbell and Willow Creek have experienced intensive land management and suffer from high sediment loading. Campbell Creek, Supply Creek, and Willow Creek have been noted as having extremely high rates of sedimentation and are highly impaired due to sediment/turbidity. Supply Creek was also recently impacted by large fine sediment input in winter of 2009. Mill and Tish Tang Creek are also considered impaired due to sedimentation as a result of timber harvest and road-building and experience high rates of sedimentation (USEPA 2001). The majority of sediment in the Lower Trinity originates from roads and landslides (USEPA 2001).

Impaired Water Quality

Impaired water quality poses a moderate stress to the Lower Trinity population. In some smaller tributary streams, water temperatures can increase to levels stressful for rearing coho salmon in the summer months (>16 °C). Water temperature in the mainstem often reaches >20^{o} C. Mainstem and tributary migratory habitat is impaired by high summer temperatures and thermal barriers. Releases from Lewiston Dam to support North Coast Regional Water Quality Control Board (NCRWQCB) and ROD temperature criteria have substantially improved conditions (USFWS and HVT 1999). However, criteria for the Lower Trinity River do not prohibit temperature increases after July 9 (or June 15 in Dry and Critically Dry Water Years). Temperature readings at Hoopa often exceed the thermal tolerance of coho salmon starting in June and extending into September (USFS 2003b). Juveniles often rely on thermal refugia during the summer in areas of the mainstem where water quality is poor. Localized areas of non-point source pollution likely exist (e.g., runoff from roads, parking lots, and agricultural lands). Recent large algae blooms in the Lower Trinity River are likely associated with high levels of nutrients in runoff from various agricultural operations, particularly near the town of Willow Creek.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions pose a low to moderate stresses across all life stages. Evaluations of streamside canopy cover range from fair to very good throughout the watershed based on existing survey data. The Willow Creek HSA appears to have fair riparian conditions, while the Burnt Ranch and New River HSAs have very good riparian conditions. The Hoopa HSA was not rated for streamside canopy cover. Many of the riparian areas in the Lower Trinity have been disturbed through timber harvesting, natural storm events, landslides, and wildfires. Changes in timber management have helped foster recovery of riparian zones, although hardwoods now dominate canopy cover where it was once conifer dominated. While LWD recruitment potential may be reduced, the shade component along tributary streams has been re-established through encroachment of alders and other riparian vegetation. While riparian canopy closure conditions have substantially recovered, forest openings and degraded riparian forest remain along most tributaries, particularly along Willow Creek. The mainstem Trinity generally does not have extensive shade-producing riparian cover because the width of the channel reduces closure.

Barriers

Barriers pose a moderate stress to coho salmon in the Lower Trinity River and are especially detrimental to juveniles, smolts, and adults. The extent of impact from barriers is largely unknown due to the number of private diversions in the Lower Trinity, however the impact could be large. There are no large dams in the Lower Trinity River drainage, except on McDonald Creek, where the town of Burnt Ranch gets its water. The dam is upstream of where coho salmon can migrate. There are 25 road-stream crossing structures that are total barriers to juvenile and adult salmonid migration in the Lower Trinity River population area and a total of 33 unscreened diversions (CalFish 2009). More of the remaining 30 diversions on private land may also be unscreened. Two barriers are a high priority for removal and two are a moderate priority (CalFish 2009). The location of most road crossings and diversions suggests that most of the watershed remains accessible to coho salmon and these barriers are not substantially restricting the availability of habitat. One exception is the barrier on Sharber Creek which is blocking access to approximately 2 miles of high quality rearing and spawning habitat on one of the last remaining productive streams. Low water barriers and thermal barriers (e.g., mainstem reaches) may seasonally limit coho salmon rearing and migratory habitat. Permanent natural barriers also prevent access to potential spawning and rearing habitat (e.g., Campbell Creek, Sharber Creek, and Hawkins Creek).

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Increased Disease/Predation/Competition

Disease is a medium to low stress across all life history stages in the Lower Trinity River. Coho salmon smolts may be exposed to diseases like Ceratomyxosis during their downstream migration in the Trinity and Klamath River. The rates of infection for these smolts are likely somewhat low given that disease rates in the Trinity are generally low and the zones with the highest rates of infection in the Klamath are upstream of the Trinity confluence (Bartholomew 2008). By the time adult coho salmon from the Trinity River enter the Lower Klamath River (late fall to early winter), *Ceratonova shasta* (Ceratomyxosis) and *Flavobacterium columnare* (Columnaris) are probably not a significant issue. Releases of Chinook salmon from Trinity River Hatchery may result in competition for limited rearing space and food in thermal refugia during the summer months.

Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the Lower Trinity River migrate to and from the ocean through the mainstem Lower Trinity, Lower Klamath River, and the Klamath River estuary. The Klamath River estuary may play an important role in providing foraging and refuge opportunities for juvenile coho salmon from the Lower Trinity River. This type of non-natal rearing may be especially important because a lack of summer and winter rearing habitat in the Lower Trinity may force juveniles to move downstream and rear in the estuary. The degraded conditions that exist throughout the Trinity basin may mean that the estuary plays a very important role by providing the opportunity for growth and refugia prior to entering the ocean. The estuary, although relatively intact, suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain. Mainstem conditions contribute to this stress because of the issues with water quality, sedimentation and accretion, and degraded habitat in mainstem reaches of the Lower Klamath River. Juveniles, smolts, and adults transitioning through mainstem habitat are stressed by the degraded conditions in these migratory habitats and suffer from the lost opportunity for increased growth, and consequently have a lower survival rate. The loss and degradation of estuarine and mainstem habitat is considered a low to medium stress for the population, with the most affected life stages being juveniles and smolts.

38.6 Threats

Table 38-5. Severity of threats affecting each life stage of coho salmon in the Lower Trinity River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile [1]	Smolt	Adult	Overall Threat Rank
1	Hatcheries[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Channelization/Diking[1]	Low	Very High	Very High[1]	High	Medium	Very High
3	Climate Change	Low	Medium	Very High	High	High	High
4	Roads	High	High	High	Medium	Medium	High
5	Dams/Diversions	Low	High	High	Medium	Medium	High
6	High Severity Fire	Medium	Medium	Medium	Medium	Medium	Medium
7	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
8	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
9	Urban/Residential/Industrial Dev.	Low	Medium	Medium	Medium	Low	Medium
10	Fishing and Collecting	-	-	Low	Low	Medium	Low
11	Road-Stream Crossing Barriers	Low	Low	Medium	Low	Low	Low
12	Mining/Gravel Extraction	Low	Low	Medium	Low	Low	Low
13	Invasive Non-Native/Alien Spices	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are hatcheries and channelization/diking.

Hatcheries

Hatcheries pose a very high threat to all life stages of coho salmon in the Lower Trinity River sub-basin. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Channelization/Diking

Channelization and diking poses a low to very high threat to coho salmon. Although channelization and diking is not widespread in the population area, localized restrictions where roads parallel streams reduce floodplain connectivity and function. These areas are important for coho salmon rearing and growth. This reduces the amount of spawning and rearing habitat available to coho salmon by reducing habitat complexity and increasing water velocity, particularly during the winter months. For example, lower reaches of tributaries such as Supply and Mill Creeks in the Hoopa HSA have been straightened and diked, reducing the complexity and natural meandering tendency that produces complex habitat, diversity in foraging opportunities, and high quality rearing habitat. In cases where streams have been straightened and confined, swift currents and lack of habitat are expected to reduce survival of rearing juveniles, fry, and cause a reduction in egg-to-fry survival.

Climate Change

Climate change poses a high threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 3 °C in the summer and by 1 °C in the winter. Predictions indicate annual precipitation will have little change in the next century. However, snowpack in upper elevations of the Trinity River basin will decrease with changes in temperature (California Natural Resources Agency 2009). Climate change is expected to reduce the amount of snowpack in the Trinity Alps (Mote et al. 2005; Regonda et al. 2005; Mote 2006) and shift streamflow timing (i.e. peak streamflow) by 20–40 days earlier in many streams during the 21st century (Stewart et al. 2005). NMFS expects that climate change will cause the amount of coldwater thermal refugia habitat and the amount of available rearing area to decline over time. The increase in water temperatures is expected to reduce growth or cause negative growth of juvenile coho salmon in the summer months by elevating metabolism beyond daily ration (McCarthy et al. 2009). The vulnerability of the downstream Klamath estuary to sea level rise is low to moderate, and therefore does not pose a significant threat to estuarine rearing habitat downstream. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, with all populations in the ESU, adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Roads

Roads are a moderate to high threat for this population. About one third of the area with high potential to support juveniles occurs in areas with high or very high road densities. Data indicate road density is very high (>3 mi/sq. mi) in the Hoopa and Willow Creek HSAs where small tributary streams with high or medium IP stream reaches are accessible to coho salmon. Given the sedimentation problems observed in the watershed, unpaved roads contribute to landslide potential and chronic sedimentation. Approximately 45 percent of sedimentation in the Lower Trinity originates from roads, especially road-related landslides (USEPA 2001). Highway 299 significantly affects Willow Creek, as it runs along much of the creek's mainstem. At the landscape scale, correlative evidence suggests that roads are likely to influence the frequency, timing, and magnitude of disturbance to aquatic habitats (Gucinski et al. 2001). Roads can act as barriers to migration, lead to water temperature changes, and alter flow regimes (Gucinski et al. 2001). The Road Hazard Potential indicator used by the USFS represents the potential for altered hydrologic regime (changes in runoff response) and stream diversions associated with roads (USFS 2003b). USFS (2003) ranked the area from the New River to the South Fork Trinity River as having a high road hazard potential. The area from the South Fork Trinity River Trinity to Tish Tang a Tang Creek was given a moderate hazard rating. Given the large tracts of

U.S. Forest Service land in the watershed and the current trends toward decreasing timber harvest and increasing road decommissioning and storm-proofing on public land, the number of new roads and impacts from legacy roads is likely to decrease in the future. Road building for access to marijuana cultivation sites is common in many areas of the SONCC coho salmon recovery domain. Many of these roads are likely unpermitted and contribute excessive amounts of fine sediment to coho salmon streams.

Dams/Diversions

Dams and diversions are a low to high threat across life history stages. Numerous wells and diversions varying from single domestic spring boxes to community water systems occur throughout the watershed. The impact of these diversions is dependent on the amount and location of the withdrawal. The reduction in surface and subsurface flow in tributaries can reduce the amount of cool water refugia at their confluence with the Trinity River and impacts can increase during dry water years. The towns of Willow Creek, Burnt Ranch, Hawkins Bar and Hoopa obtain water from streams in the Lower Trinity River. The Campbell Creek diversion supplies much of the west-side Hoopa Valley. Additionally, there are vineyards and small farms that utilize water in the Lower Trinity River sub-basin, but their effect on stream flows has not been studied. Tributary accretions in the Lower Trinity River sub-basin, combined with relatively unconfined floodplain and valley characteristics, probably ameliorate some of the impacts of the Central Valley Project, such as lack of flushing flows, reduced winter habitat quantity and quality, and loss of large woody debris recruitment.

Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

High Severity Fire

High severity fire poses a moderate threat to the population due to current level of fire risk and the predicted future increase in fire risk that is expected as a result of climate change. Fires such as the Megram Fire in 1999 and the complex of fires in 2008 have swept through regions of the Lower Trinity River in the recent past. Fuel loads, climate, and vegetative characteristics in the sub-basin have resulted in a high to extreme fire risk (USFS 2003b). Human-related causes are the predominant type of fire starts within the area especially within the Trinity River corridor. Lightning fire starts, although relatively infrequent when compared to human related starts, are a significant cause of wildfires along the upper slopes and ridges of the watersheds (USFS 2003b). Present and future challenges to fire and fuels management include significant areas of private lands which may prohibit fire use and prescribed fire; prevention of unnatural fire starts; limited access due to topography or intermixed ownership; and vegetation mortality and fuel accumulation in the area affected by the Megram Fire (USFS 2003b).

Agricultural Practices

There are several agricultural operations in the Lower Trinity River sub-basin, consisting of several small farms, vineyards and small cattle grazing operations. Agriculture is a medium threat to coho salmon in the Lower Trinity River watershed given the current and expected level of agriculture in the area. However, in the area of Willow Creek, where much of the agriculture occurs, localized impacts of reduction in thermal refugia areas and excessive nutrient loads could cause substantial impacts. These impacts may increase in the future as the demand for high quality fruits and vegetables in the area grows. Recent algae blooms in the Lower Trinity River are thought to be associated with agricultural practices near the town of Willow Creek. Also of concern is marijuana cultivation and the associated water, and fertilizer and pesticide use.

Timber Harvest

Timber harvest poses a medium threat to the Lower Trinity River population. Much of the area is in public ownership (USFS) and has a substantial portion of federally-designated wilderness. Current and future timber harvesting on Forest Service land is small in scale and is conducted under strict guidelines designed to protect aquatic resources. Based on data from CalFire (2009) a total of 12,287 acres within the Upper and Lower Trinity and Lower Klamath River sub-basins have THPs that could potentially be harvested in the future (0.5 percent of total watershed area). The Hoopa Valley Tribe owns 15 percent of the Lower Trinity population area. Timber harvest is ongoing on these lands, and the extent of its environmental impacts are unknown but presumed to be low given Tribal timber management practices. One of the greatest impacts of all timber harvest in the Lower Trinity is the input of sediment. Timber harvest makes up approximately 5 percent of all sedimentation in the Lower Trinity (USEPA 2001).

Urban/Residential/Industrial Development

Rural population growth will continue to present a low to moderate threat to coho salmon in the Lower Trinity River. Human population in the Lower Trinity River drainage is tempered by the large amount of publicly-owned land as well as the steep surrounding terrain. The principal communities near the Lower Trinity River are Willow Creek, Hoopa, and Burnt Ranch. There are also a few smaller towns, like Del Loma and Big Flat, which may increase in population during this time. Areas likely to experience the greatest impacts from development include Willow Creek and mainstem river near major population areas. The demand for water in the drainage is expected to increase in the future. Development generally results in floodplain disconnection, removal of vegetation, increased sediment generation and delivery and introduction of exotic species. Subdivision of existing parcels will exacerbate this threat. Increased diversions associated with the population growth were addressed under Dams/Diversions above.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Road-stream Crossing Barriers

There are 25 road-stream crossing structures that are total barriers to juvenile and adult salmonid migration in the Lower Trinity River watershed (CalFish 2009). However, the majority of these barriers, including low priority barriers listed in the table below, are on streams inaccessible to coho salmon. There may be additional road-stream crossing barriers on private or Tribal land; however, their status and impacts are unknown at this time. The location of most known road crossings and diversions suggests that most of the watershed remains accessible to coho salmon and these barriers are not substantially restricting the availability of habitat. One exception to this is the barrier on private land on Sharber Creek, which blocks or reduces access to approximately 2 miles of high quality rearing and spawning habitat upstream.

Table 38-6. List of road-stream crossing barriers in IP habitat in the Lower Trinity River basin (CalFish 2009).

Priority	Stream Name	Road Name	County	Barrier Status*
High	Sharber Creek	Fountain Ranch Rd	Trinity	Total
Low	Hawkins Creek	Hawkins Bar Rd	Trinity	Total
Low	Hawkins Creek	Flame Tree Rd	Trinity	Total
Low	Boise Creek	Hwy 299	Trinity	Total
Low	Bell Creek- New River	Denny Rd	Trinity	Total
Low	Panther Creek #1-New River	Denny Rd	Trinity	Total
Low	Quinby Creek- New River	Denny Rd	Trinity	Total
Low	Hospital Creek	Hwy 96	Trinity	Total
Medium	Campbell Creek	Hwy 96	Trinity	Partial

Mining/Gravel Extraction

A number of gravel mining operations occur on private land and on Tribal land in the Lower Trinity River. A total of nine sites are mined on an annual, rotational or intermittent basis. NMFS issued a Biological Opinion on these operations in 2009 (NMFS 2009b) and a new consultation will likely be completed in 2015 after the permits expire. Suction dredge gold mining was common in the Trinity River until it was stopped by a court order in 2009. The California Department of Fish and Wildlife is currently prohibited by statute from issuing suction dredge permits. (Fish & G. Code, § 5653.1, subd. (b), making it unlawful to use any vacuum or suction dredge equipment in any river, stream, or lake in California (see http://www.dfg.ca.gov/suctiondredge)). This prohibition will remain in effect until CDFW completes a court-ordered environmental review of its permitting program and institutes any changes that are necessary to its former suction dredge permit regulations. Gravel and dredge mining primarily affect juvenile coho and their habitat and given the extent of mining in the area this is considered a moderate threat to this life stage but a low threat overall.

Invasive Non-Native/Alien Species

This threat is currently considered to be low for the population but has the potential to increase in the future if New Zealand mud snails or other exotic species cause trophic shifts. Brown trout, although in substantial numbers in the Upper Trinity River, do not inhabit the lower Trinity River in substantial numbers.

38.7 Recovery Strategy

Naturally-produced coho salmon in the Lower Trinity River are depressed in abundance relative to their historical numbers. An important consideration for recovery of the Lower Trinity River population is how naturally-produced coho salmon interact with the 500,000 coho salmon smolts released annually in the Trinity River, or the 11 million hatchery salmonids that are released into the Klamath Basin. Minimizing these interactions and the stresses that naturally-produced coho salmon experience from residing in a river system with millions of hatchery fish should be a high priority for coho salmon recovery. Protecting and enhancing thermal refugia and streams that are relatively intact and support coho salmon (e.g., Horse Linto and Sharber-Peckham creeks) should be the primary focus of recovery efforts. Protection and restoration of spawning and rearing habitat in potential coho salmon habitat (e.g., Mill Creek, Willow Creek) is also important over the long-term to ensure adequate spatial distribution and productivity. Creeks with the potential for floodplain connectivity include Supply, Mill, Tish Tang a Tang and Willow creeks. Recovery of the Lower Trinity River population of coho salmon will not be possible without significant restoration efforts to reconnect and expand the floodplain habitat in these and other creeks. Activities that reduce sediment delivery, improve water quantity and quality, and promote increased floodplain and channel structure should be the highest priority because these are the primary stresses for the population. Set back or removal of levees and dikes as well as instream habitat projects aimed at increasing floodplain size and connectivity need to be priorities. Sharber/Peckham Creek is considered the most productive coho salmon stream in the Lower Trinity River population (Collins 2012). Removal of the fish passage barrier on Sharber Creek is also a high priority for recovery given the area's importance to coho salmon production in the Lower Trinity.

Vital habitat in the Lower Trinity includes areas that provide thermal refugia for juveniles in the summer, areas of current production, and areas with relatively intact habitat features such as clean spawning gravel, functional floodplain and channel structure, and established riparian forest. Coldwater discharges from tributaries are a key component of the thermal regime of the mainstem of the Trinity River. Localized coldwater refugia are often found where tributary flows enter the Trinity River. Some streams such as Coon, Bremmer, China, Soctish, McDonald, and Kirkham creeks do not provide much anadromous habitat, but they are generally well-shaded and provide high quality thermal refugia and cool clean water for the Trinity River. Juvenile and adult salmonids hold in the Trinity River near the confluence of these tributaries or, when accessible, in the lower reaches of the tributaries during mid- to late summer. The stressful stream temperatures in July, August, and September within the mainstem underscore the importance of maintaining these cool water tributaries for these species. Horse Linto Creek provides an excellent refugia area for juvenile and adult coho salmon (Strange, J., pers. comm. 2008). Horse Linto Creek has cool, clean water that originates in the Trinity Alps Wilderness, moderating the high temperature of the Trinity River in the summer months at the confluence of the two waterways. At times, hundreds of juvenile salmonids congregate in this area. Other potential refugia areas are given in Table 38-7, although there are numerous unnamed seeps and smaller tributaries, all of which are important to survival of coho salmon in the summer months.

Table 38-7. Potential temperature refugia in the Lower Trinity River basin.

Watershed	Stream Name	Ownership
Hoopa	Horse Linto Creek	Public
Hoopa	Mill Creek	Tribal
Hoopa	Supply Creek	Tribal
Hoopa	Soctish Creek	Tribal
Hoopa	Coon Creek	Private
Hoopa	Tish Tang a Tang Creek	Tribal
Hoopa	Hostler Creek	Tribal
Burnt Ranch	Sharber Creek	Private
Willow Creek	Willow Creek	Private

Many watersheds within the Burnt Ranch and New River watersheds are likely properly functioning with regard to aquatic habitat and watershed conditions. These streams have a large portion of their watersheds in the Trinity Alps Wilderness and remain in a relatively undisturbed state. Given the low abundances of the population, all these areas in Table 38-7 are considered vital habitat for the population and should be prioritized for recovery. Horse Linto Creek is a designated Tier-1 Key watershed by the Northwest Forest Plan, meaning the creek is intended to serve as refugia for maintaining and recovering habitat for at-risk stocks of anadromous salmonids (USDA and USDI 1994).

An unnamed tributary (known to U.S. Forest Service biologists as Sharber-Peckham Creek) has one of the strongest populations of coho salmon in the Lower Trinity River (Cyr 2008, Boberg 2008). Between the area spanning the Hoopa Tribe reservation and the North Fork Trinity River, Sharber-Peckham Creek is the single greatest producer of coho salmon in the Lower Trinity River (Boberg 2008). The Sharber-Peckham Creek area is spring-fed, has side channel and overwintering habitat, and is low gradient (Cyr 2008, Boberg 2008). The coho salmon here are found mainly in an unnamed tributary that emanates from springs between Sharber and Quinby creeks near the Forest Service boundary (Cyr 2008, Boberg 2008). This unnamed tributary is perennial and during winter, part of Sharber Creek is diverted into this unnamed tributary (Cyr 2008, Boberg 2008). This diversion is part of an old mining activity. The rearing habitat is split between Forest Service and private property (Cyr 2008, Boberg 2008). The spawning habitat is on private property. Coho are probably using Sharber Creek, but it is overgrown with brush, is difficult to survey, and likely doesn’t have the spring support for rearing as does Sharber-Peckham Creek (Cyr 2008, Boberg 2008).

In order to recover the Lower Trinity River coho salmon population, special attention should be given to important tributaries discussed above. Creeks with the potential for floodplain connectivity include Supply, Mill, Tish Tang a Tang and Willow creeks. Recovery of the Lower Trinity River population of coho salmon will not be possible without significant restoration efforts to reconnect and expand the floodplain habitat in these and other creeks that are currently confined by diked and channelized reaches. A focus on habitat complexity and connecting off channel ponds, backwaters, and large woody debris should be an essential part of restoring these streams. Several crossing barriers in the population unit should also upgraded in order to maximize habitat area available to coho salmon. Many road systems throughout the population unit need to go through decommissioning or upgrading to limit sedimentation. Consumptive water use within the population unit should be quantified and monitored. Measures should be employed to reduce water consumption by farms, residences, and municipalities. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 38-8 on the following page lists the recovery actions for the Lower Trinity River population.

Table 38-8. Recovery action implementation schedule for the Lower Trinity River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LTR.3.1.38	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	Bull, Limb Camp, Soctish, Lower Mill, Hostler, Lower Tish Tang, Lower Cedar, Campbell Ridge, Hospital, Supply, Horse Range, Summit, E.F. Willow, Ruby, Bunchgrass, Mill (Burnt Ranch HSA), Trinity Village, Hawkins, Quinby, and Sharber creeks	2a
SONCC-LTR.3.1.38.1	*Identify and cease unauthorized water diversions*					
SONCC-LTR.3.1.58	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	Population wide	2b
SONCC-LTR.3.1.58.1	*Identify and cease unauthorized water diversions*					
SONCC-LTR.2.1.11	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	New River and Tish Tang a Tang, Hostler, Willow, Mill, Horse Linto, Sharber, Supply, Cedar, and Campbell creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-LTR.2.1.11.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LTR.2.1.11.2	*Place instream structures, guided by assessment results*					
SONCC-LTR.2.1.53	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-LTR.2.1.53.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-LTR.2.1.53.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LTR.2.2.7	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	New River and Tish Tang a Tang, Hostler, Willow, Mill, Horse Linto, Sharber, Supply, Cedar, and Campbell creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-LTR.2.2.7.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LTR.2.2.7.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-LTR.2.2.8	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	New River and Tish Tang a Tang, Hostler, Willow, Mill, Horse Linto, Sharber, Supply, Cedar, and Campbell creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-LTR.2.2.8.1	*Assess habitat to determine where potential exists to re-connect existing off-channel ponds, wetlands, and side channels. Map existing features so that connection can be maintained*					
SONCC-LTR.2.2.8.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-LTR.2.2.55	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-LTR.2.2.55.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-LTR.2.2.55.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-LTR.2.2.56	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-LTR.2.2.56.1	*Assess habitat to determine where potential exists to re-connect existing off-channel ponds, wetlands, and side channels. Map existing features so that connection can be maintained*					
SONCC-LTR.2.2.56.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LTR.2.2.12	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	New River and Tish Tang a Tang, Hostler, Willow, Mill, Sharber, Supply, and Campbell creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-LTR.2.2.12.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-LTR.2.2.12.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-LTR.2.2.54	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Population wide	2b
SONCC-LTR.2.2.54.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-LTR.2.2.54.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-LTR.17.2.37	Hatcheries	Yes	Reduce adverse hatchery impacts	Identify and reduce impacts of hatchery on SONCC coho salmon	Trinity River Hatchery	2a
SONCC-LTR.17.2.37.1	*Develop and implement Hatchery and Genetic Management Plan*					
SONCC-LTR.5.1.31	Passage	No	Improve access	Remove barrier	Hostler Creek	2a
SONCC-LTR.5.1.31.1	*Remove barrier from old water supply system*					
SONCC-LTR.5.1.36	Passage	No	Improve access	Remove Sharber-Peckham culvert	Sharber-Peckham Creek	2a
SONCC-LTR.5.1.36.1	*Remove culvert on Sharber-Peckham creek*					
SONCC-LTR.1.2.33	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary	2a
SONCC-LTR.1.2.33.1	*Implement recovery actions for Lower Klamath River population that address the target "Estuary", including the creation/restoration of off-channel rearing habitat throughout the lower Klamath River*					
SONCC-LTR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-LTR.3.1.4.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-LTR.3.1.4.2	*Implement water dedications to increase instream flows using the streamlined process*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-LTR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-LTR.3.1.5.1		*Establish a categorical exemption under CEQA for water leasing to increase instream flows*				
SONCC-LTR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-LTR.3.1.6.1		*Establish a comprehensive groundwater permit process*				
SONCC-LTR.3.1.28	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	Population wide	2b
SONCC-LTR.3.1.28.1		*Develop plan to manage stream flows and water temperature during periods of drought*				
SONCC-LTR.3.1.28.2		*Manage stream flows, guided by the plan*				
SONCC-LTR.3.1.29	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	Population wide	2b
SONCC-LTR.3.1.29.1		*Develop plan to protect coho salmon from effects of climate change*				
SONCC-LTR.3.1.29.2		*Implement plan based on findings*				
SONCC-LTR.5.1.32	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	2b
SONCC-LTR.5.1.32.1		*Evaluate and prioritize barriers for removal*				
SONCC-LTR.5.1.32.2		*Remove barriers, guided by the assessment*				
SONCC-LTR.5.1.59	Passage	No	Improve access	Remove barriers	Population wide	2d
SONCC-LTR.5.1.59.1		*Evaluate and prioritize barriers for removal*				
SONCC-LTR.5.1.59.2		*Remove barriers, guided by the assessment*				
SONCC-LTR.3.1.51	Hydrology	No	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	2b
SONCC-LTR.3.1.51.1		*Conduct study to determine instream flow needs of coho salmon at all life stages.*				
SONCC-LTR.3.1.51.2		*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*				
SONCC-LTR.3.1.51.3		*Implement coho salmon instream flow needs plan.*				
SONCC-LTR.26.1.50	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-LTR.26.1.50.1		*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LTR.14.2.14	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of invasive species	Population wide	2b
SONCC-LTR.14.2.14.1	*Adopt fishing regulations and educational programs that encourage and allow for the take of an unlimited number of brown trout*					
SONCC-LTR.14.2.14.2	*Euthanize all brown trout captured at CDFW weirs*					
SONCC-LTR.8.1.13	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Bull, Limb Camp, Soctish, Lower Mill, Hostler, Lower Tish Tang, Lower Cedar, Campbell Ridge, Hospital, Supply, Horse Range, Summit, E.F. Willow, Ruby, Bunchgrass, Mill (Burnt Ranch HSA), Trinity Village, Hawkins, Quinby, and Sharber creeks	2c
SONCC-LTR.8.1.13.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-LTR.8.1.13.2	*Decommission roads, guided by assessment*					
SONCC-LTR.8.1.13.3	*Upgrade roads, guided by assessment*					
SONCC-LTR.8.1.13.4	*Maintain roads, guided by assessment*					
SONCC-LTR.8.1.60	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	2d
SONCC-LTR.8.1.60.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-LTR.8.1.60.2	*Decommission roads, guided by assessment*					
SONCC-LTR.8.1.60.3	*Upgrade roads, guided by assessment*					
SONCC-LTR.8.1.60.4	*Maintain roads, guided by assessment*					
SONCC-LTR.3.1.2	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Hoopa, Willow Creek, Burnt Ranch, New River HSAs (particularly Willow, Sharber, Mill, and Supply creeks)	3a
SONCC-LTR.3.1.2.1	*Perform studies to determine if consumptive water use in specific areas is reducing the amount of rearing habitat or limiting the availability of cold water refugia*					
SONCC-LTR.3.1.2.2	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-LTR.3.1.39	Hydrology	Yes	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	3b
SONCC-LTR.3.1.39.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-LTR.3.1.39.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-LTR.3.1.39.3	*Implement plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LTR.2.2.9	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	New River and Tish Tang a Tang, Hostler, Willow, Mill, Horse Linto, Sharber, Supply, Cedar, and Campbell creeks, and all streams where coho salmon would benefit immediately	3c
SONCC-LTR.2.2.9.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-LTR.2.2.9.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-LTR.2.2.9.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-LTR.2.2.57	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	3d
SONCC-LTR.2.2.57.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-LTR.2.2.57.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-LTR.2.2.57.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					
SONCC-LTR.10.7.49	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-LTR.10.7.49.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LTR.10.7.49.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-LTR.10.7.52	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-LTR.10.7.52.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-LTR.10.7.52.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-LTR.2.2.10	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	3d
SONCC-LTR.2.2.10.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-LTR.16.1.16	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LTR.16.1.16.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-LTR.16.1.16.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-LTR.16.1.47	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-LTR.16.1.47.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-LTR.16.1.47.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-LTR.16.1.17	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LTR.16.1.17.1	*Determine actual fishing impacts*					
SONCC-LTR.16.1.17.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-LTR.16.1.48	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-LTR.16.1.48.1	*Determine actual fishing impacts*					
SONCC-LTR.16.1.48.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-LTR.16.2.18	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LTR.16.2.18.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-LTR.16.2.18.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-LTR.16.2.19	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-LTR.16.2.19.1	*Determine actual impacts of scientific collection*					
SONCC-LTR.16.2.19.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-LTR.10.2.30	Water Quality	No	Reduce pollutants	Educate stakeholders	Population wide	3d
SONCC-LTR.10.2.30.1	*Develop and implement an educational program that promotes Salmon Safe methods for agricultural operations and Integrated Pest Management for rural residents*					

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39. Upper Trinity River Population

Interior Trinity River Diversity Stratum

Core Population

Moderate Extinction Risk

Population likely above depensation threshold

5,800 Spawners Required for ESU Viability

1,183 mi^2 watershed (69% Federal ownership)

365 IP-km (227 IP-mi) (0% High)

Dominant Land Uses are Recreation and Timber Harvest

Key Limiting Stresses are ‘Altered Hydrologic Function’ and ‘Adverse Hatchery Related Effects’

Key Limiting Threats are ‘Dams/Diversions’ and ‘Hatcheries’

Highest Priority Recovery Actions

• Prioritize and provide incentives for use of CA Water Code Section 1707 • Establish a comprehensive groundwater permit process for instream purposes • Increase instream flows	• Identify and cease illegal water diversions • Provide artificial passage for fish at Lewiston and Trinity Dams • Streamline process for water leasing under CA Water Code Section 1707 for instream purposes

39.1 History of Habitat and Land Use

Land use activities in the Trinity include mining, timber harvesting, road construction, recreation and a limited degree of residential development in certain locations (U.S. Environmental Protection Agency (USEPA) 2001). The construction of Trinity and Lewiston dams in the early 1960s had and continues to have a major impact on the flow, function and use of the Trinity River (USEPA 2001). The dams block access to 109 miles of habitat. Problems facing the Upper Trinity River coho salmon population include degradation of spawning and rearing habitat, sparse spawning gravel recruitment, lack of deep pools, stressful late summer water temperatures, water diversions, channelization and confinement, irregular timing of flows, fragmentation of populations, genetic and ecological interactions with hatchery salmonids, migration barriers, water quality problems, and unscreened diversions.

Historically, the upper Trinity River functioned as a dynamic river reach that effectively created and maintained quality spawning and rearing habitat for anadromous fish. In 1957, construction began on the Trinity River Division (TRD) of U.S. Bureau of Reclamation's Central Valley Project (CVP), which transfers water from the Trinity River portion of the Klamath Basin to the Sacramento Basin. The division consists of a series of dams, lakes, power plants, a tunnel, and other related facilities. Lewiston Dam, part of the CVP, was constructed in 1963 near Lewiston, California, and is now the upper limit of anadromous fish migration on the Trinity River. At times, 90 percent of the Trinity River flow was diverted to the Sacramento Basin, contributing to the decline of Chinook salmon, coho salmon, and steelhead.

These water withdrawals, which extracted a large portion of Trinity River water, also caused severe degradation of fish habitat of the Trinity River (US Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT) 1999). Located at the base of Lewiston Dam, Trinity River Hatchery (TRH) began production of salmon and steelhead in 1958 to mitigate for the loss of 109 miles of anadromous fish habitat upstream of the dam (USFWS and HVT 1999).

Out of concern for declines in anadromous fish populations, Congress enacted the Trinity River Fish and Wildlife Restoration Act (P.L. 98-541) in 1984. This Act directed the Secretary of the Interior to take actions necessary to restore the fisheries resources of the Trinity River Basin. The Central Valley Project Improvement Act (CVPIA) of 1992 (P.L. 102-575, Title 34) legislated alterations in the operation of the CVP for the improvement of fish and wildlife habitat and resources.

In December 2000, Interior Secretary Bruce Babbitt signed the Record of Decision for the Trinity River Mainstem Fishery Restoration Environmental Impact Statement and Environmental Impact Report (EIS/EIR) (hereafter referred to as the ROD; USDOI 2000, USFWS et al. 2000). The ROD adopted the preferred alternative, a suite of actions that included a variable annual flow regime, mechanical channel rehabilitation, sediment management, watershed restoration, and adaptive management. The U.S. Bureau of Reclamation has been and continues to implement the flows described in the Trinity ROD.

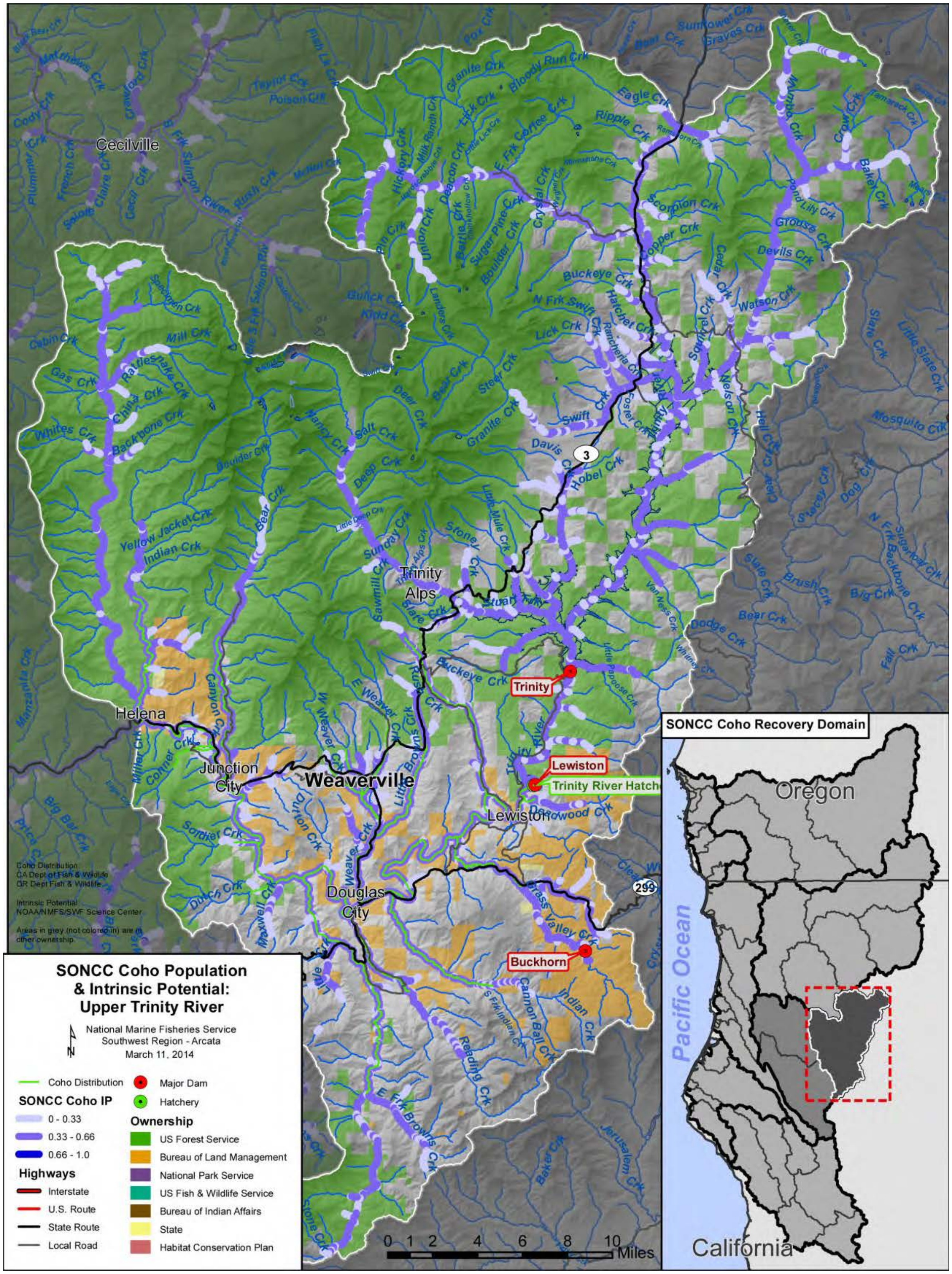

Figure 39-1. The geographic boundaries of the Upper Trinity River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Trinity River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The minimal static flow levels released after the completion of Lewiston Dam in 1964 until the early 2000s were insufficient to maintain the alluvial nature of the upper river and, as a consequence, much of the river channel between Lewiston and the North Fork Trinity River confluence became confined within a narrow channel bordered by a dense riparian corridor. Timber harvest practices, road construction, and floodplain development within the Trinity River watershed have also contributed significantly to habitat degradation (USFWS and HVT 1999). Clearcutting has promoted increased sediment loading; removal of streamside vegetation has increased water temperatures; and logjams at the mouths of tributary streams have blocked access for fish spawning and rearing (USFWS and HVT 1999). Timber harvest within the sub-basin has necessitated the construction of hundreds of miles of unpaved timber management roads and skid trails (USFWS and HVT 1999). The resulting increased yield of sediment in the mainstem Trinity River and its tributaries has reduced the biological productivity and fish carrying capacity of the river (USFWS and HVT 1999). Much of the mainstem Trinity River and virtually all its tributaries have been subjected to hydraulic mining activities (USFWS and HVT 1999; USEPA 2001).

Many tributaries downstream of Lewiston Dam presently or historically contained salmonid habitat, particularly in the lower gradient reaches. These tributaries, such as Rush, Reading, Brown's and Canyon creeks have been subjected to some form of habitat modification, including historic hydraulic mining, current water diversions, road construction and timber harvesting (USEPA 2001). De la Fuente et al. (2000) and USEPA (2001) determined that Weaver and Rush creeks are impaired based on an analysis of the stream and watershed condition indicators. The water quality and channel conditions in Weaver and Rush creeks were rated as functioning at risk and the watershed hazard condition was high (USEPA 2001). The same assessment determined that Brown's Creek was in a moderate condition (De la Fuente et al. 2000, USEPA 2001). In other words, physical and biological conditions suggest that aquatic and riparian systems' abilities to support dependent species and retain beneficial uses of water are at risk.

Numerous studies have identified and evaluated sediment sources and delivery from Grass Valley Creek, which is considered to be the primary producer of sand-size sediment to the mainstem Trinity River (USEPA 2001). As a result, the Trinity River Restoration Program (TRRP) supported the development of an extensive erosion control program. Based on a survey initiated by Pacific Watershed Associates (PWA 2000, USEPA 2001) in 1992, stream channel conditions in Grass Valley Creek appeared to be improving (pools were more common, larger and deeper; substrate was more coarse; and channel complexity increased). Because Grass Valley Creek is a transport-dominated system (PWA 2000, USEPA 2001), most of the sediment is transported to the mainstem Trinity River, aside from what is trapped in the sediment retention basins. Even though sediment production has decreased, the creek continues to discharge sand-size sediment in quantities that are affecting the mainstem (USEPA 2001).

The North Fork Trinity, East Fork North Fork Trinity and Stuart Fork Trinity rivers and Coffee Creek watersheds are presently considered "properly functioning" with regard to aquatic habitat and watershed conditions (De la Fuente et al. 2000, USEPA 2001). These streams have a large portion of their watersheds in the Trinity Alps Wilderness and remain in a relatively undisturbed state. Of these, the North Fork Trinity and East Fork North Fork Trinity rivers remain accessible to coho salmon; Lewiston and Trinity dams are complete fish passage barriers. However, the accessible streams are higher gradient rivers that currently support populations of anadromous steelhead and minimal coho salmon production (Everest 2008), and may not have historically supported robust populations of coho salmon.

39.2 Historic Fish Distribution and Abundance

Approximately 5,000 wild adult coho salmon migrated past the town of Lewiston annually prior to the construction of the Trinity River Division (CDFG and USFWS 1956; USFWS and HVT 1999). Accurate estimates of coho salmon production below Lewiston prior to dam construction are not readily available. Although limited high quality coho salmon habitat exists throughout the Upper Trinity River recovery area (e.g., Weaver Creek), the IP model shows the greatest amount of high IP (IP > 0.66) habitat is upstream of Trinity Dam. Coho salmon are thought to have inhabited many of the smaller creeks and tributaries to the Trinity River in the area upstream of where Trinity Dam now lies (USFWS and HVT 1999). In the late 1940s and early 1950s, juvenile coho salmon were rescued from an irrigation diversion near Ramshorn Creek, which enters the Trinity River approximately 42 miles upstream from Lewiston (CDFG and USFWS 1956, USFWS and HVT 1999). An estimated 90 percent of coho salmon spawning between Willow Creek and Lewiston Dam are of hatchery origin (USFWS and HVT 1999). The estimated escapement of naturally produced coho salmon adults and jacks upstream of the Willow Creek weir from 1997 to 2010 ranged from 539 to 9,055, with an average of 2,028. Unknown is the proportion of these coho salmon that spawn in the lower Trinity River, as many are likely migrating to the Upper Trinity River. Salmon spawner surveys in 1995 indicate substantial usage in many of the tributaries from the North Fork upstream to Deadwood Creek. Surveys in the 1980s (USFS 1988) revealed coho salmon in some tributaries. The USFS (2000d) reported that coho salmon are rarely found in the New River.

From this information, NMFS infers that coho salmon once were well distributed throughout the Upper Trinity River sub-basin with the highest concentrations in lower gradient tributaries. Table 39-1 lists those tributaries with high IP values. The tributary below Lewiston Dam with the most incidences of high IP reaches is Weaver Creek and its tributaries (Figure 39-1). The close proximity of Deadwood and Rush creeks to Trinity River Hatchery has led to a high degree of straying by hatchery steelhead into these streams (Yurok Tribe, unpublished data). If coho also stray at high rates into these streams, this will limit the effectiveness of recovery efforts.

Table 39-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006). Access to most of the streams in the Upper Trinity River subarea is blocked by Lewiston Dam.

Subarea[1]	Stream Name	Subarea[1]	Stream Name
Upper Trinity River	Hobel Creek	**Douglas City**	Deadwood Creek
	Mule Creek		Rush Creek
	Stewart Fork Trinity River		Browns Creek
	Trinity River		Little Browns Creek
	East Fork Trinity River		Indian Creek
Weaver Creek	Weaver Creek and tributaries		Grass Valley Creek
Helena	Trinity River		Little Grass Valley Creek

[1]Subarea refers to hydrologic subarea (HSA) in the CALWATER classification system.

39.3 Status of Upper Trinity River Coho Salmon

Spatial Structure and Diversity

Coho salmon are found in only a fraction of their historic habitat areas in the upper Trinity River sub-basin, due mainly to loss of habitat resulting from the erection of Lewiston and Trinity dams. Thirty-six percent of the historic IP-km has been lost (Williams et al. 2008). The presence of coho salmon has been confirmed in a variety of streams in the Upper Trinity River sub-basin such as Grass Valley Creek, Sidney Gulch, Deadwood Creek, Rush Creek, Weaver Creek, East Weaver Creek, West Weaver Creek, Little Browns Creek, Sidney Gulch, Dutch Creek, Indian Creek, Canadian Creek, Soldier Creek, Canyon Creek, North Fork Trinity River, East Fork North Fork Trinity River, Manzanita Creek, Big French Creek, New River and East Fork New River (Hill 2008, Everest 2008). Coho salmon also likely occur in Reading and Browns creeks. However, most of these streams do not have a substantial amount of high IP (IP > 0.66) when compared to the Trinity River upstream of Lewiston Dam. In the mainstem Trinity River, rearing juvenile coho salmon occur in highest densities within the first 12 km downstream of Lewiston Dam (CDFG 2008c). None were found downstream of river kilometer 163 (CDFG 2008c), which is approximately 5 km upstream of Steel Bridge. CDFG (2008c) documented the majority of observations of juvenile coho salmon were at water temperatures of 48.2 to 53 °F. The highest water temperature observed for a juvenile coho salmon was 60.8 °F. Within the mainstem Trinity River, the distribution of coho salmon can likely be explained, at least in part, by water temperature.

Hatchery influences are substantial in the Upper Trinity River sub-basin. Each year, Trinity River Hatchery releases approximately 500,000 coho salmon smolts, 800,000 steelhead, and 4.3 million Chinook salmon. Currently, hatchery fish dominate coho salmon returns to the Trinity River (USFWS and HVT 1999). From 2003 to 2005, over 75 percent of adults returning to the Trinity River, as estimated at Willow Creek, were of hatchery origin (Table 39-2). A population of native fish is at least at moderate risk of extinction if the fraction of naturally spawning hatchery fish exceeds five percent (Williams et al. 2008). Hatchery fish may negatively affect wild fish or mixed populations of wild and hatchery fish through genetic interactions (Reisenbichler and Rubin 1999; Mclean et al. 2003; Araki et al. 2007). Straying of hatchery fish into tributaries of the Trinity presents a particular threat to the population's diversity, as the hatchery fish may reduce the reproductive success of the overall population (Mclean et al. 2003).

Although not well documented, there appears to be some diversity of life history strategies in the Upper Trinity River. Data on run timing and outmigration indicate that there is some variation in the life history characteristics of the population. Coho salmon enter the Trinity River between September and November and spawning in the river continues into January (CDFG 2009b). Also, both young-of-the-year and yearling coho salmon are captured at downstream migrant traps located in the Trinity River near Willow Creek (Pinnix et al. 2007). Dispersing of age 0+ coho occurs over several months between March and September as does outmigration of age 1+ (CDFG 2009b). Outmigration of subyearling coho may be an expression of a life history type that rears in non-natal streams prior to emigrating to the ocean. Some of the dispersion of subyearling coho salmon is likely due to competition for rearing habitat and resources.

Population Size and Productivity

NMFS made adjustments to the low risk spawner threshold number proposed by Williams et al. (2008) for the Upper Trinity River population unit. The amount of available IP habitat was determined to be 365 IP-km and a spawner density of 20 fish/IP-km. This resulted in a low risk extinction threshold of 5,800 adult coho salmon spawners.

Population estimates for individual tributaries are not available. Limited presence/absence data are available from the U.S. Forest Service's Weaverville Office. Given land use changes and activities such as timber harvest and mining, coho salmon abundance in smaller tributaries like Weaver and Reading creeks is probably much less than it was historically. Although there may be robust numbers of spawners occasionally in some years, the overall number of naturally produced coho salmon in the Upper Trinity River watershed is low compared to historic conditions, and hatchery fish dominate the run (Table 39-2). In some years, it appears that naturally produced spawners returned to the Trinity River in sufficient numbers to meet the low risk extinction threshold specified above. However, a small proportion of the coho salmon that are judged to be of natural origin are non-clipped hatchery fish (generally less than 1%).

Table 39-2. Estimated run sizes of adult and jack coho salmon based on observations at Willow Creek weir

CDFW (2013c). Hatchery-origin fish were identified by a mark (right maxillary clip).

Year	Number Unmarked	Number Marked	% Hatchery	% Natural
1997	651	7,284	92%	8%
1998	1,132	11,348	90%	10%
1999	586	4,959	89%	11%
2000	539	14,993	97%	3%
2001	3,373	28,768	90%	10%
2002	596	15,420	96%	4%
2003	4,093	24,059	86%	14%
2004	9,055	29,827	77%	23%
2005	2,740	28,679	92%	8%
2006	1,624	18,454	92%	8%
2007	1,199	4,551	79%	21%
2008	1,312	8,671	87%	13%
2009	642	5,753	90%	10%
2010	861	7,085	89%	11%

Table 39-3 shows the number of spawners, and the estimated number of recruits, in the Upper Trinity River. Counts occur at Willow Creek, but most of the fish are thought to spawn in the Upper Trinity River. These data indicate that the amount of recruits produced per female spawner in the Upper Trinity River is substantially less than two, meaning the population is failing to replace itself. Chilcote et al. (2010) found that the recruits produced per coho salmon spawner decreases as the mean proportion of hatchery fish in the spawning population increases, a finding similar to that of Buhle et al. (2009). This is particularly important given that a high percentage (~80 percent) of coho salmon spawners in the upper Trinity River is of hatchery origin. The population growth rate for the Upper Trinity is therefore negative, and the population relies on the heavy influence of hatchery fish to maintain current abundance levels. Due to the low natural population abundance and a negative population growth rate, the Upper Trinity River population does not meet the minimum standards of a viable salmonid population.

Table 39-3. Estimated number of adult recruits per female spawner in the Upper Trinity River. Adult return data from CDFG (2013c).

Run Year	Marked and Unmarked natural adult female spawners (S)	*Estimated adult unmarked recruits (R) (year+3)	R/S	LN (R/S)
1997	529	390	0.74	-0.31
1998	2,933	3,424	1.17	0.15
1999	839	538	0.64	-0.44
2000	3,164	4,389	1.39	0.33
2001	8,666	10,021	1.16	0.15
2002	3,356	2,903	0.86	-0.15
2003	7,235	1,736	0.24	-1.43
2004	11,356	1,261	0.11	-2.20
2005	5,630	1,361	0.24	-1.42
2006	4,964	573	0.12	-2.16
2007	1,222	1,010	0.83	-0.19
2008	1,709			
2009	1,084			
2010	1,286			

*Harvest by the Yurok and Hoopa tribes as well as incidental mortality in ocean Chinook salmon fisheries added into recruits.

Extinction Risk

The Upper Trinity River population is at moderate risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one, but the ratio is less than the minimum required spawner density (both criteria described in Williams et al. 2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Upper Trinity River population is a core, Functionally Independent population within the Interior Trinity River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Upper Trinity River core population should have at least 5,800 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Upper Trinity population may serve as a source of spawner strays for nearby populations.

39.4 Plans and Assessments

Hoopa Valley Tribal Fisheries and Hoopa Valley Environmental Program

http://www.hoopa-nsn.gov

Monitoring activities include fish tagging, weir operations, juvenile outmigrant trapping, screw trap monitoring, creel census, and net harvest monitoring. Much of the data gathered through these monitoring activities is used to estimate future anadromous runs in order to determine allocation between the ocean fishery, Tribal fisheries, and the sports fishery. Along with the monitoring and reporting, Hoopa Tribal Fisheries takes several measures to ensure optimal spawning habitat and rearing grounds in the seven major tributaries located within the Hoopa Reservation. Through habitat typing, channel morphology characterization, and sediment loading analysis, Tribal Fisheries is able to assess local stream habitat and address shortcomings through restoration activities. Hoopa Tribal Environmental Protection Agency offers a multitude of services to the Hoopa Valley Tribe in environmental protection, public outreach and education, air quality monitoring, water quality planning, solid waste management, hazardous waste protection, and environmental compliance.

Yurok Tribal Fisheries Program and Yurok Tribal Environmental Program

http://www.yuroktribe.org/departments/fisheries/
http://www.yuroktribe.org/departments/ytep/

The Yurok Tribe has several reports and assessments available for the Trinity River basin on salmon populations, salmon habitat, and water quality. The Yurok Tribe is an active participant in the Trinity River Restoration Program, performing fisheries research, salmon population monitoring such as redd and carcass surveys and habitat restoration. The Yurok Tribe also monitors and reports on water quality in the Trinity River.

U.S. Forest Service- Shasta-Trinity and Six Rivers National Forests

http://www.fs.fed.us/r5/shastatrinity/

The U.S. Forest Service (USFS) has a variety reports and assessments available for the Trinity Basin. USFS has programs benefitting salmon and steelhead habitat in the Trinity River basin. USFS maintains an active road decommissioning and sediment abatement program that aims to minimize fine sediment delivery to streams. Fuels reductions programs implemented by the USFS are activities that help reduce the risk of catastrophic forest fires and subsequent erosion. The USFS is an active participant in the Trinity River Restoration Program and performs salmon and steelhead monitoring, restoration, and habitat assessments.

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The specific restorative recommendations developed by the Coho Recovery Team and CDFG for the Upper Trinity River have been considered and incorporated into the table of population-specific recovery actions.

North Coast Regional Water Quality Control Board (NCRWQCB)
www.waterboards.ca.gov/northcoast

The NCRWQCB has identified the Trinity River as impaired under the Clean Water Act (CWA) Section 303(d) due to elevated sedimentation. The NCRWQCB is required to develop the measures which will result in implementation of the TMDLs in accordance with the requirements of 40 CFR 130.6. The North Coast Basin Plan identifies both numeric and narrative water quality objectives for the Trinity River.

Five Counties Salmonid Conservation Program

http://www.5counties.org/

The Five Counties Salmonid Conservation Program (5C) has reports and plans available on sediment reduction, barriers to migration and fish habitat in the Trinity River basin. The 5C promotes improved understanding and support for road-related conservation and restoration efforts by providing roads, salmon, and water quality workshops, fish passage engineering training, and planning and policy meetings for County and other agency staff. Among other goals, the 5C seeks to:

- Improve County policies and road maintenance practices with a strong emphasis on training.
- Identify potential restoration opportunities through inventories of fish passage barriers and potential sediment sources on County maintained roads.
- Increase the amount of salmonid habitat by replacing stream crossings that are barriers to migration with structures that provide for passage.
- Improve water quality by treating identified sources of road related sediment.

Trinity River Restoration Program (TRRP)

The Trinity River Restoration Program focuses substantial resources on restoration of the upper Trinity River, particularly the mainstem Trinity River between Lewiston Dam and the North Fork Trinity River. The TRRP also has an active watershed program that performs restoration work in tributaries. A variety of plans and assessments are available from www.trrp.net.

39.5 Stresses

Table 39-4. Severity of stresses affecting each life stage of coho salmon in the Upper Trinity River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Adverse Hatchery-Related Effects[1]	Very High	Very High	Very[1] High	Very High	Very High	Very High
2	Altered Hydrologic Function[1]	Low	Very High	Very[1] High	High	Medium	Very High
3	Barriers	Low	High	High	High	Very High	Very High
4	Lack of Floodplain and Channel Structure	Medium	High	High	Low	High	High
5	Increased Disease/Predation/Competition	Low	High	High	Medium	Low	High
6	Impaired Water Quality	Low	Medium	High	Low	Medium	Medium
7	Impaired Estuary/Mainstem Function	Low	Low	Medium	Medium	Medium	Medium
8	Degraded Riparian Forest Conditions	Low	Medium	Medium	Medium	Low	Medium
9	Altered Sediment Supply	Medium	Medium	Medium	Low	Medium	Medium
10	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low

[1]Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

Several factors limit the viability of the Upper Trinity population. The most dominant of these factors stem from the effects of the large-scale dams, reservoirs, and diversion on hydrologic function. The juvenile life stage is the most limited and quality summer and winter rearing habitat is lacking for the population. In addition, the negative impacts of Trinity River Hatchery, altered floodplain and channel structure, and the lack of habitat access upstream of Lewiston Dam create substantial stresses to the Upper Trinity River coho salmon population. Heating of water in Lewiston Reservoir during the summer months contributes to limiting the amount of habitat available to rearing juvenile coho salmon in the mainstem Trinity River.

Trinity River Hatchery plays a role in limiting the productivity (recruits produced per spawner) of the Upper Trinity River population through negative genetic and ecological interactions. Competition with hatchery fish released from Trinity River Hatchery limits rearing and spawning capacity in the Upper Trinity River. Competition of hatchery fish with naturally produced fish almost always has the potential to displace wild fish from portions of their habitat (Flagg et al. 2000). Both intra- and inter-specific redd superimposition on the spawning grounds can substantially affect salmon reproductive success (Essington et al. 2000) and the spawning areas downstream of Lewiston Dam are likely near carrying capacity. Another negative effect of the

Trinity River Hatchery is predation on wild coho salmon fry by hatchery-reared salmonids (Naman 2008). Cumulatively and in concert with other habitat-related stresses, adverse hatchery-related impacts are a key stress for the population.

Altered hydrologic function has a major impact on the productivity of this population. Rearing opportunities and capacity are low due to a reduced and dampened flow regime. Loss of flow variability and reduced rearing habitat during the fall and winter months as a result of water storage and regulation is expected to reduce the ability of the habitat in the Upper Trinity River to support winter rearing of juvenile coho salmon. Water withdrawals from important tributaries like Weaver and Rush creeks reduce baseflows in the summer and fall months, contributing to low flows and high water temperatures. Variability of the natural flow regime is inherently critical to ecosystem function and native biodiversity (Poff et al. 1997, Puckridge et al. 1998, Bunn and Arthington 2002, Beechie et al. 2006). In the summer, flow regimes and the lack of LWD and off-channel habitat leads to poor hydrologic function, disconnection and diminishment of thermal refugia and off-channel habitat, and poor water quality in tributaries and the mainstem during dry years. Floodplain disconnection and poor riparian function as a result of reduced flow and variability is being addressed through restoration efforts but will continue to be a limiting factor for the population.

In order to improve the viability of this population it will be imperative to address the issues related to the hatchery and to improve habitat conditions for juveniles and adults. Addressing other stresses and threats and improving habitat for all life stages and life history strategies will also be an important component of recovery for this population.

Adverse Hatchery-Related Effects

The Trinity River Hatchery was built to mitigate for the impacts of the dams on the population, but the negative consequences of genetic and ecological interactions under current management goals is likely to be suppressing the productivity of the population (e.g., Chilcote et al. 2010). The Trinity River Hatchery currently releases 4.3 million juvenile and yearling Chinook salmon, 500,000 yearling coho salmon, and 800,000 yearling steelhead. Hatchery-origin coho salmon make up most of the spawning run to the Trinity River each year. On average, only three percent of in-river spawners were not reared in a hatchery (USFWS and HVT 1999). Between 1997 and 2002, hatchery fish constituted between 85 percent and 97 percent of the fish (adults plus jacks) returning to the Willow Creek weir in the Lower Trinity River (CDFG 2009b). Most of these fish likely migrate upstream and interact with naturally-produced coho salmon in the Upper Trinity River.

Recent studies have shown that steelhead released from TRH suppress wild salmon populations via predation (Naman 2008). Currently, spawners of natural origin are making very little genetic contribution, and the amount of natural influence in the hatchery population is extremely low (median proportion of natural influence = 0.045). It is important to note that TRH protects the Upper Trinity River coho salmon population from catastrophic losses, and could take on a very important role in the protection and recovery of this population. Available data indicate that substantial straying of TRH fish occurs into tributaries and mainstem habitat throughout the Upper Trinity (Yurok Tribal Fisheries Program unpublished data), negatively affecting the genetic and life history diversity of the population via outbreeding depression and competition.

Adverse hatchery-related effects pose a very high risk to all life stages, because more than thirty percent of adults are of hatchery origin (Appendix B) and there is significant potential for ecological interactions.

Altered Hydrologic Function

Hydrologic function is a high stress for coho salmon in the Upper Trinity River. Roughly half of the mainstem Trinity River flow is diverted to the Sacramento River Valley and remaining flows and variability are reduced downstream of the Trinity dam. Fry, juvenile, and smolt life stages are all negatively affected by changes in flow. Available fry and juvenile rearing habitat is reduced during certain times of the year, particularly winter months, by reduced flow volumes. Habitat complexity and food supply are likely limited by reduced flow variability. The reduction of scouring flows in the mainstem has contributed to habitat simplification. In the mainstem Trinity River, regulated flows from Lewiston Dam create static flow releases of 300 CFS for the fall and winter months. Arthington et al. (2004) stated that simplistic, static, environmental flow rules are misguided and will ultimately contribute to further degradation of river ecosystems. Flow variability is an important component of river ecosystems which can promote the overall health and vitality of both rivers and the aquatic organisms that inhabit them (Poff et al. 1997, Puckridge et al. 1998, Bunn and Arthington 2002, Arthington et al. 2004). Variable flows trigger longitudinal dispersal of migratory aquatic organisms and other large events allow access to otherwise disconnected floodplain habitats (Bunn and Arthington 2002), which can increase the growth and survival of juvenile salmon (Jeffres et al. 2008). Lack of flow variability in the mainstem Trinity River in the winter months is likely limiting the growth and survival of rearing coho salmon. In some streams such as Weaver and Rush creeks where water is utilized for residential purposes, summer and fall baseflows are likely impacted from the water withdrawals.

Seaward migration of juveniles is often triggered by the incremental increases in flow (Tripp and McCart 1983, Annear et al. 2002). Elevated flows occur only once during the year and there is little flow variability to trigger or aid in fish migration in the upper reaches of the Trinity River until tributary accretion begins to add flow variability. The current physical and hydrologic conditions in the Upper Trinity River reach likely impair adult migration. Upstream migration is often triggered by flow variability in the fall; however in the Upper Trinity River flows are stable throughout the summer and fall (Groot and Margolis 1991). Winter flows are particularly low in the mainstem Trinity River and overwintering habitat for juvenile coho salmon is limited. Channel and floodplain-forming flows are absent from the system, leaving simplified rearing habitat. Additional impacts on water quality likely result from flow alteration.

Barriers

The stress table shows that barriers cause a high stress across all life stages except the egg life stage. Lewiston and Trinity dam block a majority of the high IP habitat in the sub-basin. The loss of this habitat has led to a restricted spatial structure and the reliance on a limiting amount of spawning and rearing habitat downstream. The lack of available spawning and rearing habitat downstream of Lewiston Dam is a limiting stress for the population and limits the productivity of the population. Additionally, many road-related barriers preclude access to potential coho salmon habitat. The California Fish Passage Assessment Database (CalFish 2009) lists 17 sites on county roads where barriers exist in the Upper Trinity sub-basin. Additional barriers on private land may also exist. In certain instances, these road-related barriers block access to stream reaches where the potential for coho salmon habitat and refugia exists. At least seven total barriers block habitat on the North Fork Trinity, Canyon Creek, Browns Creek, Reading Creek, Weaver Creek, and Middle Weaver Creek (CalFish 2009). Other high priority total barriers exist on tributaries with the potential for providing coho salmon habitat. In addition, four partial barriers exist within the range of coho salmon on Weaver Creek, Browns Creek, and Canyon Creek. Thermal barriers are also a potential stress for the population. Because thermal refugia appear to be decreasing due to climate change and other factors, migratory habitat in some tributaries may be limited and thermal barriers may prevent movement between habitats.

Lack of Floodplain and Channel Structure

Floodplain and channel structure is a high stress for the population and particularly affects fry, juveniles, and adults. Poor floodplain and channel structure is attributed to changes in the hydrology of the sub-basin. Changes in sediment supply, storage, and transport, in combination with altered mainstem flow following construction of the TRD, altered the channel geomorphology. Riffle-pool sequences associated with point bars were replaced with monotypic runs after dam construction, which reduced the quantity, quality, and diversity of aquatic habitats. Important habitat types affected by the change in floodplain and channel structure include pools that provide cover from predators and refugia for juveniles and adults; gravel riffles for spawning; open gravel/cobble bars that create shallow, low-velocity zones important for emerging fry; and slack water habitats for rearing juveniles (USFWS and HVT 1999). The Trinity River does not approach a pre-dam channel geomorphology until the confluence with the North Fork (USFWS and HVT 1999). Mainstem reaches are generally disconnected from floodplain habitat and many tributaries experience simplified instream structure and habitat diversity. Pool depths and frequencies are thought to be poor to fair throughout the population area, but data are limited. Data on instream LWD are also limited; however, given the timber harvesting that has occurred in the watershed and the changes in riparian vegetation characteristics, LWD is likely limiting the development of complex stream habitat throughout much of the population area.

There is a direct link between the filling of pools and thermal impacts on water quality. The deepest pools prior to the TRD, were as much as 7 degrees Fahrenheit cooler than the shallow pools and provided important thermal refugia for juveniles (Moffett and Smith 1950). The change in channel geomorphology has eliminated much of the temperature stratification in pools, particularly in the summer and early fall months. In addition, changes in channel structure and substrate quality have reduced benthic macroinvertebrate production. Production of benthic macroinvertebrates takes place on the submerged portions of a streambed (Frederiksen, Kamine, and Associates 1980). Substrate quality and particle size within the streambed can greatly influence the production of benthic macroinvertebrates. Boles (1980) documented an increase in productivity, biomass, and diversity of benthic organisms following the “flushing” of granitic sand from a riffle in the Junction City reach of the Trinity River. However, the EIS noted that based on investigations of macroinvertebrate production in the Trinity compared with other basins, benthic food production does not appear to be a major factor in limiting fish production in the mainstem Trinity at the current time (USFWS and HVT 1999, App. B-13)

Increased Disease/Predation/Competition

Approximately 30 percent of hatchery yearling smolts perished within or did not migrate further than 10 km from the TRH (Beeman et al. 2009). Disease and predation are possible explanations for this smolt mortality (Beeman et al. 2009), as are tagging and handling and naivety of hatchery coho salmon. Coho salmon smolts may be exposed to diseases like Ceratomyxosis once they reach the Klamath River. Since the zones with the highest rates of infection in the Klamath Basin are in the Klamath River upstream of the Trinity and Klamath rivers confluence (Bartholomew 2008), the level of stress for Trinity smolts is likely lower than for the populations located further upstream in the Klamath Basin. Bacterial kidney disease infection rates at Trinity River Hatchery may be substantial.

Competition and predation by non-native brown trout and hatchery-released salmon and steelhead are also a source of stress and mortality for coho salmon fry, juvenile, and smolts. Coho salmon eggs are consumed by juvenile hatchery steelhead and returning adult hatchery steelhead (Naman 2008). Naman (2008) also found that residualized steelhead can consume large quantities of coho salmon fry.

Impaired Water Quality

Water quality in the Upper Trinity is primarily impacted on a localized basis by fine sediment loading and temperature impairments. No coho salmon were found downstream of river kilometer 163 (CDFG 2008c), which is approximately 5 km upstream of Steel Bridge. CDFG (2008c) documented the majority of observations of juvenile coho salmon were at water temperatures of 48.2 to 53 °F. The highest water temperature observed for a juvenile coho salmon was 60.8 °F. It is likely that within the mainstem Trinity River, the distribution of coho salmon can be explained, at least in part, by water temperature. Although mainstem water temperatures during the summer months in the Upper Trinity River are generally cool downstream to roughly Douglas City, temperatures can be problematic during years when storage in Trinity Reservoir is low, tributary runoff is low, or air temperatures are high for long durations. Violations of NCRWQCB temperature criteria in the mainstem Trinity River occur often enough to warrant concern. Downstream of Douglas City, daily average mainstem water temperatures during the summer months are higher than the published range for juvenile coho salmon rearing. In some smaller tributary streams, water temperatures can increase to levels stressful for rearing coho salmon in the summer months. Juvenile coho are unlikely to have a sufficient amount of thermal refugia during the summer due to competition and the effects of climate change. Stress from water quality ranges from low to high across life history stages.

Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the Upper Trinity River migrate to and from the ocean through the mainstem Trinity, the mainstem Klamath River and the Klamath River estuary. The Klamath River estuary plays an important role in providing holding habitat and foraging and refuge opportunities for outmigrating juvenile coho salmon from the Upper Trinity River, especially since there is a significant number of subyearling coho salmon that leave the Upper Trinity and presumably rear downstream in non-natal habitat. Although the estuary is short and small compared to the large size of the watershed, it does provide the opportunity for juvenile and smolt growth and refugia prior to entering the ocean. The estuary, although relatively intact, suffers from poor water quality, elevated sedimentation and accretion, loss of wetland habitat, and disconnection from tributary streams and the floodplain. Levees along the Lower Klamath and development on the floodplain have led to the loss and degradation of habitat in the estuary. Mainstem conditions contribute to this stress because of the issues with water quality, sedimentation and accretion, and degraded habitat in the Lower Trinity and the Lower Klamath River. Juveniles, smolts, and adults transitioning through mainstem habitat are stressed by the poor water quality, degraded habitat, and increased rates of disease in these migratory habitats.

Degraded Riparian Forest Conditions

Riparian forest conditions present medium to low stresses across all life history stages. Where data exist, the assessment of streamside canopy cover ranges from fair to very good throughout the watershed. The Weaver and Helena areas appear to have fair riparian conditions, while portions of the Helena and Upper Trinity areas have very good riparian conditions. The dynamics of the Trinity River riparian forest have changed dramatically as a result of flow regulation. Whereas natural flow regimes would historically have naturally produced diverse riparian forests with the ability to provide large wood and in-stream structure for coho salmon, the current flow regime favors simplified riparian forests with little habitat diversity. In addition, the removal of riparian canopy cover in some tributaries has resulted in increased solar radiation on the stream, and consequent elevated water temperatures.

Altered Sediment Supply

Altered sediment supply presents Low to Medium stress across all life history stages. The mainstem has an oversupply of sediments because of hydraulic mining, dredging, timber harvest, and road building. Specifically, the substrates that coho salmon require for particular life stages are limited. Below Lewiston Dam, the already coarse channel bed coarsened even more without significant channel down-cutting (USFWS and HVT 1999). Larger particles that were commonly transported during pre-dam floods were no longer mobilized, such that only finer gravels and sands were transported downstream (USFWS and HVT 1999). This caused the riverbed to become armored, which inhibited redd construction. Despite flow re-regulation to produce a scaled-down natural hydrograph, anthropogenic boundary controls have severely altered processes associated with geomorphic self-sustainability and instream habitat availability (Brown and Pasternack 2008). Inadequate spawning gravel has likely led to density dependent reductions in salmon populations and effects to the wild genome that have progressed through time (Ligon et al. 1995). Spawning gravel augmentation under the TRRP takes place below TRH and at the cableway site near Lewiston. This augmentation has helped supplement some of the loss of spawning gravels in the mainstem river and will likely continue to do so in the future.

Fine sediment input was high in the Upper Trinity River and consequently the Trinity River watershed in Trinity County was listed as sediment impaired in California's 1995 CWA Section 303(d) list, adopted by the State of California North Coast Regional Water Quality Control Board (NCRWQCB). Excessive fine sediment in tributaries and the mainstem have limited coho salmon habitat by infiltrating spawning gravel and increasing egg and alevin mortality, depositing on exposed cobble bars and impacting coho salmon fry and over-wintering rearing habitat, and filling pools and off-channel habitat and limiting juvenile summer rearing habitat (Graham Matthews and Associates (GMA) 2001). Downstream of the first tributaries, salmon egg survival to emergence appears to drop and is lowest below Grass Valley Creek (Poker Bar site), likely due to increased tributary derived fine sediment (GMA 2001). Permeability levels in several other tributaries are low as well. Studies have found that permeability levels in several of the tributaries can be quite low (98cm/hr. in Reading Creek; 258 cm/hr. in Indian Creek; 363 cm/hr. in Rush Creek; 521 cm/hr. in Canyon Creek) and could be indicative of low survival rates of salmonids (GMA 2001). The majority of fine sediment in the Trinity River originates from roads, timber harvest, and natural sediment loading from landslides and erosion (USEPA 2001).

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

39.6 Threats

Table 39-5. Severity of threats affecting each life stage of coho salmon in the Upper Trinity River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Hatcheries[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Dams/Diversions[1]	Medium	High	Very High[1]	High	Very High	Very High
3	Road-Stream Crossing Barriers	Low	High	High	Low	High	High
4	Climate Change	Medium	Medium	Very High	High	Medium	High
5	Invasive Non-Native Alien Species	Medium	High	High	Medium	Low	Medium
6	High Severity Fire	Medium	Medium	Medium	Medium	Medium	Medium
7	Roads	High	High	High	Medium	Medium	High
8	Agricultural Practices	Low	Medium	Medium	Medium	Medium	Medium
9	Channelization/Diking	Low	Low	Medium	Medium	Medium	Medium
10	Urban/Residential/Industrial Dev.	Low	Low	Medium	Medium	Low	Medium
12	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
11	Fishing and Collecting	-	-	Low	Low	Medium	Low
13	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are hatcheries and dams/diversions.

Hatcheries

Hatcheries pose a very high threat to all life stages of coho salmon in the Upper Trinity sub-basin. The rationale for these ratings is described under the Adverse Hatchery-Related Effects stress. Approval and implementation of a hatchery and genetic management plan at TRH will be a critical step to reduce the effect of the genetic and ecological interactions between hatchery salmonids and coho salmon in the Upper Trinity River population. Increasing the proportion of natural influence, as well as reducing ecological effects from hatchery salmonids on coho salmon, are both important components of hatchery reform which should be addressed in an HGMP or similar regulatory process.

Dams/Diversions

Dams and diversions are a significant threat across all life history stages. Lewiston and Trinity dams block access to the vast majority of high quality coho salmon habitat. Using the IP model, Lewiston Dam blocks access to 46 percent of the habitat in the Upper Trinity River population. The Trinity River downstream from Lewiston now must mimic and take on the functional role of the mainstem lost beneath the reservoirs and the smaller tributary streams, now cut off by the dams. The Trinity River below Lewiston Dam now has to provide for year-round rearing for fry and juvenile coho salmon, as well as suitable habitat for adult salmonid holding, spawning, and egg incubation and spawning. Based on the limited spawning and rearing conditions downstream of the dams this threat will likely continue to have a negative effect on all life stages of the population in the future.

Based on an average inflow to Trinity Reservoir, the U.S. Bureau of Reclamation diverts approximately 57 percent of Trinity River flows to the Central Valley Project (CVP). Remaining flows downstream of the diversion are managed according to water-year type under the Trinity River Record of Decision (USDOI 2000). The continuing impacts of diversion and storage are numerous and include reduced water quality during dry years, altered hydrologic function, and reduced rearing habitat availability and access. As mentioned above, loss of flow variability in the winter months resulting from static flows from Lewiston Dam is likely to result in reduced growth and survival of juvenile coho salmon.

Numerous small-scale wells and diversions for domestic uses, stock watering, and small agricultural operations occur throughout the watershed and reduce stream flows during critical low-flow periods in the late summer and fall. The Fish Passage Assessment Database lists 154 diversions in the upper Trinity River population, many of which are unscreened (CalFish 2009). Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

A ten-foot defunct concrete diversion dam on Garden Gulch prevents access to high quality low gradient habitat. East Weaver Creek supplies the town of Weaverville with its water. The town’s municipal diversion dam creates a barrier to salmon migration and to gravel movement in the creek, which degrades habitat below the dam in addition to blocking fish passage. Developments, like the housing development along Rush Creek, as well as the town of Weaverville (Weaver Creek), draw water from important tributaries used by coho salmon. Water use along these and other small creeks during the summer and fall months likely reduces baseflow in some areas, which reduces the amount of habitat available and contributes to elevated water temperatures.

Road-Stream Crossing Barriers

Although much work has been done to remove barriers in the watershed, road-stream crossing barriers remain that prevent access to several stream reaches. Numerous road-stream crossing barriers exist in the Upper Trinity River population unit. These present a high threat to several life stages of coho salmon because they inhibit fish passage and cause erosion-related effects in downstream reaches. The Fish Passage Assessment database lists 112 road stream crossing barriers in the Upper Trinity River. There are 30 road stream crossing structures that are total barriers to migration in the Upper Trinity River watershed and 25 partial barriers. Two-road stream crossing barriers have been prioritized for removal and 21 prioritized for assessment (CalFish 2009). Important road-stream crossing barriers within the range of the Upper Trinity population are listed below (Table 39-6). Impacts may result when juveniles are unable to pass these culverts during summer low flows and access to potential rearing habitat is restricted. No information exists on the occurrence of road-related barriers on private lands.

Table 39-6. List of road-stream crossing barriers.

Priority*	Stream Name	Road Name	County	Barrier Status*
High	Conner Creek	Conner Creek Rd	Trinity	Total
High	Oregon Gulch	Sky Ranch Rd	Trinity	Total
High	Middle Weaver Creek	Easter Ave	Trinity	Total
High	Weaver Creek	Highway 299	Trinity	Partial
High	Sidney Gulch	Highway 299	Trinity	Partial
High	Sidney Gulch	Weaver Bally Drive	Trinity	Partial
High	Sidney Gulch	Weaver Bally Loop Road	Trinity	Total
High	Ash Hollow	Highway 299	Trinity	Total
High	Five Cent Gulch	Highway 299	Trinity	Partial
High	Ten Cent Gulch	Highway 299	Trinity	Partial
High	Ten Cent Gulch	Highway 3	Trinity	Partial
Medium	Unnamed Tributary	Goose Ranch Rd	Trinity	Total
Low	McKinney Gulch	Conner Creek Rd	Trinity	Total
Low	Trinity House Gulch	Browns Mountain Rd	Trinity	Total
*From Taylor (2002 and USFS, Weaverville office)				

Climate Change

The Trinity River is a snowmelt-based river system. This has important implications in terms of climate change because snow pack has been decreasing in the western U.S. (Knowles and Cayan 2004; Mote 2006), and is expected to continue to decrease in the future as a result of the warming trend (Zhu et al. 2005, Vicuna et al. 2007), despite increases in precipitation (Hamlet et al. 2005). This may limit summer base flows in small tributary streams, increase stream temperatures, and cause earlier onsets of peak runoff. Mainstem Trinity River flows could also decrease if the hydrologic yield of Trinity Reservoir decreases over time, which could limit habitat availability for rearing juvenile salmonids. Summertime heating of Lewiston Reservoir poses a substantial threat both to Trinity Reservoir storage flexibility and to water temperatures in the Trinity River, impacting most life stages, but juveniles in particular.

Climate change poses a high threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is warmer than the past and modeled regional average temperature predicts a large increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 3 °C in the summer and by 1 °C in the winter. Changes in flow and air temperature will influence water quality in the Trinity River. During drought years, temperatures will likely rise above levels that are stressful for coho salmon.

Annual precipitation is predicted to change little over the next century. Snowpack in upper elevations of the Trinity River basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009). The vulnerability of the Klamath estuary to sea level rise is low to moderate and therefore does not pose a significant threat to estuarine rearing habitat downstream. Juvenile and smolt rearing and migratory habitat are most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, with all populations in the ESU adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

Invasive Non-Native/Alien Species

Competition and predation from brown trout, a non-native species, poses a substantial threat to coho salmon (Glova and Field-Dodgson 1995) in the Upper Trinity. Brown trout eat other fish species, and compete with them at all life stages for food, rearing habitat and spawning habitat (Waters 1983; Dewald and Wilzbach 1992; Wang and White 1994; McHugh and Budy 2006). Coho are absent where brown trout were present, and preferred habitats were left unoccupied by coho salmon (CDFG 2009b). Data from weirs operated by CDFG indicate several hundred brown trout pass through the Junction City area annually. Brown trout are abundant enough in the Trinity River to make up a substantial proportion of observations by biologists collecting juvenile salmonid habitat utilization data (Martin, A., pers. comm. 2009).

High Severity Fire

Fires have swept through regions of the Upper Trinity River in the recent past. The altered vegetation characteristics throughout the watershed present a moderate threat for future high severity fires, which could alter sedimentation processes as well as riparian vegetation characteristics. Fire risks will continue to increase in the future as conditions become drier and hotter as a result of climate change. Higher temperatures, reduced snowpack, and earlier spring snowmelt all contribute to the frequency, intensity, and extent of fires. Elevated fire frequency and intensity will continue to degrade spawning and rearing habitat through sedimentation and loss of riparian vegetation. Areas prone to fire risk are spread throughout the Trinity Basin.

Roads

Roads are a moderate to high threat across most life history stages. Data indicate road density varies from Very High to Low across the watershed. Most of the habitat with the greatest potential to support coho salmon in this area occurs in areas with road densities greater than 2.5

miles/sq. mile, and much of that habitat is in areas with greater than 3 miles/sq. mile. Given the sedimentation problems seen in the watershed, roads should be considered for removal or upgrade to reduce sediment delivery. Of particular importance are the many roads in the Weaverville and Douglas City areas, where small tributary streams containing reaches with high or medium IP value are accessible to coho salmon. Road building for access to marijuana cultivation sites is common in many areas of the SONCC coho salmon recovery domain. It is likely that many of these roads are unpermitted and contribute excessive amounts of fine sediment to coho salmon streams.

In total, 636 high and high/moderate priority sites have been identified for treatment on Trinity Country Roads including 149 high priority road-stream crossing sites (Trinity County 2000). In addition, Two County roads, Trinity Dam Boulevard and East Side Road, account for 57.8 percent of the total (708,583 yd^3) stream crossing related volume of potential sediment delivery. This potential volume is the result of roads built on highly erodible decomposed granitic soils. Numerous studies have identified and evaluated decomposed granite sediment sources and delivery from Grass Valley Creek. This creek has been determined to be the largest source of decomposed granite sediment in the reach. Portions of Trinity Dam Boulevard, Lewiston Turnpike, Old Lewiston and other roads in the Lewiston area cross through decomposed granite soils and act as sediment sources. Some sites have already been treated and the County and its partners will continue to target road-related sediment issues to reduce sediment inputs into the river.

Agricultural Practices

Limited agricultural activities exist in the upper Trinity River sub-basin. There are small-scale agricultural operations, such as small farms, vineyards and cattle grazing operations. Agriculture is a minor factor affecting coho salmon in this population and is therefore considered a low threat. One associated impact of agricultural practices that is addressed under the threat of dams and diversions (see above) is the diversion of water.

Channelization/Diking

Channelization and diking was ranked a low to medium threat in the threats table. Although channelization and diking is not widespread throughout the watershed, localized restrictions occur if roads run parallel to streams where they reduce floodplain connectivity and function. In addition, growth of the riparian berms in the upper Trinity River has been found to limit habitat availability. Other localized instances of channelization near tributary confluences should be identified and evaluated for potential restoration to improve floodplain function and provide off-channel habitat.

Urban/Residential/Industrial Development

Rural population growth will continue to present a moderate threat to coho salmon in the Upper Trinity River. The population of Trinity County increased 9.9 percent from 2000 to 2006 according to the U.S. Census Bureau (U.S. Census Bureau 2008), equating to an annual increase of 1.7 percent. The five principal communities in the area (Trinity Center, Weaverville, Lewiston, Douglas City, and Junction City) are home to approximately half of the people in Trinity County. In the future, demand for water for public use is expected to increase as more people move to the area. Towns will divert more surface flow from streams and waterways in order to provide the public with clean water near towns, and the number of rural residential groundwater wells will likely increase as well. However, the extent of that demand is likely limited due to the relatively small number of people expected to occupy the area. Such growth also results in removal of vegetation, increased sediment generation and delivery and introduction of exotic species. Subdivision of existing parcels will exacerbate this threat.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Timber Harvest

Timber harvest poses a medium threat to the Upper Trinity River population. Much of the population area is in public ownership (U.S. Forest Service and Bureau of Land Management), including a substantial portion of federally-designated Wilderness. Under current management practices and the financial, administrative and legal restrictions on timber harvest on public land, the USFS and BLM are unlikely to implement large timber sales in the next ten years. Additionally, timber practices are governed by the rigorous protective measures for water quality that are required for actions on public lands under the Northwest Forest Plan Aquatic Conservation Strategy and Standards and Guidelines. Timber harvest in the Upper Trinity has been on the decline over the past 50 years (GMA 2001).

Almost all recently harvested land in the Trinity watershed is privately owned and the extent of its environmental impacts are unknown (USEPA 2001). Approximately 15 percent of the Trinity Basin is under private industrial timber management (USEPA 2001). Based on data from CalFire (2009) on approved private land timber harvest plans (THPs) in the Trinity River, the majority of timber harvest occurs as large timber sales on industrial timberlands. Most timber harvest on private land will occur in the Douglas City, Weaver Creek, and Upper Trinity HSAs of the Trinity River. Based on the extent and restrictions on future timber harvest it is considered a medium threat to the Upper Trinity population.

Mining/Gravel Extraction

Gravel extraction and mining is a low threat for the population. Very little in-stream gravel mining occurs in the Upper Trinity River. The bedrock underlying the Trinity River supports natural pool and riffle formation and maintenance, providing a buffer against detrimental effects of mining on coho salmon habitat (Wolff, L, pers. comm. 2009). Suction dredge mining for gold probably presents a low threat to coho salmon because of the small number and scale of these operations, and the current moratorium on suction dredge mining. NMFS expects the effects of this activity to remain the same or decrease in the future.

39.7 Recovery Strategy

Naturally-produced coho salmon in the Upper Trinity River are depressed in abundance and have a restricted distribution. Recovery activities in the watershed should promote increased spatial distribution as well as increased productivity and abundance. Curtailing the effects of hatchery fish on this population is of utmost importance. Returns of hatchery fish are several times greater than historical runs and several times greater than the low risk threshold presented by Williams et al. (2008). Activities that increase streamflows, reduce summertime stream temperatures, increase fish distribution through barrier removal, promote increased floodplain and channel structure and improve long-term prospects for LWD recruitment, should be a priority in the watershed. Specific goals for each stress are listed below and in the table of recovery actions that follows. These goals identify activities that are expected to reduce the stresses currently affecting the Upper Trinity River coho salmon population.

The presence of coho salmon has been confirmed in a variety of streams in the Upper Trinity River Sub-basin such as Grass Valley Creek, Sidney Gulch, Deadwood Creek, Rush Creek, Weaver Creek, East Weaver Creek, West Weaver Creek, Little Browns Creek, Sidney Gulch, Dutch Creek, Soldier Creek, Canyon Creek, North Fork Trinity River, East Fork North Fork Trinity River, Manzanita Creek, Big French Creek, New River and East Fork New River (Hill 2008; Everest 2008). Coho salmon are also likely to be found in Reading and Browns creeks. The following actions are essential for the coho salmon population in the Upper Trinity River coho salmon population to recover to the extent necessary for recovery of the SONCC coho salmon ESU. Streams considered a high priority of recovery actions include those streams listed in Table 39-1.

Several steps will be necessary to recover the Upper Trinity population of coho salmon. The hatchery reforms discussed above, including a Hatchery and Genetic Management Plan, need to be implemented to align hatchery production with recovery standards for hatcheries. Road stream crossing barriers discussed above should be addressed and ameliorated. Areas that contain high road densities, particularly with areas of decomposed granite should be targeted for road decommissioning. A new, more variable and dynamic flow regime to replace static 300 cfs baseflows, which occur from October to May in the mainstem Trinity River, is critical for rearing coho salmon. Adequate protections for the cold water pool in Trinity Reservoir and a strategy to compensate for thermal heating in Lewiston Reservoir are necessary to buffer coho salmon production in the mainstem Trinity River from drought and climate change. The effects of fishing on this population’s ability to meet its viability criteria should be evaluated.

Table 39-7 on the following page lists the recovery actions for the Upper Trinity River population.

Table 39-7. Recovery action implementation schedule for the Upper Trinity River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UTR.3.1.18	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-UTR.3.1.18.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-UTR.3.1.18.2	*Implement water dedications to increase instream flows using the streamlined process*					
SONCC-UTR.3.1.19	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-UTR.3.1.19.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-UTR.3.1.20	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-UTR.3.1.20.1	*Establish a comprehensive groundwater permit process*					
SONCC-UTR.3.1.21	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2c
SONCC-UTR.3.1.21.1	*Assess basin wide water diversion projects and prioritize areas in need of increased flows. Develop a plan to obtain adequate flows for riparian resources*					
SONCC-UTR.3.1.21.2	*Reduce diversions, guided by the plan*					
SONCC-UTR.3.1.36	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Mainstem above Douglas City, Grass Valley, Indian, Hayfork, Reading, Weaver, East Fork Weaver creeks, and all streams where coho salmon would benefit immediately	2c
SONCC-UTR.3.1.36.1	*Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow*					
SONCC-UTR.3.1.36.2	*Monitor forbearance compliance and flow*					
SONCC-UTR.3.1.37	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Weaver and East Weaver creeks	2c
SONCC-UTR.3.1.37.1	*Pump water from mainstem Trinity River for Weaverville municipal water supply during periods of low flow*					
SONCC-UTR.3.1.65	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-UTR.3.1.65.1	*Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow*					
SONCC-UTR.3.1.65.2	*Monitor forbearance compliance and flow*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-UTR.3.1.44	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	North Fork Trinity River and Canyon, Browns, Reading, Weaver, Middle Weaver Creeks, Grass Valley, Indian, Hayfork, Reading, Weaver, East Fork Weaver Creek, and all streams where coho salmon would benefit immediately	2c
SONCC-UTR.3.1.44.1		*Identify and cease unauthorized water diversions*				
SONCC-UTR.3.1.67	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	Population wide	2d
SONCC-UTR.3.1.67.1		*Identify and cease unauthorized water diversions*				
SONCC-UTR.17.2.1	Hatcheries	Yes	Reduce adverse hatchery impacts	Identify and reduce impacts of hatchery on SONCC coho salmon	Trinity River Hatchery	2c
SONCC-UTR.17.2.1.1		*Develop and implement a Hatchery and Genetic Management Plan*				
SONCC-UTR.17.2.1.2		*Increase proportion of natural influence by reducing production of coho salmon smolts, adopt naturally-produced (unmarked) broodstock targets, trap and cull excess hatchery broodstock, and encourage a terminal recreational fishery to help decrease the number of hatchery fish on the spawning grounds*				
SONCC-UTR.17.2.1.3		*Monitor genetic diversity by collecting tissue samples from all fish returning to the hatchery*				
SONCC-UTR.17.2.1.4		*Reduce genetic impacts of hatchery on wild fish by adopting a 1:1 mating protocol*				
SONCC-UTR.17.2.1.5		*Reduce steelhead ecological interactions by reducing hatchery steelhead production*				
SONCC-UTR.17.2.1.6		*Provide geographic segregation of spawning to runs of Chinook salmon, coho salmon, and steelhead by operating weirs or other systems aimed at limiting redd superimposition*				
SONCC-UTR.5.1.35	Passage	No	Improve access	Provide artificial passage	Lewiston and Trinity Dams	2c
SONCC-UTR.5.1.35.1		*Study feasibility of fish passage at Lewiston and Trinity dams*				
SONCC-UTR.5.1.35.2		*Provide passage for all life stages, guided by plan*				
SONCC-UTR.1.2.41	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary	2c
SONCC-UTR.1.2.41.1		*Implement recovery actions for Lower Klamath River population that address the target "Estuary", including the creation/restoration of off-channel rearing habitat throughout the lower Klamath River*				
SONCC-UTR.3.1.59	Hydrology	No	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	2c
SONCC-UTR.3.1.59.1		*Conduct study to determine instream flow needs of coho salmon at all life stages.*				
SONCC-UTR.3.1.59.2		*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*				
SONCC-UTR.3.1.59.3		*Implement coho salmon instream flow needs plan.*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UTR.2.1.9	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Mainstem above Douglas City, Grass Valley, Indian, Hayfork, Reading, Weaver, East Fork Weaver Creek, and all streams where coho salmon would benefit immediately	2c
SONCC-UTR.2.1.9.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UTR.2.1.9.2	*Place instream structures, guided by assessment results*					
SONCC-UTR.2.1.62	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-UTR.2.1.62.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UTR.2.1.62.2	*Place instream structures, guided by assessment results*					
SONCC-UTR.26.1.58	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2c
SONCC-UTR.26.1.58.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-UTR.2.2.7	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Mainstem, Grass Valley, Indian, Hayfork, Reading, Weaver, East Fork Weaver Creek, and all streams where coho salmon would benefit immediately	2c
SONCC-UTR.2.2.7.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-UTR.2.2.7.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-UTR.2.2.63	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-UTR.2.2.63.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-UTR.2.2.63.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-UTR.14.2.22	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of brown trout	Population wide	2c
SONCC-UTR.14.2.22.1	*Adopt fishing regulations and educational programs that encourage and allow for the take of an unlimited number of brown trout*					
SONCC-UTR.14.2.22.2	*Euthanize all brown trout captured at CDFW weirs*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UTR.10.1.14	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase flow	Weaver, Reading, Grass Valley, and Indian creeks, and all streams where coho salmon would benefit immediately	2c
SONCC-UTR.10.1.14.1	*Develop a plan to address water quality and quantity*					
SONCC-UTR.10.1.14.2	*Implement plan to address water quality and quantity*					
SONCC-UTR.10.1.60	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase flow	Population wide	2d
SONCC-UTR.10.1.60.1	*Develop a plan to address water quality and quantity*					
SONCC-UTR.10.1.60.2	*Implement plan to address water quality and quantity*					
SONCC-UTR.3.1.45	Hydrology	Yes	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	3c
SONCC-UTR.3.1.45.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-UTR.3.1.45.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-UTR.3.1.45.3	*Implement plan*					
SONCC-UTR.3.1.17	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Coldwater mainstem tributaries, Grass Valley, Indian, Reading, Weaver, East Fork Weaver Creek	3c
SONCC-UTR.3.1.17.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-UTR.3.1.38	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	All streams where coho salmon would benefit immediately	3c
SONCC-UTR.3.1.38.1	*Develop a plan to manage stream flows and water temperature during periods of drought, protecting coho salmon from effects of climate change*					
SONCC-UTR.3.1.38.2	*Implement plan based on findings*					
SONCC-UTR.3.1.66	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	Population wide	3d
SONCC-UTR.3.1.66.1	*Develop a plan to manage stream flows and water temperature during periods of drought, protecting coho salmon from effects of climate change*					
SONCC-UTR.3.1.66.2	*Implement plan based on findings*					
SONCC-UTR.3.1.16	Hydrology	Yes	Improve flow timing or volume	Manage flows	Population wide	3c
SONCC-UTR.3.1.16.1	*Assess how climate change and likely reduced snowpack might influence water availability*					
SONCC-UTR.3.1.16.3	*Update Trinity River allocations, if needed, based on assessments of ROD flows*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UTR.5.1.11	Passage	No	Improve access	Reduce sediment barriers	Tributary confluences where coho salmon would benefit immediately	3c
SONCC-UTR.5.1.11.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-UTR.5.1.11.2	*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*					
SONCC-UTR.5.1.69	Passage	No	Improve access	Reduce sediment barriers	Population wide	3d
SONCC-UTR.5.1.69.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-UTR.5.1.69.2	*Remove alluvial deposits, construct low flow channels, or reduce stream gradient to provide fish passage at all life stages*					
SONCC-UTR.5.1.10	Passage	No	Improve access	Remove barriers	North Fork Trinity and Canyon, Browns, Reading, Weaver, Middle Weaver Creeks, and all streams where coho salmon would benefit immediately	3c
SONCC-UTR.5.1.10.1	*Assess highest priority road-stream and diversion related barriers. Develop a plan for removal*					
SONCC-UTR.5.1.10.2	*Remove barriers, guided by the plan*					
SONCC-UTR.5.1.68	Passage	No	Improve access	Remove barriers	Population wide	3d
SONCC-UTR.5.1.68.1	*Assess highest priority road-stream and diversion related barriers. Develop a plan for removal*					
SONCC-UTR.5.1.68.2	*Remove barriers, guided by the plan*					
SONCC-UTR.2.2.8	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	Grass Valley, Indian, Hayfork, Reading, Weaver, East Fork Weaver Creek, and all streams where coho salmon would benefit immediately	3c
SONCC-UTR.2.2.8.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-UTR.2.2.8.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-UTR.2.2.64	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	Population wide	3d
SONCC-UTR.2.2.64.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-UTR.2.2.64.2	*Implement education and technical assistance programs for landowners, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UTR.10.1.13	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Reduce warm water inputs	Lewiston Dam on mainstem Trinity	3c
SONCC-UTR.10.1.13.1	*Study and evaluate methods to reduce thermal heating in Lewiston Reservoir*					
SONCC-UTR.10.1.13.2	*Implement plan to reduce thermal heating based on findings*					
SONCC-UTR.10.7.57	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-UTR.10.7.57.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-UTR.10.7.57.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-UTR.10.7.61	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-UTR.10.7.61.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-UTR.10.7.61.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-UTR.16.1.23	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UTR.16.1.23.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-UTR.16.1.23.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-UTR.16.1.55	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-UTR.16.1.55.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-UTR.16.1.55.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-UTR.16.1.24	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UTR.16.1.24.1	*Determine actual fishing impacts*					
SONCC-UTR.16.1.24.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UTR.16.1.56	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-UTR.16.1.56.1	*Determine actual fishing impacts*					
SONCC-UTR.16.1.56.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-UTR.16.2.25	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UTR.16.2.25.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-UTR.16.2.25.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-UTR.16.2.26	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UTR.16.2.26.1	*Determine actual impacts of scientific collection*					
SONCC-UTR.16.2.26.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-UTR.2.2.43	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	3d
SONCC-UTR.2.2.43.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					

40. South Fork Trinity River Population

Interior-Trinity Diversity Stratum

Non-Core 1, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

970 Spawners Required for ESU Viability

932 mi^2 watershed (82% Federal ownership)

242 IP-km (150 IP-mi) (26% High)

Dominant Land Uses are Agriculture and Timber Harvest

Key Limiting Stresses are 'Altered Hydrologic Function' and 'Impaired Water Quality'

Key Limiting Threats are 'Dams/Diversions' and 'Roads'

High Priority Recovery

• Prioritize and provide incentives for use of CA Water Code Section 1707 • Streamline process for water leasing under CA Water Code Section 1707 for instream purposes • Establish a comprehensive groundwater permit process	• Increase instream flows by reducing diversions • Increase instream flows by increasing storage capacity or delivery capability at Ewing Reservoir • Implement a Hatchery and Genetic Management Plan

40.1 History of Habitat and Land Use

The South Fork Trinity River is the largest undammed river in California. Past and present land use practices in the South Fork Trinity River basin have led to a decreased ability to support salmon and steelhead, as evidenced by significantly decreased runs of spawning salmonids (Pacific Watershed Associates [PWA] 1994). Activities such as mining, road construction, fire suppression, stream diversion, and timber harvest have modified streamflow and natural erosion processes and altered stream channels in the South Fork Trinity River basin (U.S. Forest Service (USFS) 2008). These disturbances have been widely distributed and have caused sustained alteration of ecosystem structure and function, particularly in riparian areas (USFS 2008).

Overgrazing in the late 1800s and early 1900s damaged riparian vegetation and led to significant erosion (Tetra Tech 2000). By 1977, 52 percent of forested areas within the basin had been logged. An additional 4 percent of the old growth had been lost to fire. At the time, total road length was 3,456 miles, 92 percent of which were associated with timber harvests (California Department of Water Resources (DWR) 1979, PWA 1994). Since that time, an undetermined, but substantial, amount of additional acreage has been affected by timber harvest, road construction and wildfires. Industrial pollution from lumber mills, domestic pollution from poorly functioning septic systems, and pollution from agricultural non-point sources have also contributed to the declines of salmonids in the South Fork Trinity River (PWA 1994).

The mid-1850s saw the beginning of placer mining on several tributaries of the South Fork Trinity, followed later by dragline mining and hardrock mining. The timber industry developed concurrently and became economically important in the area. The 1905 formation of the Trinity Forest Reserves (later the Trinity National Forest) led to changes in forest management practices, particularly in grazing and fire suppression (USFS 1999c). Changes in land use led to accelerated natural erosion processes in the South Fork Trinity River basin, resulting in increased sedimentation in the river channels. Smaller tributaries generally have been affected less severely than mainstem lower gradient reaches. Sedimentation is most notable in the Hyampom Valley, with most of the sediment being delivered from South Fork Mountain tributaries, particularly downstream of Hyampom Valley and the Pelletreau Creek sub-watershed, both of which have been heavily logged since the 1940s (PWA 1994).

Fire is a significant disturbance factor within the South Fork Trinity River basin (USFS 2008). Prior to the initiation of organized fire suppression in the early 1900s, low intensity, surface fires of relatively short intervals of 5 to 30 years were typical in the basin (USFS 2008). The suppression of fire, along with unnatural fuel loading, has initiated a transition to a fire regime characterized by more frequent, high severity fires and vegetative community changes such as greater abundance of white fir (USFS 2008). Several intense wildland fires have burned in the South Fork Trinity basin since fire suppression commenced. Continued accelerated sediment production is found in many of the areas where large-scale forest fires have burned (U.S. Environmental Protection Agency (EPA) 1998).

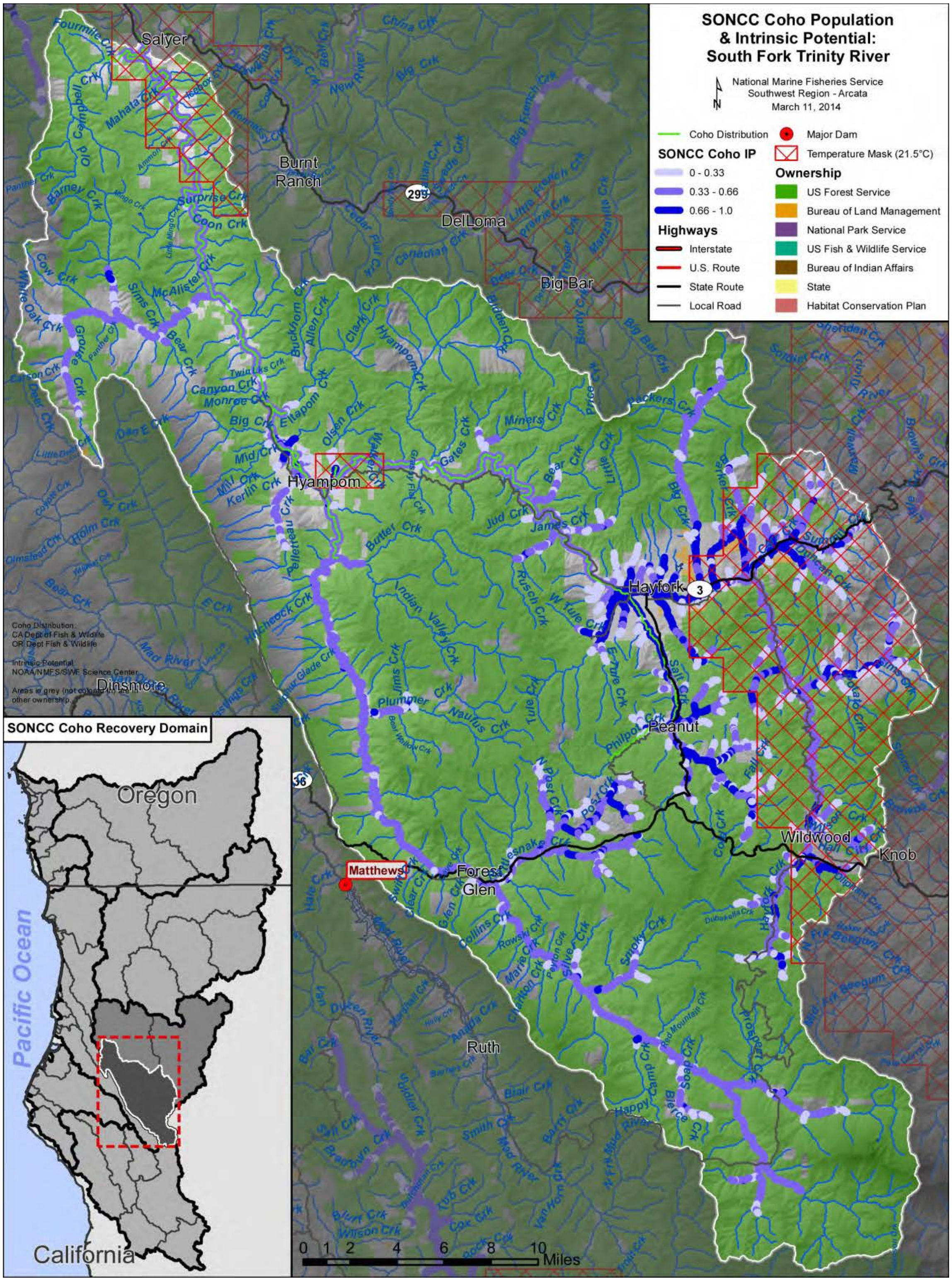

Figure 40-1. The geographic boundaries of the South Fork Trinity River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Trinity River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

Salmon in the South Fork Trinity River have also been affected by a number of large floods over the past several decades, especially by the flood of December 1964 (USEPA 1998). The 1964 flood caused tremendous soil loss in tributaries, especially those that had been logged (MacCleery 1974). Sedimentation from road failures and mass wasting associated with roads and clearcut logged areas choked the channels of many of these tributaries. As these tributary streams delivered sediment into the South Fork Trinity River, additional streamside landslides were triggered (PWA 1994). "Unstable geology, along with erosion-producing land use practices have been blamed for the many mass wasting events triggered by the 1964 flood, which resulted in dramatic instream changes, including channel widening, aggradation, and loss of pool depth, all of which adversely affected salmonids" (USEPA 1998). The Salyer reach (river mile 1.5 to 6.2) showed about 20 feet of aggradation after the 1964 flood (Dresser et al. 2001). Hyampom Valley (as of 1982) still had 25 feet of aggradation and the channel has widened 66 feet due to the 1964 flood (PWA 1994). Since that time, further changes suggest improvements in some locations, while continued, chronic sediment inputs may be hindering a more complete or faster recovery (USEPA 1998).

Recently, Van Kirk and Naman (2008) found that river discharge of the South Fork Trinity River was significantly lower in the period from 1977 to 2005 than the period from 1966 to 1976. This decrease in flow is likely due to a combination of increasing water utilization, land use changes, and climate change, which has resulted in a decrease in snowpack in the region (Van Kirk and Naman 2008). Water utilization and the resulting reduction in the water table also results in longer recharge times for aquifers. This means that the increase in streamflows associated with fall and winter rains is often delayed as groundwater resources recharge.

The Hayfork Creek sub-basin (the largest tributary to the South Fork) includes approximately 191,000 acres of public land and 52,000 acres of private land (South Fork Trinity River Coordinated Resource Management and Planning Group 2008). The Hayfork Creek sub-basin is a relatively geologically stable basin in comparison to the rest of the South Fork Trinity River basin. The majority of water diversions and water quality issues (high water temperatures, high nutrient loads, low dissolved oxygen) in the South Fork Trinity River basin occur in the Hayfork sub-basin, where depleted summer flows and lack of riparian shading have adversely affected salmonid production in Hayfork Creek (PWA 1994). The upper reaches of Hayfork Creek are covered by the temperature mask (Figure 40-1), making it uninhabitable to coho salmon without thermal refugia from coldwater springs or groundwater. The loss of riparian canopy (from grazing and timber harvest) contributes significantly to increased water temperatures, which can exceed 80 °F in Hayfork Creek (PWA 1994). Flow depletion, lack of riparian cover, and water pollution all affect the ability of Hayfork Creek and its major tributaries to produce salmon and steelhead. Because of its high water temperature, Hayfork Creek increases temperature problems in the main stem South Fork Trinity River in some years, whereas it formerly provided a moderating influence (PWA 1994).

40.2 Historic Fish Distribution and Abundance

It was noted by USFWS and CDFG (1956) that "Silver [coho] salmon enter most lower Trinity River tributaries to spawn." Similarly, Moffet and Smith (1950) stated that "Silver [coho] salmon enter the lower Trinity River to spawn." Although it is thought that anadromous fish, including coho salmon, were abundant in the middle 20th century, their populations have declined dramatically since the flood of 1964 (Borok and Jong 1997, Dresser et al. 2001). Beyond these few statements, little information is available on the historic distribution and abundance of coho salmon in the South Fork Trinity River basin.

CDFG operated a weir on the South Fork Trinity River at Sandy Bar—about two kilometers upstream of the confluence with the Trinity River—between 1984 to 1990 (Jong and Mills 1992). In 1985 and 1990, years when enough adult and jack coho salmon returned to the river to make escapement estimates possible, it was estimated that 127 [95 percent CI = 109 to 222] and 99 [95 percent CI = 68 to 256] adult and jack coho salmon returned to the river (Jong and Mills 1992). However, 35.8 percent of the adult coho salmon captured in 1985 were of hatchery origin (Jong and Mills 1992). Consistent marking of coho salmon at Trinity River Hatchery did not occur until 1996, but the hatchery fish in 1985 could be identified by marks made in the hatchery as part of a separate experiment (Marshall, L., pers. comm. 2008).

Based on the Intrinsic Potential (IP) of the watershed, Williams et al. (2008) calculated that the low-risk spawner threshold for the South Fork Trinity River population is 6,400 coho salmon. The depensation (high risk) threshold is 242 coho salmon (Williams et al. 2008). Moderate IP reaches exist throughout the South Fork Trinity River basin, both in the mainstem, the East Fork of the South Fork Trinity River, and tributaries such as Butter Creek. There are several streams that contain high IP reaches (IP > 0.66) such as Hayfork Creek and Salt Creek, however, many of these high IP stream reaches are on private land in the low-gradient valley floors of the watershed and experience high temperatures during the summer (Table 40-1). There are no historical accounts of coho salmon presence in the Hayfork Valley, and their prevalence in Hayfork Valley remains in question. There is a section in Hayfork Creek thought to inhibit coho salmon migration into Hayfork Valley because of its high gradient, particularly in dry water years.

Coho salmon in the upper reaches of the South Fork Trinity River were likely dissimilar to those of the coast range and lower Trinity River. In order to access spawning grounds in the Hayfork Valley, Salt Creek, and upper mainstem South Fork Trinity River, they would have begun their spawning migration in late September or October. These “long-run” coho salmon most likely had run timing that was similar to that of coho salmon in the Shasta River. This is unlike coho salmon in the coast range that enter rivers and streams to spawn in November and December following winter rains. The far distance that they travel, distinctive geology and ecology of the Yolla Bolly Mountains, and unregulated flow of the South Fork Trinity River, would have made this population of coho salmon unique among Trinity River coho salmon populations.

Table 40-1. Tributaries with high IP reaches in the South Fork Trinity River (IP > 0.66) (Williams et al. 2006).

Subarea[1]	Stream Name	Subarea[1]	Stream Name
Hayfork Valley	Hayfork Creek	**Forest Glenn**	Rattlesnake Creek
	Salt Creek		Post Creek
	Big Creek	**Corral Creek**	Corral Creek
	Barker Creek	**Hyampom**	Olsen Creek
Forest Glenn	Butter Creek	**Grouse Creek**	Eltapom Creek

[1]Subarea refers to hydrologic subarea (HSA) in the CALWATER classification system.

40.3 Status of South Fork Trinity River Coho Salmon

Spatial Structure and Diversity

Coho salmon are limited in their distribution in the South Fork Trinity River basin and occur only in the mainstem South Fork Trinity River up to Butter Creek, Butter Creek, Hayfork Creek up to Corral Creek, Eltapom Creek, Olsen Creek, and Madden Creek (Everest 2008; Boberg 2008). There are no know barriers to migration for coho salmon in the South Fork Trinity River upstream of Butter Creek, and Rattlesnake Creek has moderate and high IP reaches. Yet no coho salmon are known to inhabit these stream reaches. Coho salmon have not been found in Hayfork Creek near or upstream of the town of Hayfork. This area has the greatest concentration of high IP values of any stream in the basin. It is not clear if coho salmon are currently able to migrate through Hayfork Creek upstream of Corral Creek, or if they were historically able to migrate past Corral Creek. However, it is likely that habitat conditions, such as high summer water temperatures and low dissolved oxygen, arising from land use, water utilization, climate change and channel aggradation are currently limiting the spatial structure of coho salmon in the South Fork Trinity River basin. The more restricted and fragmented the distribution of individuals within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk.

Each year, Trinity River Hatchery releases approximately 500,000 coho salmon smolts, 800,000 steelhead, and 4.3 million Chinook salmon. Currently, coho salmon returns to the Trinity River are dominated by hatchery fish (US Fish and Wildlife Service (USFWS) and Hoopa Valley Tribe (HVT) 1999; Table 40-2). From 2003 to 2005, over 75 percent of coho salmon adults returning to the Trinity River, as estimated at Willow Creek, were of hatchery origin (Table 40-2). In 1985, Jong and Mills (1992) found that 35.8 percent of adult coho salmon returning to the South Fork Trinity River were of hatchery origin. Straying of hatchery fish into tributaries such as the South Fork Trinity River presents a particular threat to the diversity of the population because the hatchery fish may reduce the reproductive success of the overall population (Mclean et al. 2003) through outbreeding depression (Reisenbichler and Rubin 1999).

Table 40-2. Coho salmon run size estimates for the Trinity River. Based on counts at the Willow Creek counting weir. Data are from CDFG (2008c).

Year	Dates*	Location	Catch	Hatchery proportion of catch	Estimated Run Size
2003	17 Sep-18 Nov	Willow Creek	250	86	28,152
2004	10 Sep-25 Nov	Willow Creek	1,009	77	38,882
2005	3 Sept-4 Nov	Willow Creek	772	92	31,419
2005	24 Sep-2 Dec	Junction City	1,161	92	24,615

**Note that naturally produced coho salmon may return to the Trinity River later than their hatchery counterparts and/or after the weir at Willow Creek is removed from the river.*

Little is known about life history diversity in the South Fork Trinity River such as unique migration timing, redistribution of juveniles, or non-natal rearing. There does appear to be some diversity of life history strategies in the Trinity River based on data on run timing and outmigration. Coho salmon enter the Trinity River between September and November and spawning in the river continues into December (CDFG 2009b). Also, both young-of-the-year and yearling coho salmon are captured at downstream migrant traps located in the Trinity River near Willow Creek (Pinnix et al. 2007). Outmigration of age 0+ coho salmon occurs over a large time period between March and September as does outmigration of Age 1+ (Pinnix et al. 2007). Outmigration of subyearling coho salmon may be due to competition for rearing habitat or sub-optimal rearing conditions or it may be due to a unique life history type that may rear in natal or non-natal streams or both prior to emigrating to the ocean. It is unknown whether the South Fork Trinity population has any of these unique life history characteristics because no juvenile salmonid trapping currently occurs in the basin.

Because of the high numbers of adult hatchery coho salmon migrating past the South Fork Trinity River, and because they are known to stray into non-natal tributaries, the South Fork Trinity River population of coho salmon is, at least, at a moderate risk of extinction with regards to the diversity viability parameter. Based on current spawning densities and locations, the South Fork Trinity River population is at an elevated risk of extinction because its spatial structure and diversity are very limited compared to modeled IP.

Population Size and Productivity

The only population estimates for the South Fork Trinity River are based on work by Jong and Mills (1992) who estimated that 127 adult and jack coho salmon returned to the South Fork Trinity River in 1985 and 99 returned in 1990. With 35.8 percent (46) of the adult coho salmon captured in 1985 being of hatchery origin, the total wild population was likely under 100 adults during these years (Jong and Mills 1992). However, in other years, few or no hatchery coho salmon were trapped on the South Fork Trinity River (Jong and Mills 1992). In 1985, several hundred coho salmon juveniles were trapped in the South Fork Trinity River below the mouth of Madden Creek (CDFG 1993). More recent data on population sizes, other than that of Jong and Mills (1992) are unavailable. Overall, if a spawning population is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 242 spawners are needed each year in the South Fork Trinity River to avoid depensatory effects of extremely low population sizes. If we assume abundances are similar to those found in 1985 and 1990, the South Fork Trinity River population does not meet this depensation threshold and is at high risk of extinction. The population growth rate in South Fork Trinity River basin has not been quantified but is likely negative based on loss of habitat, declining water quality, and detrimental hatchery influences. This downward trend further adds to the extinction risk of the population.

Extinction Risk

The South Fork Trinity River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role of Population in SONCC Coho Salmon ESU Viability

The South Fork Trinity River population is a non-core, Functionally Independent population within the Interior Klamath River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). The South Fork Trinity population is strongly influenced by other Interior Trinity River populations. Adult strays from these populations spawn and interact with coho salmon in the South Fork Trinity River. To contribute to stratum and ESU viability, the South Fork Trinity River non-core population needs to have at least 970 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Furthermore, the South Fork Trinity population will contribute toward stratum and ESU viability by providing rearing, migratory, and refugia habitat to other populations in the Trinity and Klamath river basins.

40.4 Plans and Assessments

Trinity County Resource Conservation District

http://www.tcrcd.net/index.htm

Trinity County R.C.D. is a county wide agency encompassing 2.1 million acres in rural Northern California, and receives funding from local, state, federal agencies and non-governmental organizations. TCRCD has several reports and assessment on stream conditions and habitat within the South Fork Trinity River. The Board of Directors is guided by landowners and the community in their decisions and actions. Employees of the District carry out the day to day operations, guided by priorities and policies set by the Board. The purpose of the District is to focus attention on land, water and related resource problems, develop programs to solve them, and to enlist and coordinate help from all public and private sources that can contribute to accomplishing the district's goals.

South Fork Trinity River Coordinated Resource Management Plan Committee

Action Plan for Restoration of the South Fork Trinity River Watershed and Its Fisheries
http://www.krisweb.com/biblio/sft_usbor_pwa_1994_sftplan/pwa1.htm

The Action plan for the South Fork Trinity River Watershed and Its Fisheries is a thorough investigation of key limiting factors in the South Fork Trinity River. The plan has a variety of recommendations for improving habitat in the South Fork Trinity River.

U.S. Forest Service- Shasta-Trinity and Six Rivers National Forests

http://www.fs.fed.us/r5/shastatrinity/

The U.S. Forest Service (USFS) has a variety reports and assessments available for the Trinity Basin. USFS has programs benefitting salmon and steelhead habitat in the Trinity River basin. USFS maintains an active road decommissioning and sediment abatement program that aims to minimize fine sediment delivery to streams. Fuels reductions programs implemented by the USFS are activities that help reduce the risk of catastrophic forest fires and subsequent erosion. The USFS is an active participant in the Trinity River Restoration Program and performs salmon and steelhead monitoring, restoration, and habitat assessments.

State of California

Total Maximum Daily Load
http://www.swrcb.ca.gov/northcoast/

The South Fork Trinity River Watershed is on the list of impaired waterbodies under Clean Water Act Section 303(d) for sediment and temperature. The South Fork Trinity River Technical TMDL for Sediment was established by US EPA in December 1998. Development of a South Fork Trinity River Temperature TMDL has not been scheduled.

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The State of California published a plan for the recovery of coho salmon in California that contains recommendations for restoration actions in the Trinity River basin. The specific restorative recommendations developed by CDFG for Trinity River have been considered and incorporated into the table of population-specific recovery actions.

40.5 Stresses

Table 40-3. Severity of stresses affecting each life stage of coho salmon in the South Fork Trinity River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Adverse Hatchery-Related Effects	Very High	Very High	Very High	Very High	Very High	Very High
2	Altered Sediment Supply	High	High	High	Medium	High	High
3	Impaired Water Quality[1]	Low	Medium	High[1]	High	Medium	High
4	Altered Hydrologic Function[1]	Medium	High	High[1]	Medium	High	High
5	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
6	Lack of Floodplain and Channel Structure	Medium	High	High	High	Medium	High
8	Barriers	-	Low	High	Low	High	High
7	Impaired Estuary/Mainstem Function	-	Low	Medium	Medium	Medium	Medium
9	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
10	Increased Disease/Predation/Competition	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

Several factors limit the viability of the South Fork Trinity River coho salmon population. The most dominant of these factors stem from the effects of agricultural practices on private land, legacy sediment-related impacts from past floods, fire, and land management. Impaired water quality and altered hydrologic function are the most likely stresses limiting productivity of the South Fork Trinity population. Juveniles are the most likely limited life stage due to the poor summer rearing conditions.

The majority of high IP habitat exists on private land in the Hayfork Valley. This area is characterized by poor water quality, a lack of hydrologic function, sedimentation and high water temperatures. High water temperatures, while affected by high summer air temperatures, are exacerbated by reduction of riparian trees, stream widening due to aggradation, over-grazing of riparian zones, flow depletion and agricultural runoff. The stream bed may remain unstable for a long duration, making recolonization of stream side trees difficult even by invasive species such as willows or alders (e.g., lower reaches of Pelletreau Creek and the South Fork Trinity River at Hyampom; Lisle 1981). Several studies and habitat typing reports have noted stream temperature as a major limiting factor for fisheries in the South Fork Trinity (USFS 1990; PWA 1994). Stream temperatures in the mainstem below Hyampom and in Hayfork Creek often reach lethal levels during the summer and tributaries with the potential for thermal refugia often lack adequate flows during the summer (PWA 1994). Poor water quality leads to reduced survival and growth of juveniles and can contribute to thermal barriers for migrating juveniles and smolts.

A limited amount of habitat with adequate temperatures and habitat attributes for juvenile summer rearing exists in the South Fork Trinity. Riparian vegetation is reestablishing in some smaller tributaries and is expected to experience improved water quality in the future (e.g., Sulphur Glade Creek). However many of these streams lack the flow and/or habitat requirements of juvenile coho salmon.

High levels of fine sediment indicate that excessive sediment may also be a major limiting factor in some tributaries and mainstem reaches, for example, the South Fork Trinity River near Hyampom and Hayfork Creek (Gilroy et al. 1992, Dresser et al. 2001). Many streams exhibiting higher channel gradients have flushed substantial amounts of introduced coarse sediment, similar to a pattern of recovery described by Lisle (1981) and Hagans et al. (1986). The mainstem South Fork Trinity River downstream of Hyampom to the confluence with the Trinity River has flushed a substantial portion of the sediment deposited in the 1964 flood. Hyampom Valley transitions from a low gradient, wide alluvial valley to a narrow canyon downstream. The transition area functions as a pinch point that prevents the mobilization of the greater than 25 feet of sediment that filled the Hyampom valley during the 1964 flood. Channel recovery is exacerbated by continued delivery of more sediment than the channel can transport. Headwater streams have also, in some cases, experienced re-growth of riparian zones that has promoted lower stream temperatures. However, reaches of the mainstem South Fork Trinity River upstream of lower Hyampom Valley, and lower Hayfork Creek, seem to be lagging in recovery both in terms of flushing recently introduced sediment and lowering water temperatures (Dale 1990). Water quality and water yield appear to be the main limiting factors to fisheries recovery in the potentially productive Hayfork Creek watershed. In order to improve the viability of this population it will be imperative to improve habitat conditions for juveniles and adults, and address the issues related to straying hatchery adults.

Vital habitat for the South Fork Trinity coho salmon population exists in areas that provide thermal refugia for juveniles in the summer and in areas with relatively intact habitat features such as clean spawning gravel, functional floodplain and channel structure, and established riparian forest. Potential coho salmon refugia areas exist at many stream confluences with the South Fork Trinity River. Madden Creek provides excellent refugia for juvenile and adult coho salmon in the lower South Fork Trinity River (Boberg 2008). It has cool, clean water that originates in the mountains of the Six Rivers National Forest and moderates the high temperature of the South Fork Trinity River in the summer months near the confluence of the two waterways. At times, hundreds of juvenile salmonids congregate in this area. Table 40-4 lists other potential refugia areas.

Table 40-4. Potential thermal refugia in the South Fork Trinity River.

HSA	Stream Name	Ownership
Grouse Creek	Madden Creek	Private/Public
Grouse Creek	Grouse Creek	Private/public
Forest Glenn	Butter Creek	Private
Forest Glenn	Rattle Snake Creek	Private/Public
Hyampom	Olsen Creek	Private
Grouse Creek	Eltapom	Public

Areas with relatively intact spawning and rearing habitat exist in isolated patches of Hayfork Creek and in other, smaller tributaries to the South Fork Trinity. Madden Creek is in the late stages of recovery from the 1964 flood and represents one of the few tributaries flowing off South Fork mountain with good water quality and the potential to accommodate spawning and rearing. The lower part of Hayfork Creek has the greatest extent of high IP, and with increased water quality, this section of Hayfork Creek could serve as the major seat of recovery for coho salmon in the South Fork Trinity River basin. Other important tributaries where coho salmon have recently been found include Butter Creek, Eltapom Creek, Olsen Creek, and Madden Creek (Everest 2008; Boberg 2008).

Adverse Hatchery-Related Effects

No hatcheries or artificial propagation occur in the South Fork Trinity River population area, but Trinity River Hatchery is upstream on the Trinity River. Trinity River Hatchery currently releases 4.3 million juvenile and yearling Chinook salmon, 500,000 yearling coho salmon, and 800,000 yearling steelhead. Jong and Mills (1992) found that 35.8 percent of returning adults to the South Fork Trinity River in 1985 were of hatchery origin. Because adult coho salmon returns to Trinity Hatchery have been in excess of 25,000 fish during some years, it is likely that the stray rate of hatchery coho salmon to the South Fork Trinity River has continued to be high (>35 percent). Because hatchery smolts are not likely to migrate from the Trinity River upstream into the South Fork Trinity River, ecological interactions, such as competition and predation, between juveniles are not likely to occur within the South Fork Trinity River. However, juvenile coho salmon from the South Fork Trinity River population may compete with hatchery fish for food and habitat while rearing in the Lower Trinity River and in the Lower Klamath River. Adverse hatchery-related effects pose a very high stress to all life stages in the South Fork Trinity River sub-basin, because more than 30 percent of the spawners are of hatchery origin (Appendix B) and there is significant potential for ecological interactions.

Altered Sediment Supply

Altered sediment supply presents a high stress for most life stages. The 1964 flood resulted in widespread erosion in the mainstem South Fork Trinity River and many tributaries. Adding to these effects was the extensive harvesting of steep inner gorge slopes and widespread land disturbance. Many basins still suffer from chronic erosion and sedimentation as well as thick deposits of stored sediment and resultant wide, shallow streambeds (PWA 1994). Although the 1964 flood delivered substantial sediment to the South Fork Trinity River, there is evidence that some sites affected by the 1964 flood have since downcut to pre-flood levels (Dresser et al. 2001). In areas where sediment loading is still ongoing, sediment has filled pools, widened channels, and simplified stream habitat. In many reaches, aggradation reduced surface flows, potentially limiting access to migrating juveniles. Stream channels with the greatest fine sediment accumulations in pools and with associated low juvenile fish densities include lower Salt Creek, Hayfork Creek above 9-mile bridge, the entire main stem, East Fork South Fork and Grouse Creek (PWA 1994). High turbidity also has negative impacts on respiration and feeding as well as egg incubation. Sediment loading is greatest in the Hyampom Valley, with most of the sediment being delivered from South Fork Mountain tributaries. The Grouse Creek and Pelletreau Creek sub-watersheds, both of which have been heavily logged since the 1940s, are both major sediment contributors (PWA 1994). “In the 1964 flood, many debris torrents caused significant aggradation (from 15 to 20 ft. in some locations), which probably then triggered many inner gorge landslides" (USEPA 1998), along with substantial channel widening, up to 60 feet in areas. Studies have identified landslides as the major source of sediment, followed by streambank erosion, road surface erosion, and hillslope surface erosion. Hillslope sediment inputs seem to have declined dramatically, indicating that upslope conditions are recovering (Raines 1999, Dresser et al. 2001). There has been some indication that fine sediment levels may be limiting for fish, and it is thought that pools are too shallow now for temperature stratification (Gilroy et al. 1992, PWA 1994). Federally managed watersheds in which cumulative erosion and sedimentation effects are likely to be problems include Butter Creek, Rattlesnake Creek, Plummer Creek, South Fork Mountain Tributaries, East Fork South Fork, Upper South Fork, Hidden Valley, Upper Hayfork Creek, Hyampom and Gulch watersheds.

Impaired Water Quality

The stress of poor water quality is generally high and has the greatest impact on juveniles and smolts due to poor seasonal rearing and migratory conditions. Areas of poor water quality related to accelerated erosion rates, elevated temperature, and contaminant runoff are scattered throughout the basin (PWA 1994). Water quality primarily affects fish and fish habitat in the mainstem South Fork Trinity River and in Hayfork Creek. In Hayfork Creek, water diversion, agricultural practices, residential septic systems, and industrial pollution all contribute to impaired water quality. Water quality has been so bad some years in Hayfork Creek that seasonal fish kills have been documented in the past (PWA 1994). Water temperature in Hayfork Creek and the mainstem South Fork Trinity can reach levels stressful or even lethal (>17 °C) for rearing coho salmon in the summer months (PWA 1994; USFS 1990). Hayfork Creek contributes to poor water temperatures in the mainstem (PWA 1994). In addition to temperature, turbidity effects have been found in the more erodible portions of the basin in the Upper and Lower South Fork sub-basins, particularly west of the mainstem, and in areas where land management practices are most intense (PWA 1994). Other tributaries including, but not limited to Salt Creek, Rattlesnake Creek, Post Creek, Rusch Creek, Tule Creek also suffer from high stream temperatures and associated low dissolved oxygen in the summer months. Many of these streams are adversely affected by illegal water withdrawals, and nutrient and pesticide loading associated with outdoor marijuana cultivation and associated road building and land clearing. Localized areas of non-point source pollution exist and nutrients and toxins from agriculture, roads, and developed areas contribute to poor water quality in the South Fork Trinity basin.

Altered Hydrologic Function

Altered hydrologic function represents a high stress for the population and is especially significant for fry, juveniles, and adults. Flows are naturally low during the summer due to the low elevations in the basin, the bedrock geology and the low water holding capacity. The summers are hot and dry for several months and there is often little water flowing in most creeks during the summer (USFS 1996c). Exacerbating this issue is the substantial water utilization in the South Fork Trinity River, especially Hayfork Creek and its tributaries (PWA 1994), and Rattlesnake Creek (Wiseman, E., pers. comm. 2011) which has caused reductions in the amount of habitat available to rearing juvenile salmon in the summer and restricted access to spawning grounds in the fall. Hayfork Creek below the East Fork has been designated as a critical water shortage area (PWA 1994). Water uses within the Hayfork watershed include numerous withdrawals from Hayfork Creek and East Fork Hayfork Creek for mostly domestic, agricultural and livestock watering purposes. Quantification of the amount diverted is difficult because only an estimated 13 percent of the water diverted from Hayfork Creek is under an appropriated water right (USFS 1996c). Groundwater is also utilized in several portions of the watershed, like Hayfork Valley, and remains undocumented and unregulated. Marijuana cultivation is a serious problem in many areas, such as the Rattlesnake Creek watershed and likely has a significant impact on the hydrologic function of tributary streams during critical low-flow periods in the summer and fall. The South Fork Trinity River basin is also susceptible to rain-on-snow events and intense flooding. Adding to this are the effects grazing and timber harvest have had on the hydrologic function of several streams in the basin by removing trees and vegetation, compacting soils, widening streams and decreasing pool depth. As a result, flows can be flashy and intense at time, leading to possible reduced survival of eggs and fry.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions present a high to medium stress across all life history stages of the South Fork Trinity River population. Decades of intensive grazing, timber harvest, and intense fire impacted the riparian plant and forest communities throughout the basin (Tetra Tech 2000), impacting stream cover and water temperatures during the summer months. Habitat impairments have been identified in Hayfork Creek and its tributaries related to the lack of riparian vegetation. Loss of riparian vegetation can cause a stream to erode its bed, leading to subsequent streambank erosion problems. In some cases, stream down cutting can cause a drop in the local water table, which leads to reduced floodplain connectivity (PWA 1994). In past surveys, the U.S. Forest Service assessed riparian areas and identified watersheds that have more than 15 percent of their riparian zone acreage with low LWD recruitment potential and low shade. From least (17 percent) to greatest (30 percent) were Butter, Corral, Upper S.F. Trinity, Plummer, Lower Hayfork, Eltapom, Rattlesnake, Hidden Valley, Upper Hayfork, and Salt. Grouse Creek and Eltapom Creek in the Crouse Creek HSA, Naufus, Indian Valley, Dobbins, Rattlesnake, and Salt Creeks also show signs of low LWD recruitment. The Upper South Fork, by comparison, has a riparian forest composed largely of Douglas fir and White fir, with canopy closures ranging between 70 percent and 80 percent. Future LWD recruitment in these stands is excellent, with some of the highest recorded volume measurements in the Trinity Basin (USFS 1999c).

Lack of Floodplain and Channel Structure

Floodplain and channel structure present a high to medium stress across life history stages. Lack of floodplain and channel structure is primarily the result of the 1964 flood, with many stream reaches still not recovered. Past and present activities such as mining, road construction, stream diversion, and timber harvest have also modified streamflow and natural erosion processes and altered the dynamic equilibrium of stream channels in areas of the South Fork watershed such as the Hayfork Valley (USFS 1996c). Piles of mine tailings still line the channels of streams such as Hayfork Creek, constricting flows in places, producing sediment sources, and reducing the proper functioning condition of the stream and associated riparian zone. Recent data on instream LWD is limited but an apparent lack of LWD is likely adding to a lack of channel complexity and floodplain connectivity. Juvenile coho salmon are especially affected by a lack of stream complexity because they rely on instream structure and off-channel habitat for freshwater rearing.

Barriers

Barriers are a medium stress across all life stages except the egg life stage. There are no large dams in the South Fork Trinity River drainage; however, numerous small barriers are scattered throughout the sub-basin and could potentially block a significant amount of available habitat. Devastation slide is an adult migration barrier on Grouse Creek and Hyampom (mainstem) and Hayfork (Hayfork Creek) valleys may be temperature barriers to rearing juvenile coho salmon. According to CalFish (2009), there are potentially 4 small dams and 147 road-stream crossing barriers. Of these potential barriers for coho salmon, 11 have been identified as priorities for removal in this database. An assessment on county-owned roads identified 12 low priority stream crossings and four moderate to high priority stream crossings (Trinity County 2000). The number of diversions that act as fish passage barriers to juvenile coho salmon is unknown but presumed to be potentially large given the amount of agriculture in the sub-basin. Unscreened diversions may act to trap juveniles and may prevent upstream or downstream movement.

Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the South Fork Trinity River migrate to and from the ocean through the mainstem Lower Trinity, Lower Klamath River, and the Klamath River estuary. The Klamath River estuary likely plays an important role in providing holding habitat and foraging and refuge opportunities for some juvenile coho salmon from the South Fork Trinity River, given the results of recent research indicating the importance of non-natal rearing in the Lower Klamath River. The degraded conditions that exist throughout the Trinity basin may mean that the estuary plays a very important role by providing the opportunity for juvenile and smolt growth and refugia prior to entering the ocean. The estuary, although relatively intact, suffers from poor water quality, elevated sedimentation and accretion, loss of habitat, and disconnection from tributary streams and the floodplain. Mainstem conditions contribute to this stress because of the issues with water quality, sedimentation and accretion, and degraded habitat in mainstem reaches of both the Lower Trinity and the Lower Klamath rivers. Juveniles, smolts, and adults transitioning through mainstem habitat are exposed to the degraded conditions in these migratory habitats and suffer from the lost opportunity for increased growth and consequently a lower survival rate. The loss and degradation of estuarine and mainstem habitat is considered a medium stress for the population, with the most affected life stages being juveniles, smolts, and adults due to the degradation of rearing and migratory habitat.

Adverse Fishery-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Increased Disease/Predation/Competition

Disease is a medium to low stress across life history stages in the South Fork Trinity River. By the time adult coho salmon enter the Lower Klamath River, columnaris (gill rot) is probably not a significant issue. Coho salmon smolts may be exposed to diseases like ceratomyxosis once they reach the Klamath River; however, the rates of infection are likely to be somewhat low given that the zones with the highest rates of infection are upstream of the Trinity-Klamath confluence (Bartholomew 2008). Competition and predation by non-native German Brown trout, which have been found in the South Fork Trinity River (Jong and Mills 1992), may cause stress to fry, juvenile, and smolt coho salmon. However brown trout numbers are not significant enough to cause high mortality rates.

40.6 Threats

Table 40-5. Severity of threats affecting each life stage of coho salmon in the South Fork Trinity River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Hatcheries	Very High	Very High	Very High	Very High	Very High	Very High
2	Roads[1]	High	Very High	Very High[1]	Medium	High	Very High
3	Dams/Diversions[1]	Medium	High	Very High[1]	Medium	High	High
4	Climate Change	Low	Medium	High	Medium	High	High
5	Agricultural Practices	Low	High	Very High	Medium	Low	Medium
6	High Severity Fire	Medium	Medium	Medium	Medium	Medium	Medium
7	Fishing and Collecting	-	-	Low	Low	Medium	Low
8	Channelization/Diking	Low	Medium	Low	Low	Low	Low
9	Timber Harvest	Low	Low	Low	Low	Low	Low
10	Urban/Residential/Industrial Dev.	Low	Medium	Low	Low	Low	Low
11	Road-Stream Crossing Barriers	-	Low	Medium	Low	Low	Low
12	Invasive Non-Native/Alien Species	Low	Low	Low	Low	Low	Low
13	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low

[1] Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and dams/diversions.

Hatcheries

Hatcheries pose a very high threat to all life stages in the South Fork Trinity River sub-basin. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

Roads

Roads are a high to very high threat across most life history stages. Data indicate road density is very high (>3 miles/square mile) throughout much of the watershed. There are 1,946 miles of roads within the South Fork Trinity River watershed not including skid trails (Tetra Tech 2000). Road density ranges from a high of 5.1 mi/mi2 in Rattlesnake Creek to a low of 1.7 mi/mi2 in Happy Camp and the Upper South Fork Trinity sub-basins (Tetra Tech 2000). The East Fork of Hayfork Creek also has a dense road network on private land in the upper sub-watersheds (USFS 1996c). Impacts associated with roads and tractor skid trails include increased peak flows and increased rates of fine sediment production and incidence of mass failures (Tetra Tech 2000). Sedimentation associated with roads continues to alter natural river processes and salmonid habitat by filling in pools and reducing the quality of spawning gravels. High rates of aggradation resulting in decreased channel complexity and decreased pool depth can be found throughout the South Fork Trinity (Dresser et al. 2001). Road building for access to marijuana cultivation sites is common in many areas of the SONCC coho salmon recovery domain. It is likely that many of these roads are unpermitted and contribute excessive amounts of fine sediment to coho salmon streams.

Dams/Diversions

Dams and diversions present a high threat to the population and affect multiple life stages. Although no major dams exist in this part of the South Fork Trinity River, numerous wells and diversions for domestic and agricultural uses occur throughout the watershed and reduce streamflows during critical low-flow periods. Ewing Reservoir is a small reservoir northeast of Hayfork, but Ewing Gulch, where the dam is located, does not provide habitat for salmon. Numerous vineyards, small farms, and marijuana plantations use water from the South Fork Trinity River and its tributaries including, but not limited to, Rattlesnake and Post creeks. It has been estimated that only 13 percent of water currently diverted from Hayfork Creek and its tributaries have recognized permits (Trinity County 1987, PWA 1994). The effects of diversion are particularly acute in the Hyampom and Hayfork Valleys as well as the Forest Glenn area where summer low flows lead to elevated water temperatures and a constriction of summer rearing habitat. Unscreened diversions can also act as fish passage barriers for juvenile coho salmon and it is likely that many if not all of the illegal diversions in the watershed are unscreened. Although there is a need for more recent assessments, the need for fish screens on diversions in Barker, Big, E. Fork Hayfork, Upper Hayfork, Little, Olsen, Salt, and Tule creeks was identified by PWA (1994). Because of the impacts on summer rearing, diversions pose a very high threat to the juvenile life stage.

Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Climate Change

Climate change poses a high threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 3 °C in the summer and by 1.2 °C in the winter. Bartholow (2005) showed that temperature has already been increasing at a rate of 0.5 °C per decade (1966 to 1979). Annual precipitation amount is predicted to change little over the next century. However, the proportion of precipitation falling as snow is expected to decrease. Snowpack in upper elevations of the basin will decrease with changes in temperature (California Natural Resources Agency 2009). Many of the peaks which now hold snow during the winter months are at elevations that are low enough to be on the cusp of the transition point of snow and rain (<1,800m; Knowles and Cayan 2004, Mote 2006, Regonda et al. 2005). This means that additional warming in the area will immediately impact accumulation of snow, regardless of trends in precipitation. Additionally, the southerly latitude of the basin (Mote 2006) within the SONCC coho salmon ESU puts this basin at a relatively high risk for snowpack loss, which will exacerbate low summer discharge. For the South Fork Trinity River, the trend towards less snowpack, earlier onset of spring snowmelt, and reductions in summertime surface flow are expected to continue into the future (Zhu et al. 2005, Vicuna et al. 2007). Juvenile and smolt rearing and migratory habitat in the South Fork Trinity River and mainstem Klamath River is most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. McCarthy et al. (2009) ran three climate change scenarios in two representative streams in the South Fork Trinity River basin. Simulated temperature increases ranged from 1.4 °C to 5.5 °C during the summer and from 1.5 °C to 2.9 °C during the winter. These temperature increases amplified the weight loss in fish (McCarthy et al. 2009). They concluded that feeding rate and temperature during the summer currently limit the growth and productivity of salmonids (steelhead and rainbow trout) in low-order streams in the South Fork Trinity River basin and predicted that climate change will have detrimental effects on fish growth as well as on macroinvertebrate communities and stream ecosystems in general (McCarthy et al. 2009). Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Also, with all populations in the ESU adult coho salmon will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Agricultural Practices

The effects of water utilization, agricultural runoff, non-point source pollution and sedimentation associated with small farms and wineries is a significant threat to most life stages. Agricultural practices often result in development within floodplain habitat, removal of riparian vegetation, simplification of stream habitat, and degradation of water quality. Substantial portion of low gradient valley reaches in the South Fork Trinity River watershed are used for farming (including marijuana) and ranching. These sub-basins include Hayfork Creek, Rattlesnake Creek, and streams near Hyampom Valley. A survey of parcels owners in the early 1990s who were using water indicated that they can be expected to increase their use of water in the future (PWA 1994). Many survey respondents envisioned expanded water systems, new fences to increase pasture lands, and expanded crops and gardens in the future (PWA 1994). The U.S. Soil Conservation Service reported that groundwater is limited in the Hayfork Valley, so drilling of wells will be of limited utility in meeting future water needs. Illegal marijuana cultivation on public and private land also adds to this threat due to the associated illegal diversion of water and the potential dewatering of tributaries during critical low-flow periods. Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain. Although the number of plants grown each year is unknown, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality in coho salmon streams. The juvenile and fry life stages are most affected by agriculture due to the impacts on summer rearing habitat and water quality.

High Severity Fire

High severity, widespread fire has swept through regions of the South Fork Trinity River in the recent past, such as the complex of fires in 2008. Fires present a medium to high threat across life stages and particularly affect the fry life stage. Although low-severity fire is a natural and healthy process in the watershed, fires are now greater in intensity and severity than they were historically (USFS 2008). Stand-replacing fire in the sub-basin occurs due to excess fuel loads resulting from decades of fire suppression and timber harvest. Impacts to salmon include altered sedimentation processes as well as degraded riparian vegetation characteristics.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Channelization/Diking

Channelization and diking is a low threat to coho salmon in the South Fork Trinity given the large amount of public land in the watershed. Although channelization and diking are not widespread throughout the watershed, localized restrictions of the channel in areas where roads parallel streams reduce floodplain connectivity and function. Other localized instances of channelization near tributary confluences likely occur but the extent of this problem has not been documented. Because the Hayfork Valley does have a substantial amount of private land, this area has the greatest threat from future channelization and diking.

Timber Harvest

Timber harvest is a low overall threat in the South Fork Trinity River drainage. Much of the watershed is in public ownership (U.S. Forest Service). Timber harvest on public land is highly regulated and current and future timber harvesting on Forest Service land is projected to be relatively small in scale and is conducted under strict guidelines designed to protect aquatic resources. However, several extensive vegetation management projects on Forest Service lands in the watershed are planned in the next decade (Rattlesnake, Smoky, East Fork) which will have some effects on hydrologic response despite strict application of best management practices (BMPs).

Timber resources on private land are limited for the most part, but are concentrated in some highly unstable watersheds south and west of Hyampom. Intensive industrial crop forestry in these areas continues to contribute to cumulative watershed effects that have resulted from legacy timber harvest practices. While impacts from private forestry are largely localized to the upper reaches of these western tributaries, sediment routed from these streams, particularly Pelletreau Creek, enters the South Fork at a critical "pinch point" where the river traverses the Hyampom Valley and aggradation is extreme. Valley confinement downstream of Hyampom has resulted in gravel accumulation that has not recovered from historic sediment pulses associated with the 1955 and 1964 floods. In this regard, the latent effects of past timber harvest practices and ongoing modification of hydrologic response on private industrial timberlands continue to impair the watershed.

Urban/Residential/Industrial Development

Rural population growth will continue to present a moderate to low threat to coho salmon in the South Fork Trinity River. In most areas human population is tempered by the large amount of publicly owned land as well as the steep surrounding terrain. However, some areas such as Hayfork and Hyampom contain relatively large tracts of level ground. The South Fork Trinity River basin contains 167 mi2 of private land (18 percent of total watershed area). Population trends indicate that in 2050, the population of Trinity County could be upward of 26,479, roughly double the current population. If this trend holds true for the South Fork Trinity River, demand for water and other resources could increase substantially as the area experiences an increase in the number of housing projects, vacation homes, ranches, vineyards, and small farms. Such growth will likely result in removal of vegetation, increased sediment generation, and the introduction and spread of exotic species. Subdivision of existing parcels will exacerbate this threat. Diversions and groundwater extraction associated with population growth are addressed above under Dams/Diversions.

Road-Stream Crossing Barriers

There are several road-stream crossing barriers in the South Fork Trinity River basin. The California Fish Passage Assessment Database (CalFish 2009) lists 147 road-stream crossing barriers in the South Fork Trinity River basin. Of these, 28 are partial barriers to fish migration, 64 are total barriers, and 42 are unknown. Because of their locations, some above the range of coho salmon, these barriers are considered only a low threat to the population. County surveys by (Trinity County 2000) indicate there are a few total barriers for anadromous fish on county roads (Table 40-6). The crossing on Barker Creek is a barrier to 1.5 miles of fair-to-good habitat. The crossings in Kingsbury Gulch also pose a threat to coho salmon due to the number of crossings (total of four crossings). The habitat upstream of these crossings, however, is of fair quality and of unknown value to coho salmon. On public land, this threat is likely to continue to decrease over time as roads are upgraded and culverts removed or upgraded.

Table 40-6. Moderate to high priority road-stream crossing barriers in the South Fork Trinity River basin.

Priority*	Stream Name	Road Name	County	Barrier Status*
High	Kingsbury Gulch #1, Hayfork Creek	Riverview Road	Trinity	Total
High	Kingsbury Gulch #2, Hayfork Creek	Morgan Hill Road	Trinity	Total
High	Little Barker Creek, Barker Creek	Barker Creek Rd	Trinity	Total
*From Trinity County 2000				

Invasive Non-Native/Alien Species

Competition and predation from German brown trout, a non-native species, poses at least a low threat to young coho salmon. Brown trout are a piscivorous species that are known to prey on juvenile coho salmon. Additionally, brown trout may compete with coho salmon at all life stages for food and rearing habitat. Green sunfish and other exotic species have also established breeding populations in drought years, however, the impacts from these populations on coho salmon are unknown (PWA 1994).

Mining/Gravel Extraction

Mining activities in the region have decreased significantly from historic levels. Suction dredge mining ceased by a court order in 2009. The California Department of Fish and Wildlife is currently prohibited by statute from issuing suction dredge permits (Fish & G. Code, § 5653.1, subd. (b), making it unlawful to use any vacuum or suction dredge equipment in any river, stream, or lake in California (see http://www.dfg.ca.gov/suctiondredge)). This prohibition will remain in effect until CDFW completes a court-ordered environmental review of its permitting program and institutes any changes that are necessary to its former suction dredge permit regulations. There are no known gravel mining operations in the South Fork Trinity River.

40.7 Recovery Strategy

The threats that pose the biggest risk to coho salmon are water diversions, agricultural practices (including marijuana cultivation) and roads. The stresses that are most acute in this population are altered hydrologic function, poor water quality, and altered sediment supply. Decommissioning of roads that are not utilized, or upgrading of roads, and stabilizing areas prone to mass wasting should be a priority for recovery efforts. This will help reduce sediment yield to the river, which will help make flushing of the current sediment load more likely. Decreasing the amount of water diverted during the summer months by promoting off-channel storage during high winter flows is imperative to recovery of this population. Bolstering water conservation initiatives should also be integral to recovery efforts and should help reduce the threats of water utilization to this population. Educating land owners and individuals about the effects of nutrient rich runoff from fertilizers and other agricultural activities is a necessary step in improving water quality. Minimizing the interactions that naturally-produced coho salmon experience after migrating into the Trinity and Klamath rivers where they encounter millions of hatchery fish could help promote recovery of coho salmon. Reducing adult hatchery coho salmon straying into the South Fork Trinity River will help reduce genetic interactions between hatchery and naturally produced fish.

Coho salmon are currently found in the South Fork Trinity River up to Butter Creek, Butter Creek, Hayfork Creek up to Corral Creek, Eltapom Creek, Olsen Creek, and Madden Creek (Everest 2008; Boberg 2008). These areas should be a priority for recovery. Also, high and moderate IP habitat exists in Pelletreau Creek in the Hyampom HSA and Rattlesnake and Post creeks in the Forest Glenn HSA. These streams should also be considered a high priority for recovery.

Several actions will be required to ensure the South Fork Trinity River population meets the recovery target. In order to make water available for use during low summer flow periods, it will be important to increase water storage and increase and improve water delivery from Ewing Reservoir. Also to reduce water diversions during the summer and fall months, it will be necessary to provide water storage tanks, education programs, and incentives to land owners with a priority on Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post creeks. Because much of the South Fork Trinity River watershed is comprised of unstable soils, it will be important to decommission unneeded roads and upgrade other roads with a priority on Corral, Butter, and Hyampom sub-basins and the Grouse Creek HSA excluding Surprise, Mingo, Hells Half Acre, and Middle Eltapom Creeks and the Forest Glenn HSA. Because the proportion of precipitation falling as snow is expected to decrease, it will be necessary to protect cold water tributary streams to ensure that the maximum amount of water is available as thermal refugia for hot summer periods. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 40-7 on the following page lists the recovery actions for the South Fork Trinity River population

Table 40-7. Recovery action implementation schedule for the South Fork Trinity River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.3.1.40	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	All areas where coho salmon would benefit immediately	2a
SONCC-SFTR.3.1.40.1	*Develop a plan to manage stream flows and water temperature during periods of drought*					
SONCC-SFTR.3.1.40.2	*Manage stream flows, guided by the plan*					
SONCC-SFTR.3.1.70	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	Population wide	2b
SONCC-SFTR.3.1.70.1	*Develop a plan to manage stream flows and water temperature during periods of drought*					
SONCC-SFTR.3.1.70.2	*Manage stream flows, guided by the plan*					
SONCC-SFTR.3.1.8	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-SFTR.3.1.8.1	*Assess water diversions, prioritize, and adjust management to benefit life history requirements of coho*					
SONCC-SFTR.3.1.42	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Hayfork Valley	2a
SONCC-SFTR.3.1.42.1	*Increase storage capacity or delivery capability for Ewing Reservoir*					
SONCC-SFTR.3.1.74	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2c
SONCC-SFTR.3.1.74.1	*Assess water diversions, prioritize, and adjust management to benefit life history requirements of coho*					
SONCC-SFTR.3.1.47	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post Creeks, and all streams where coho salmon would benefit immediately	2a
SONCC-SFTR.3.1.47.1	*Identify and cease unauthorized water diversions*					
SONCC-SFTR.3.1.72	Hydrology	Yes	Improve flow timing or volume	Secure and maintain sufficient instream flows	Population wide	2b
SONCC-SFTR.3.1.72.1	*Identify and cease unauthorized water diversions*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SFTR.17.2.46	Hatcheries	No	Reduce adverse hatchery impacts	Identify and reduce impacts of hatchery on SONCC coho salmon	Trinity River Hatchery	2a
SONCC-SFTR.17.2.46.1		*Develop Hatchery and Genetic Management Plan*				
SONCC-SFTR.17.2.46.2		*Implement Hatchery and Genetic Management Plan*				
SONCC-SFTR.3.1.3	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-SFTR.3.1.3.1		*Develop an educational program about water conservation programs and instream leasing programs*				
SONCC-SFTR.3.1.10	Hydrology	Yes	Improve flow timing or volume	Improve irrigation practices	Agricultural private lands in South Fork Trinity Sub-Basin (likely Hyampom, Hayfork, and Lower South Fork), and all areas where coho salmon would benefit immediately	2b
SONCC-SFTR.3.1.10.1		*Assess agricultural lands and develop a plan for improving water delivery systems*				
SONCC-SFTR.3.1.10.2		*Improve water delivery systems, guided by the assessment*				
SONCC-SFTR.3.1.68	Hydrology	Yes	Improve flow timing or volume	Improve irrigation practices	Population wide	2c
SONCC-SFTR.3.1.68.1		*Assess agricultural lands and develop a plan for improving water delivery systems*				
SONCC-SFTR.3.1.68.2		*Improve water delivery systems, guided by the assessment*				
SONCC-SFTR.3.1.4	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-SFTR.3.1.4.1		*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*				
SONCC-SFTR.3.1.4.2		*Implement water dedications to increase instream flows using the streamlined process*				
SONCC-SFTR.3.1.5	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-SFTR.3.1.5.1		*Establish a categorical exemption under CEQA for water leasing to increase instream flows*				
SONCC-SFTR.3.1.6	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-SFTR.3.1.6.1		*Establish a comprehensive groundwater permit process*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.3.1.7	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-SFTR.3.1.7.1	*Assess the utility of water storage tanks for private agricultural and domestic water uses during periods of low flow*					
SONCC-SFTR.3.1.7.2	*Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow*					
SONCC-SFTR.3.1.7.3	*Monitor forbearance compliance and flow*					
SONCC-SFTR.3.1.73	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2c
SONCC-SFTR.3.1.73.1	*Assess the utility of water storage tanks for private agricultural and domestic water uses during periods of low flow*					
SONCC-SFTR.3.1.73.2	*Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow*					
SONCC-SFTR.3.1.73.3	*Monitor forbearance compliance and flow*					
SONCC-SFTR.3.1.2	Hydrology	Yes	Improve flow timing or volume	Manage flow	Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-SFTR.3.1.2.1	*Establish and provide consistent (daily) water master service to ensure water is allocated according to established water rights*					
SONCC-SFTR.3.1.69	Hydrology	Yes	Improve flow timing or volume	Manage flow	Population wide	2c
SONCC-SFTR.3.1.69.1	*Establish and provide consistent (daily) water master service to ensure water is allocated according to established water rights*					
SONCC-SFTR.3.1.1	Hydrology	Yes	Improve flow timing or volume	Monitor instream flows	Hayfork, E. F. Hayfork, Summit, Big, Baker, Salt, Carr, Duncan Tule, Olsen, Butter, Corral, Pelletreau, Rattlesnake and Post Creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-SFTR.3.1.1.1	*Determine instream flow needs for coho salmon*					
SONCC-SFTR.3.1.1.2	*Measure stream flow hourly by establishing a USGS gauging station. This station to be operated in addition to USGS station 11528700*					
SONCC-SFTR.3.1.1.3	*Maintain USGS gauging station*					
SONCC-SFTR.3.1.1.4	*Perform a groundwater study to determine the volume of aquifer storage and the role of aquifers in stream flow*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.3.1.67	Hydrology	Yes	Improve flow timing or volume	Monitor instream flows	Population wide	2c
SONCC-SFTR.3.1.67.1	*Determine instream flow needs for coho salmon*					
SONCC-SFTR.3.1.67.2	*Measure stream flow hourly by establishing a USGS gauging station. This station to be operated in addition to USGS station 11528700*					
SONCC-SFTR.3.1.67.3	*Maintain USGS gauging station*					
SONCC-SFTR.3.1.67.4	*Perform a groundwater study to determine the volume of aquifer storage and the role of aquifers in stream flow*					
SONCC-SFTR.3.1.59	Hydrology	Yes	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	2b
SONCC-SFTR.3.1.59.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-SFTR.3.1.59.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-SFTR.3.1.59.3	*Implement coho salmon instream flow needs plan.*					
SONCC-SFTR.10.3.13	Water Quality	Yes	Protect cold water	Improve regulatory mechanisms	Madden, Grouse, Butter, Olsen, Eltapom, Rattlesnake Creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-SFTR.10.3.13.1	*Identify and prioritize cold water refugia areas currently or potentially supporting coho salmon and develop a plan to improve regulatory oversight*					
SONCC-SFTR.10.3.13.2	*Increase regulatory oversight over diversions affecting these areas, guided by the plan*					
SONCC-SFTR.10.3.61	Water Quality	Yes	Protect cold water	Improve regulatory mechanisms	Population wide	2c
SONCC-SFTR.10.3.61.1	*Identify and prioritize cold water refugia areas currently or potentially supporting coho salmon and develop a plan to improve regulatory oversight*					
SONCC-SFTR.10.3.61.2	*Increase regulatory oversight over diversions affecting these areas, guided by the plan*					
SONCC-SFTR.10.3.14	Water Quality	Yes	Protect cold water	Protect existing or potential cold water refugia	Madden, Grouse, Butter, Olsen, Eltapom, Rattlesnake Creeks, and all streams where coho salmon would benefit immediately	2b
SONCC-SFTR.10.3.14.1	*Develop emergency plan that will protect thermal refugia during warm periods*					
SONCC-SFTR.10.3.14.2	*Protect thermal refugia during warm periods, guided by the plan*					
SONCC-SFTR.10.3.62	Water Quality	Yes	Protect cold water	Protect existing or potential cold water refugia	Population wide	2c
SONCC-SFTR.10.3.62.1	*Develop emergency plan that will protect thermal refugia during warm periods*					
SONCC-SFTR.10.3.62.2	*Protect thermal refugia during warm periods, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.10.1.12	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase flow	Downstream of Hyampom (Butter Creek, Hayfork Creek, Eltapom Creek, Olsen Creek, and Madden Creek), and all streams where coho salmon would benefit immediately	2b
SONCC-SFTR.10.1.12.1	*Develop a plan to address water quality and quantity*					
SONCC-SFTR.10.1.12.2	*Implement plan to address water quality and quantity*					
SONCC-SFTR.10.1.60	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase flow	Population wide	2c
SONCC-SFTR.10.1.60.1	*Develop a plan to address water quality and quantity*					
SONCC-SFTR.10.1.60.2	*Implement plan to address water quality and quantity*					
SONCC-SFTR.1.2.44	Estuary	No	Improve estuarine habitat	Improve estuary condition	Klamath River Estuary	2b
SONCC-SFTR.1.2.44.1	*Implement recovery actions for Lower Klamath River population that address the target "Estuary", including the creation/restoration of off-channel rearing habitat throughout the lower Klamath River*					
SONCC-SFTR.26.1.58	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-SFTR.26.1.58.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-SFTR.10.1.11	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase conifer riparian vegetation	South Fork Trinity Sub-Basin	2c
SONCC-SFTR.10.1.11.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-SFTR.10.1.11.2	*Thin, or release conifers, guided by the plan*					
SONCC-SFTR.10.1.11.3	*Plant conifers, guided by the plan*					
SONCC-SFTR.3.1.41	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	All areas where coho salmon would benefit immediately	3a
SONCC-SFTR.3.1.41.1	*Develop plan to protect coho salmon from effects of climate change*					
SONCC-SFTR.3.1.41.2	*Implement plan based on findings*					
SONCC-SFTR.3.1.71	Hydrology	Yes	Improve flow timing or volume	Improve water management techniques	Population wide	3b
SONCC-SFTR.3.1.71.1	*Develop plan to protect coho salmon from effects of climate change*					
SONCC-SFTR.3.1.71.2	*Implement plan based on findings*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.3.1.48	Hydrology	Yes	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	3b
SONCC-SFTR.3.1.48.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-SFTR.3.1.48.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-SFTR.3.1.48.3	*Implement plan*					
SONCC-SFTR.2.1.23	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Mainstem to Butter Cr., Butter Cr., Hayfork Cr. up to Corral Creek, Eltapom Cr., Olsen Cr., Madden Cr., and all streams where coho salmon would benefit immediately	3b
SONCC-SFTR.2.1.23.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SFTR.2.1.23.2	*Place instream structures, guided by assessment results*					
SONCC-SFTR.2.1.64	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	3d
SONCC-SFTR.2.1.64.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SFTR.2.1.64.2	*Place instream structures, guided by assessment results*					
SONCC-SFTR.2.2.24	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Restore natural channel form and function	Mainstem to Butter Cr., Butter Cr., Hayfork Cr. up to Corral Creek, Eltapom Cr., Olsen Cr., and Madden Cr., and all streams where coho salmon would benefit immediately	3b
SONCC-SFTR.2.2.24.1	*Assess habitat to where potential exists to restore channelized or disconnected reaches. Develop a plan to restore prioritized reaches*					
SONCC-SFTR.2.2.24.2	*Restore natural channel form and function to prioritized reaches, guided by the plan*					
SONCC-SFTR.2.2.66	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Restore natural channel form and function	Population wide	3d
SONCC-SFTR.2.2.66.1	*Assess habitat to where potential exists to restore channelized or disconnected reaches. Develop a plan to restore prioritized reaches*					
SONCC-SFTR.2.2.66.2	*Restore natural channel form and function to prioritized reaches, guided by the plan*					
SONCC-SFTR.8.1.17	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	All areas where coho salmon would benefit immediately	3b
SONCC-SFTR.8.1.17.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-SFTR.8.1.17.2	*Implement plan to stabilize slopes and revegetate areas*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.8.1.75	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-SFTR.8.1.75.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-SFTR.8.1.75.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-SFTR.8.1.18	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Prioritize Corral, Butter, and Hyampom sub-basins and the Grouse Creek HAS excluding Surprise, Mingo, Hells Half Acre, and Middle Eltapom Creeks, and all areas where coho salmon would benefit immediately	3b
SONCC-SFTR.8.1.18.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-SFTR.8.1.18.2	*Decommission roads, guided by assessment*					
SONCC-SFTR.8.1.18.3	*Upgrade roads, guided by assessment*					
SONCC-SFTR.8.1.18.4	*Maintain roads, guided by assessment*					
SONCC-SFTR.8.1.76	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-SFTR.8.1.76.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-SFTR.8.1.76.2	*Decommission roads, guided by assessment*					
SONCC-SFTR.8.1.76.3	*Upgrade roads, guided by assessment*					
SONCC-SFTR.8.1.76.4	*Maintain roads, guided by assessment*					
SONCC-SFTR.2.2.20	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Mainstem to Butter Cr., Butter Cr., Hayfork Cr. up to Corral Creek, Eltapom Cr., Olsen Cr., Madden Cr, and all streams where coho salmon would benefit immediately	3c
SONCC-SFTR.2.2.20.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SFTR.2.2.20.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-SFTR.2.2.65	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	3d
SONCC-SFTR.2.2.65.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SFTR.2.2.65.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SFTR.8.1.19	Sediment	No	Reduce delivery of sediment to streams	Improve grazing practices	Hyampom and Hayfork, and all areas where coho salmon would benefit immediately	3c
SONCC-SFTR.8.1.19.1		*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*				
SONCC-SFTR.8.1.19.2		*Develop grazing management plans to improve water quality and coho salmon habitat*				
SONCC-SFTR.8.1.19.3		*Plant vegetation to stabilize stream bank*				
SONCC-SFTR.8.1.19.4		*Fence livestock out of riparian zones*				
SONCC-SFTR.8.1.19.5		*Remove instream livestock watering sources*				
SONCC-SFTR.8.1.77	Sediment	No	Reduce delivery of sediment to streams	Improve grazing practices	Population wide	3d
SONCC-SFTR.8.1.77.1		*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*				
SONCC-SFTR.8.1.77.2		*Develop grazing management plans to improve water quality and coho salmon habitat*				
SONCC-SFTR.8.1.77.3		*Plant vegetation to stabilize stream bank*				
SONCC-SFTR.8.1.77.4		*Fence livestock out of riparian zones*				
SONCC-SFTR.8.1.77.5		*Remove instream livestock watering sources*				
SONCC-SFTR.10.7.57	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-SFTR.10.7.57.1		*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*				
SONCC-SFTR.10.7.57.2		*Supply marine-derived nutrients to streams guided by the plan*				
SONCC-SFTR.10.7.63	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-SFTR.10.7.63.1		*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*				
SONCC-SFTR.10.7.63.2		*Supply marine-derived nutrients to streams guided by the plan*				
SONCC-SFTR.7.1.25	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Educate landowners and develop community programs	Hyampom, Madden Creek, Grouse Creek, Lower S.F. Trinity, Corral Creek, Lower Hayfork, Hidden Valley Sub-Basins, E.F. S.F. Trinity, Upper South Fork and Happy Camp Creek	3d
SONCC-SFTR.7.1.25.1		*Develop fire hazard reduction educational materials for landowners*				
SONCC-SFTR.7.1.25.2		*Develop a plan for fire break stewardship and defensible space*				
SONCC-SFTR.7.1.25.3		*Implement fire-safe community action plans in identified areas*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.7.1.26	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce fire hazard	Hyampom, Madden Creek, Grouse Creek, Lower S.F. Trinity, Corral Creek, Lower Hayfork, Hidden Valley SubBasins, E.F. S.F. Trinity, Upper South Fork and Happy Camp Creek	3d
SONCC-SFTR.7.1.26.1	*Identify forested stands for fire hazard reduction*					
SONCC-SFTR.7.1.26.2	*Based on assessment, apply appropriate management techniques (e.g., thinning, burning) to reduce risk of high severity fire*					
SONCC-SFTR.16.1.27	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SFTR.16.1.27.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-SFTR.16.1.27.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-SFTR.16.1.55	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal lands	3d
SONCC-SFTR.16.1.55.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-SFTR.16.1.55.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-SFTR.16.1.28	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SFTR.16.1.28.1	*Determine actual fishing impacts*					
SONCC-SFTR.16.1.28.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-SFTR.16.1.56	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-SFTR.16.1.56.1	*Determine actual fishing impacts*					
SONCC-SFTR.16.1.56.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFTR.16.2.29	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SFTR.16.2.29.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-SFTR.16.2.29.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-SFTR.16.2.30	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SFTR.16.2.30.1	*Determine actual impacts of scientific collection*					
SONCC-SFTR.16.2.30.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-SFTR.8.1.16	Sediment	No	Reduce delivery of sediment to streams	Improve timber harvest management practices	Private lands, especially Hayfork and Hyampom	3d
SONCC-SFTR.8.1.16.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan).*					
SONCC-SFTR.2.2.22	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Improve regulatory mechanisms	Population wide	BR
SONCC-SFTR.2.2.22.1	*Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups*					
SONCC-SFTR.2.2.21	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Increase beaver abundance	Mainstem to Butter Cr., Butter Cr., Hayfork Cr. up to Corral Creek, Eltapom Cr., Olsen Cr., and Madden Cr	BR
SONCC-SFTR.2.2.21.1	*Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort*					
SONCC-SFTR.2.2.21.2	*Implement education and technical assistance programs for landowners, guided by the plan*					
SONCC-SFTR.2.2.21.3	*Reintroduce or relocate beaver if appropriate, guided by the plan*					

41. South Fork Eel River Population

Interior Eel River Diversity Stratum

Core, Functionally Independent Population

Moderate Extinction Risk

Population likely above depensation threshold

9,300 Spawners Required for ESU Viability

689 mi^2 watershed (8% Federal ownership)

464 IP-km (288 IP-mi) (29% High)

Dominant Land Uses are Timber Production and Agriculture

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Roads' and 'Dams/Diversions'

Highest Priority Recovery Actions

• Increase instream flows by reducing diversions • Determine effects of marijuana cultivation and minimize if necessary • Increase large woody debris (LWD), boulders, or other instream structure	• Restore natural channel form and function by addressing confinement and channelization • Reduce abundance of Sacramento pikeminnow • Reduce sediment barriers formed by alluvial deposits at the confluence of tributaries

41.1 History of Habitat and Land Use

Starting in the late 1850s, the South Fork Eel River became populated by homesteaders and ranchers. Because of the remoteness of the area, the South Fork Eel River watershed did not experience rapid growth until the 1900s. The tanbark industry between 1900 and 1920 provided an economic stimulus to the region. However, harvesting tanbark killed many tanoak trees, and resulted in significant environmental impacts in the harvested areas. When synthetic tannin was developed, the industry collapsed around 1920.

After World War II, timber harvesting significantly increased in the watershed. Timber harvest has had a large impact on the physical nature of the South Fork Eel River, as has development and clearing of land for ranches and urbanization. Many riparian areas have been cleared for roads or timber production. Erosion from poorly constructed roads in the highly erosive Franciscan geology has contributed to increased sediment loads in the region's rivers, leaving streams shallower, warmer, and more prone to flooding (Bodin et al. 1982). Sediment mobilized from the 1955 and 1964 floods choked the channels with sediment. As a result, many streams have become wider and shallower (U.S. Environmental Protection Agency (EPA) 1999).

With the establishment of rural residences and smaller ranches, the need for water supplies has increased. Currently most of this demand is accommodated through in-stream diversions or shallow wells which have influenced stream flows during summer low-flow periods.

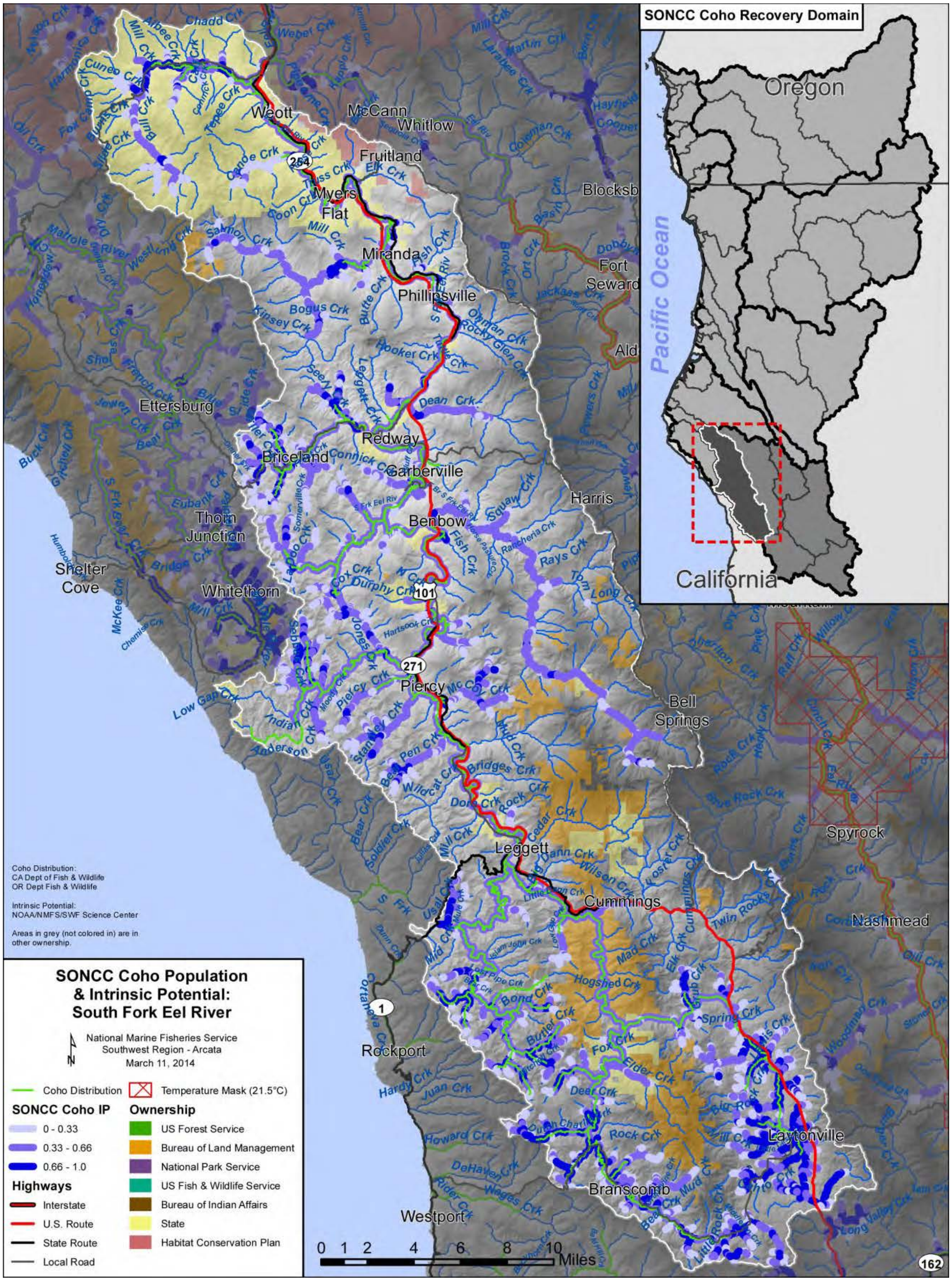

Figure 41-1. The geographic boundaries of the South Fork Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Eel River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

41.2 Historic Fish Distribution and Abundance

The South Fork Eel River watershed has been the largest producer of coho salmon in the Eel River basin, and perhaps one of the largest producers in all of California. An estimated 15,000 to 17,000 coho salmon spawners annually passed Benbow Dam in the 1930s (U.S. Bureau of Land Management [BLM] et al. 1996). In 1975, the last year fish were counted at the Benbow fish station only 509 adult coho salmon were counted (Figure 41-2). Since then, coho salmon abundance has remained low, with an estimate of 1,320 spawners in 1991 for the entire South Fork Eel River (Brown and Moyle 1991). Since 1975, coho salmon abundance has only been surveyed sparingly in the South Fork Eel River watershed. Presence-absence surveys have been conducted more frequently, and show that coho salmon are fairly well distributed in the western tributaries of the watershed. A majority of the eastern tributaries are not found to be used by coho salmon.

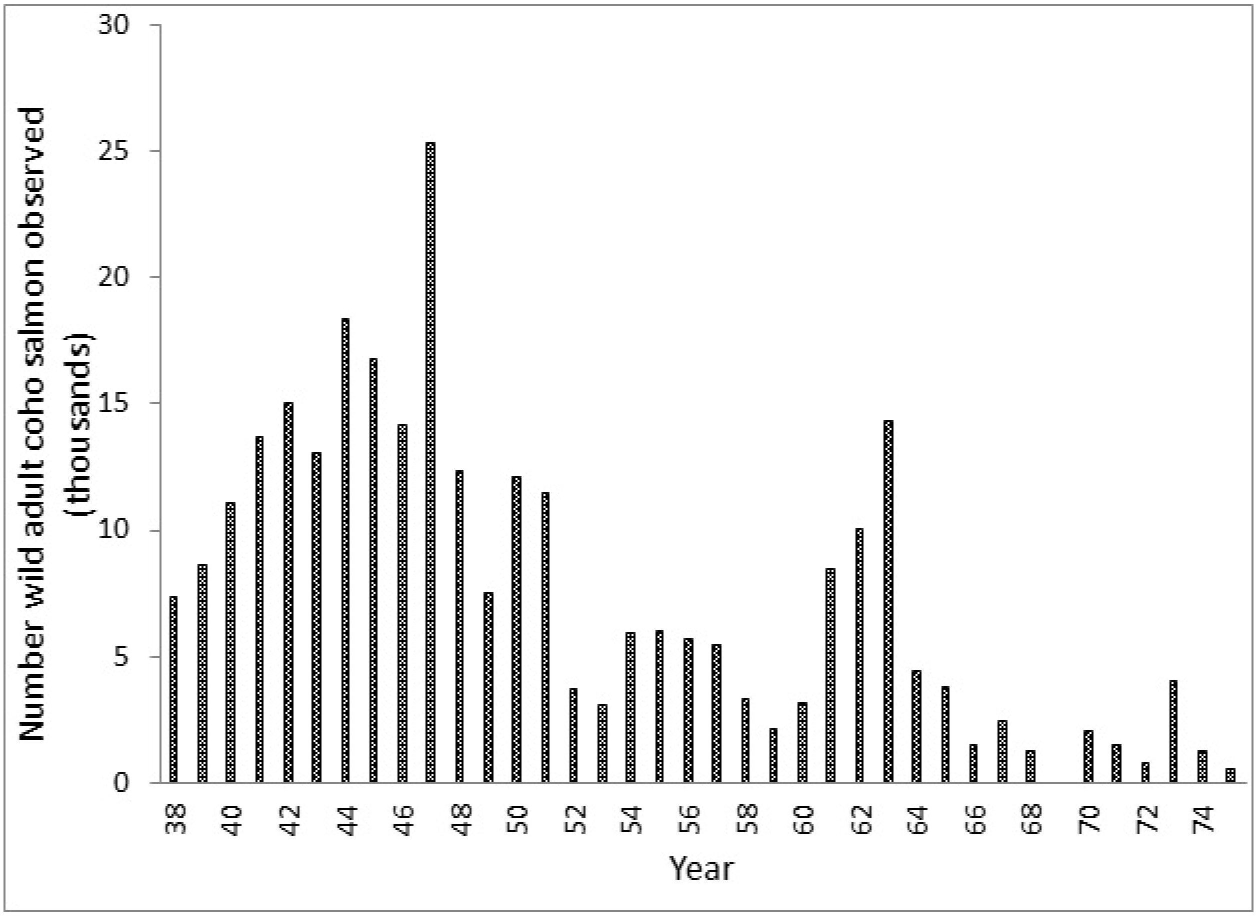

Figure 41-2. Fish counts at Benbow Fish Station, in the South Fork Eel River. Data are from 1938 to 1975 (excluding 1969). Data source: Taylor 1978.

Table 41-1. Tributaries with high IP reaches (IP >0.66) (Williams et al. 2006).

Area	Tributary
Lower	Bull Creek, Canoe Creek, Salmon Creek
Middle	Anderson Creek, Bear Creek, Bear Pen Creek, China Creek, Hollow Tree Creek (Bond Creek, Butler Creek, Huckleberry Creek, Low Gap Creek, Michaels Creek, Redwood Creek, Waldron Creek), Indian Creek, McCoy Creek, Miller Creek, Moody Creek, Piercy Creek, Sebbas Creek, Seely Creek, Sproul Creek, Standley Creek
Upper	Dutch Charley Creek, Grub Creek, Kenny Creek, Redwood Creek, Rock Creek, Tenmile Creek

41.3 Status of South Fork Eel River Coho Salmon

Spatial Structure and Diversity

Williams et al. (2008) determined that at least 20 coho salmon per IP-km of habitat are needed (9,300 spawners total) to approximate the historical distribution of South Fork Eel River coho salmon and habitat. The current distribution of spawners is mostly in western tributaries of the South Fork Eel River. The South Fork Eel population utilizes a ‘long run’ strategy in which adults and smolts must migrate great distances between the ocean to their natal spawning grounds, or vice versa.

Population Size and Productivity

Williams et al. (2008) determined at least 464 coho salmon must spawn in the South Fork Eel River each year to avoid depensatory effects.

The South Fork Eel River coho salmon population size is unknown, but is likely extremely reduced compared to historic levels. Surveys in the South Fork Eel River are limited, but indicate that coho salmon spawner abundance may be able to reach at least the 464 depensation threshold. In 2009, 357 adult coho salmon were counted at Hollow Tree Creek (Downie 2010). Because numerous other tributaries in the South Fork Eel River provide additional suitable spawning and rearing habitat for coho salmon, the potential is high for the entire South Fork Eel River population to produce at least 464 spawners. Spawning ground surveys conducted in 2011 and 2012 confirm that the number of spawners exceeds the depensation threshold of 464 spawners (Renger, A., pers. comm. 2013). Some cohorts have been lost or severely depressed in some South Fork Eel River streams and the population growth rate is unknown, but expected to be negative in most years for the majority of the tributaries in the population area. Therefore, the South Fork Eel River coho salmon population is at moderate risk of extinction given the moderate population size and probable negative population growth rate.

Nine years (1999 to 2007) of juvenile capture data from the west and south forks of Sproul Creek indicate that both forks have the potential to produce thousands of juvenile coho salmon. The highest combined population estimate of 5,218 smolts occurred in the last year of the study. In addition, a three-year (2000 to 2002) out-migrant population monitoring study in Hollow Tree Creek (Mendocino Redwood Company 2002) reported an estimated smolt population size of 35,178, 35,976, and 9,785, respectively.

Extinction Risk

The South Fork Eel River population is at moderate risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one, but the ratio is less than the minimum required spawner density (both criteria described in Williams et al. 2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, p. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The South Fork Eel River population is a core, Functionally Independent population within the Interior Eel River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the South Fork Eel River core population should have at least 9,300 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. The South Fork Eel population is the largest and most stable in the Interior Eel River diversity stratum. Besides its role in achieving demographic goals and objectives for recovery, it is expected to play a major role in the re-colonization of other populations in the stratum by providing strays.

41.4 Plans and Assessments

State of California

Total Maximum Daily Loads
http://www.swrcb.ca.gov/northcoast/

In December 1999, the USEPA published the final Total Maximum Daily Loads (TMDLs) for temperature and sediment for the South Fork Eel River. The North Coast Regional Water Quality Control Board (NCRWQCB) is required to develop measures that will result in the implementation of the TMDLs in accordance with the requirements of 40CFR 130.6.Amendments of the Water Quality Control Plan for the North Coast Region (the Basin Plan), in the form of an Action Plan, describe the steps that are necessary to meet the TMDLs.

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The Recovery Strategy includes analyses and recommendations regarding coho salmon recovery in the South Fork Eel River.

Eel River Salmon and Steelhead Restoration Action Plan

In 1997, the California Department of Fish and Game assessed the Eel River watershed and provided recommendations for restoration of salmonid stocks. Primary recommendations include removing barriers, reducing sediment inputs, improving riparian forest conditions, reducing water withdrawals, enhancing habitat, and suppressing Sacramento pikeminnow.

Mendocino Redwood Company

Habitat Conservation Plan/Natural Communities Conservation Plan

http://www.mrc.com/key-policies/habitat-conservation-planning/The Mendocino Redwood Company Habitat Conservation Plan (HCP) and Natural Communities Conservation Plan (NCCP) have been in the developmental stages since 1999 and are approaching completion. The goals of the HCP/NCCP are to maintain viable populations of covered salmonids and improve and enhance aquatic habitat conditions throughout MRC's forestlands. More information about HCPs in the South Fork Eel watershed can be found in Section 3.2.5.

Watershed Analysis for Hollow Tree Creek

MRC completed a Watershed Analysis in 2004 for their ownership in the South Fork Eel River which occurs primarily in Hollow Tree Creek, a tributary to the South Fork Eel River. It presents results of fish habitat assessments, fish distribution surveys, out-migrant population estimates, stream channel conditions, road inventory, and mass wasting inventories.

Watershed Analysis for the South Fork Eel River

In 1996, the Bureau of Land Management, Six Rivers National Forest, and the U.S. Fish and Wildlife Service finalized a watershed analysis for the South Fork Eel River. This watershed analysis focused on areas where information was available, such as lands managed by BLM and State Parks, and actions that federal agencies could implement to improve habitat.

41.5 Stresses

Table 41-2. Severity of stresses affecting each life stage of coho salmon in the South Fork Eel River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	High	Very High	Very High[1]	Very High	Very High	Very High
2	Altered Sediment Supply	Very High	Very High	Very High	High	Very High	Very High
3	Altered Hydrologic Function[1]	Medium	High	Very High[1]	High	Medium	High
4	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
5	Impaired Water Quality	Medium	High	High	High	Medium	High
6	Barriers	-	High	High	Medium	High	High
7	Increased Disease/Predation/Competition	Low	High	High	High	Low	High
8	Impaired Estuary/Mainstem Function	-	Low	High	High	Medium	High
9	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
10	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage

Key Limiting Stresses, Limited Life Stage, and Habitat

The key limiting stresses for the population include a 'Lack of Channel and Floodplain Structure' and 'Altered Hydrologic Function'. Water quantity where agricultural (marijuana growing) and domestic use coincides has become a significant stress to summer rearing life stages. This is especially the case in more urbanized areas, such as in the Salmon Creek watershed. The South Fork Eel River is a diverse watershed, where limiting stresses cannot be broadly applied to the entire watershed. Although the South Fork Eel River has been listed as water quality impaired because of elevated water temperature, the upper part of the watershed generally has water temperatures suitable for coho salmon. Elevated water temperature is a concern in the lower half of the South Fork Eel River, from approximately Benbow to the mouth (Downie 2010). Altered hydrologic function due to the dams and diversions for marijuana growing as well as for domestic use has become the key limiting stress in the population. Predation by Sacramento pikeminnow is a significant concern in the South Fork Eel River population area, as well as throughout the Eel River watershed. All of these stresses affect fry, juveniles, and smolts the most, so reducing these stresses would support successful emigration of juveniles and smolts to the ocean.

Because the juvenile life stages are the most limited in this watershed, protecting quality rearing habitat is essential for the viability of this population. Tributaries that have cold water, instream cover, and deep pools are vital for juvenile survival. Tributaries such as Indian, Hollow Tree, Jack of Hearts, Redwood, and Sproul Creeks still provide excellent rearing habitat for coho salmon.

Lack of Floodplain and Channel Structure

This stress was rated as very high for nearly all life stages. Lack of floodplain and channel structure in the South Fork Eel River is primarily due to excessive sediment loads occurring in the watershed, coupled with paucity of large woody and riparian vegetation. Pool depths have been reduced and habitat shelter ratings have diminished over time as sediment loads and a lack of woody debris result in simplified channel structure. Juveniles are stressed by a lack of channel complexity and adults are stressed by a lack of staging pools. These habitat features are important considering the long run distances required to migrate from the ocean to the natal streams, or vice versa. Roads constrict the channel where they occur parallel to the stream.

Altered Sediment Supply

Sediment was rated as a high to very high stress to coho salmon in this population. The USEPA recognized this by listing the South Fork Eel River as sediment impaired. The Eel River has the highest natural sediment load in the United States due to the highly erodible soils in the area, and anthropogenic impacts in the South Fork Eel River have exacerbated these high loads such that pools have filled and substrate quality is poor (Brown and Ritter 1971). High sediment loads result in shallower and less diverse habitat, reduce growth, and reduce reproductive success.

Altered Hydrologic Function

This stress was rated as a high threat overall. Marijuana is the primary agricultural crop grown in the population area and water diversions to support marijuana growing operations have significantly reduced summer base flows leading to dry and disconnected stream channels. Efforts by the CDFW have documented extensive marijuana growing operations in both Redwood Creek and Salmon Creek. In these areas, the CDFW estimates almost 19,000,000 gallons of water are used each growing season to irrigate marijuana crops in these two sub-basins alone. Summer base flows in tributaries to the South Fork Eel River are also affected by rural and urban water withdrawals. Low summer flows reduce habitat and contribute to higher water temperatures.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions are a high stress to the juvenile life stages. Riparian stands are currently dominated by willow, alder, and hardwood. Riparian habitat has somewhat rebounded from past large flood events. Riparian forests shade streams, provide terrestrial subsidies, increase habitat complexity, and influence sediment storage and transport. The interruption in riparian function has led to warming of water temperatures, a reduction in wood recruitment, and ultimately a simplification of habitat and loss of channel complexity.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in the population area and in adjacent population areas. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area and those mainstems in which coho salmon must migrate through are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate.

Impaired Water Quality

The primary issue with water quality in the South Fork Eel River is water temperatures and excessive nutrient inputs from marijuana growing operations. Water quality is a high stress to the population, the extent of the temperature problem warranted that the South Fork Eel River is listed as impaired for temperature under Clean Water Act Section 303(d). Water temperature in the South Fork Eel River approaches lethal levels in a number of stream reaches, is stressful in most others, and severely limits the amount of habitat available to coho salmon. High temperatures also favor Sacramento pikeminnow productivity. High temperatures are caused by reduced stream flow, lack of riparian canopy, and broader, shallower streams.

Barriers

Barriers to fish passage pose a high stress to coho salmon in the South Fork Eel River and present a significant impediment to restoration and recovery of the South Fork Eel River coho salmon population, resulting in a high stress ranking. Numerous stream-road crossings exist throughout the population area, and at least 58 crossings partially impede fish migration. The Benbow Dam is a seasonal barrier to both adults and juveniles, and has been funded to be removed in the near future. A remnant dam from the former Hollow Tree Creek Fish Hatchery remains partially in place on Hollow Tree Creek. There are currently no other dams in the South Fork Eel River watershed other than unpermitted temporary summer dams on tributaries (Downie 2010).

Increased Disease, Competition and Predation

The non-native Sacramento pikeminnow poses a high threat to coho salmon fry, juveniles, and smolts. Pikeminnow prey on all coho salmon life stages except adults, and also compete with juveniles for limited food and habitat. The pikeminnow is successful in the South Fork Eel River because it thrives in severely impacted habitat that is less favorable for salmonids.

Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the South Fork Eel River migrate to and from the ocean through the mainstem Eel River and the Eel River estuary. The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon. The degraded function of the Eel River estuary and mainstem migratory corridor is a high stress for this population. The Eel River estuary is severely impaired because of diking and filling of wetlands for agriculture and flood protection. Approximately 60 percent of the estuary has been lost through the construction of levees and dikes (CDFG 2010b). There is evidence that the estuary once supported a high degree of estuarine habitat and rearing potential, but very little of that function still exists due to the loss of tidal wetlands and simplification of habitats. Mainstem conditions contribute to this stress because of the issues with reduced flow from diversions, water quality, predation, and degraded habitat in mainstem reaches. Juveniles, smolts, and adults transitioning through estuarine and mainstem habitat are stressed by the degraded conditions in these migratory habitats and suffer from lost opportunity for increased growth and survival.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into the South Fork Eel River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

41.6 Threats

Table 41-3. Severity of threats affecting each life stage of coho salmon in the South Fork Eel River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	Very High	Very High	Very High[1]	Very High	Medium	Very High
2	Dams/Diversions [1]	Low	High	Very High[1]	Medium	High	High
3	Timber Harvest	High	High	High	High	Medium	High
4	High Severity Fire	High	High	High	Medium	High	High
5	Road-Stream Crossing Barriers	-	High	High	High	High	High
6	Urban/Residential/Industrial Dev.	Medium	High	High	High	Medium	High
7	Invasive Non-Native/Alien Species	Low	Medium	High	High	Low	High
8	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
9	Channelization/Diking	Medium	Medium	Medium	Medium	Medium	Medium
10	Climate Change	Medium	Medium	Medium	Medium	Medium	Medium
11	Mining/Gravel Extraction	Medium	Medium	Medium	Medium	Medium	Medium
12	Fishing and Collecting	-	-	Low	Low	Medium	Low
13	Hatcheries	Low	Low	Low	Low	Low	Low

[1] Key limiting threats and limited life stage

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and dams/diversions.

Roads

Dirt and gravel roads are a threat to coho salmon and habitat restoration. Roads constitute a very high threat for most life stages. Road density is very high in most of the population area. Given the sedimentation problems throughout the watershed, roads should be considered for removal or upgrade treatments to reduce sediment delivery. Road building for access to marijuana cultivation sites is common and likely to be unpermitted and contribute sediment to coho salmon streams.

Dams/Diversions

Benbow Dam is a seasonal barrier to both adults and juveniles, and is currently being studied for removal. Localized water diversion for rural residential and agricultural use reduces stream flow during critical juvenile rearing periods and in the early periods of adult migration. Marijuana cultivation has become abundant in many areas of the population. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer 2013a). Most diversion for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

The CDFW mapped the locations of marijuana plants and greenhouses in two tributaries of the South Fork Eel (Redwood Creek and Salmon Creek). CDFW estimates that marijuana grown outdoors or in greenhouses in Redwood Creek and Salmon Creek uses a combined total of 18.6 million gallons of water per season, or approximately 235,381 gallons of water per day (CDFW 2013b), based on industry-provided estimates of water needs. These figures were generated from only Salmon Creek and Redwood Creek, and do not include marijuana cultivation sites from other sub-basins. The high intensity growing in select tributaries is contributing to dry stream channels and warmer water temperatures. As stream channels dry, pools become disconnected and juveniles are subject to predation, competition, and poor water quality.

Timber Harvest

Timber harvest was ranked as a high threat because, given the percentage of the watershed that is privately owned, future timber harvest activities will continue to exacerbate the stresses caused by legacy timber harvest activities. Only a fraction of the land base which is zoned as Timber Production Zones in this watershed is covered by a draft HCP. HCPs have conservation measures and objectives to ensure that both populations of fish and their habitats are maintained or improved over time. Forest lands are being cleared and graded to create new marijuana cultivation sites. In many cases the land disturbance is not regulated, and likely contributes sediment to coho salmon streams. Land clearing and grading for marijuana growing operations has become common in both upslope and riparian areas in the population, as evidenced by Google Earth and reports issued by the CDFW (HGA 2010).

High Severity Fire

Fire constitutes a high threat to most life stages of coho salmon. The altered vegetation characteristics throughout the watershed increase the risk of high severity fires which alter sedimentation processes, as well as riparian vegetation characteristics. Historically, Native American vegetation management and natural fire cycles created a mosaic of fire resistant vegetation that lessened catastrophic fires.

Road-stream Crossing Barriers

Numerous road-stream crossings continue to block fish passage within the South Fork Eel River watershed, and contribute to a high threat to almost all life stages of coho salmon. The

California Fish Passage Assessment Database (CalFish 2009) shows that there are 76 total road crossings that may block fish passage, of which 29 are total barriers, 29 are partial or temporal, and 18 are unknown.

Urban/Residential/Industrial Development

Although Urban/Residential/Industrial Development poses a moderate threat, much of the watershed with high IP value is located in and around the city of Laytonville. Future growth of this area is likely as transportation infrastructure improves and there is further northerly migration from southern metropolitan areas due to declining water supplies and other mandatory amenities in more southerly locations. In addition, further rural residential development is likely as large agricultural holdings are subdivided into smaller ranches. Higher population densities will likely increase road building, land clearing, well drilling, septic system construction, and other development with the consequent increase in stresses.

Invasive Non-Native/Alien Species

The non-native Sacramento pikeminnow is a high threat to fry, juveniles, and smolts because they compete with and prey on the young coho salmon. Sacramento pikeminnow was introduced in Lake Pillsbury in 1979 (Brown and Moyle 1997), and has spread throughout the entire Eel River watershed. The warm water temperatures in the Eel River and Lake Pillsbury allow this voracious predator to thrive in this system. The presence of the Sacramento pikeminnow in Lake Pillsbury makes eradication of this species from the Eel River basin extremely difficult. Any effort to remove this species in the Eel River without treating the lake will only be temporary because the lake will continue to be the source population for the rest of the Eel River watershed.

Agricultural Practices

Grazing occurs throughout the watershed and may contribute to increased sediment generation and delivery. However, specific information on the magnitude of the threat is limited. In addition, remote outdoor agricultural cultivation (marijuana growing) likely results in riparian vegetation impacts, water withdrawals, diesel spills, and pesticide leaching into streams and groundwater. Marijuana cultivation has become abundant in most of the population area and is the primary crop grown. Although the number of plants grown each year is unknown, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality in coho salmon streams. Water withdrawals for agricultural uses were considered in the “Dams/Diversions” threat.

Channelization/Diking

Channelization and diking poses a moderate threat to coho salmon in the population area, and is primarily associated with road building. As populations grow and expand, the need to contain flood waters in the vicinity of towns and cities will become increasingly common. Flood control in rural areas is also a threat as marijuana growing and greenhouses become more common along the floodplains of tributaries and mainstem reaches.

Climate Change

Climate change poses a high threat to this population. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature shows a large increase over the next 50 years (see Appendix B for modeling methods). Average temperature could increase by up to 2 °C in the summer and by up to 1 °C the winter. Annual precipitation is predicted to trend downward over the next century (Feely et al. 2008). The vulnerability of the Eel River estuary to sea level rise is very high. Juvenile and smolt rearing and migratory habitat in the South Fork Eel River and mainstem Eel River is most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Rising sea level may also impact the quality and extent of wetland rearing habitat. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. Adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Mining/Gravel Extraction

Gravel extraction occurs in the South Fork Eel River, but is relatively isolated and conducted with state and federal oversight. The medium ranking for this threat reflects the sensitivity of the channel to additional disturbances (i.e., lack of floodplain and channel structure).

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the South Fork Eel River population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

41.7 Recovery Strategy

The degraded condition of the South Fork Eel River habitat, combined with the depressed coho salmon population size and distribution, increases the risk of extinction of this important, inland coho salmon population. These factors, combined with the facts that most of the watershed is in private ownership, much of the high IP areas are in developed areas, and predation and competition from non-native Sacramento pikeminnow severely limit juvenile survival, indicates that immediate measures may be necessary to sustain the South Fork Eel River population.

By addressing the major stresses to the population – by restoring summer base flows, reducing sediment from roads, increasing the complexity of stream channels, and reducing the effects of timber harvest – recovery of the South Fork Eel River population will be promoted. Restoration activities that increase summer flows, enhance the complexity of stream habitats, reduce sediment inputs, increase connectivity to floodplains, enhance estuarine habitats, increase riparian vegetation, and reduce the abundance of Sacramento pikeminnow should be immediately implemented.

Coho salmon are found in relatively high numbers in several tributaries in the western region of the population area. Areas with extant sub-populations of coho salmon such as Hollow Tree Creek should receive priority for recovery actions over those areas with little or no coho salmon. Focusing on areas where coho salmon are currently present ensures that recovery actions implemented will have maximum benefit over shorter periods of time. However, the most limited life stages are juveniles and smolts predominantly because of poor migratory habitats in the mainstem and estuary of the Eel River. Addressing Sacramento pikeminnow and the quality of the Eel River estuary as well as other actions to improve the migratory corridors for the South Fork Eel population are top priority. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 41-4 on the following page lists the recovery actions for the South Fork Eel River population.

Table 41-4. Recovery action implementation schedule for the South Fork Eel River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFER.3.1.6	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately, especially Redwood, Sproul, Indian, Salmon, and Cedar creeks	1
SONCC-SFER.3.1.6.3	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-SFER.3.1.6.4	*Provide incentives and education to landowners to reduce water consumption and reduce groundwater pumping and surface water diversion by utilizing conservation and storage*					
SONCC-SFER.3.1.5	Hydrology	Yes	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	1
SONCC-SFER.3.1.5.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-SFER.3.1.5.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-SFER.3.1.5.3	*Implement coho salmon instream flow needs plan.*					
SONCC-SFER.3.1.51	Hydrology	Yes	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2c
SONCC-SFER.3.1.51.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-SFER.3.1.51.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-SFER.3.1.51.3	*Implement plan*					
SONCC-SFER.3.1.10	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide, especially Redwood, Sproul, Indian, Salmon, and Cedar creeks	2c
SONCC-SFER.3.1.10.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-SFER.3.1.70	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	2d
SONCC-SFER.3.1.70.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-SFER.3.1.11	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2c
SONCC-SFER.3.1.11.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-SFER.3.1.11.2	*Implement water dedications to increase instream flows using the streamlined process*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFER.3.1.7	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately, especially Redwood, Sproul, Salmon, Indian, and Cedar creeks	2c
SONCC-SFER.3.1.7.1	*Establish a forbearance program modeled after the Mattole watershed*					
SONCC-SFER.3.1.7.2	*Monitor forbearance compliance and flow*					
SONCC-SFER.3.1.49	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2c
SONCC-SFER.3.1.49.1	*Identify and cease unauthorized water diversions*					
SONCC-SFER.3.1.71	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-SFER.3.1.71.1	*Identify and cease unauthorized water diversions*					
SONCC-SFER.3.1.72	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-SFER.3.1.72.1	*Establish a forbearance program modeled after the Mattole watershed*					
SONCC-SFER.3.1.72.2	*Monitor forbearance compliance and flow*					
SONCC-SFER.2.1.1	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately, prioritize Redwood, Sproul, Cedar, Indian, and Hollow Tree creeks	2c
SONCC-SFER.2.1.1.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SFER.2.1.1.2	*Place instream structures, guided by assessment results*					
SONCC-SFER.2.1.67	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-SFER.2.1.67.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-SFER.2.1.67.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFER.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately, prioritize key tributaries such as Redwood, Sproul, Cedar, Indian, and Hollow Tree creeks	2c
SONCC-SFER.2.2.3.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SFER.2.2.3.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-SFER.2.2.69	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-SFER.2.2.69.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-SFER.2.2.69.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-SFER.2.2.2	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Restore natural channel form and function	All streams where coho salmon would benefit immediately	2c
SONCC-SFER.2.2.2.1	*Conduct assessment to identify and prioritize reaches which are confined and/or channelized by man-made structures such as roads, dikes, and levees*					
SONCC-SFER.2.2.2.2	*Implement priority actions to address confinement and channelization, guided by the assessment*					
SONCC-SFER.2.2.68	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Restore natural channel form and function	Population wide	2d
SONCC-SFER.2.2.68.1	*Conduct assessment to identify and prioritize reaches which are confined and/or channelized by man-made structures such as roads, dikes, and levees*					
SONCC-SFER.2.2.68.2	*Implement priority actions to address confinement and channelization, guided by the assessment*					
SONCC-SFER.5.1.46	Passage	No	Improve access	Reduce sediment barriers	Hartsook Creek confluence with South Fork Eel and Pipeline and Poison Oak Creek, and all streams where coho salmon would benefit immediately	2c
SONCC-SFER.5.1.46.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-SFER.5.1.46.2	*Construct low flow channels, and reduce stream gradient to provide fish passage over alluvial deposits for all life stages*					
SONCC-SFER.5.1.75	Passage	No	Improve access	Reduce sediment barriers	Population wide	2d
SONCC-SFER.5.1.75.1	*Inventory and prioritize barriers formed by alluvial deposits*					
SONCC-SFER.5.1.75.2	*Construct low flow channels, and reduce stream gradient to provide fish passage over alluvial deposits for all life stages*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFER.5.1.25	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	2c
SONCC-SFER.5.1.25.1	*Evaluate and prioritize barriers for removal*					
SONCC-SFER.5.1.25.2	*Remove barriers, based on evaluation*					
SONCC-SFER.5.1.74	Passage	No	Improve access	Remove barriers	Population wide	2d
SONCC-SFER.5.1.74.1	*Evaluate and prioritize barriers for removal*					
SONCC-SFER.5.1.74.2	*Remove barriers, based on evaluation*					
SONCC-SFER.1.2.43	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	2c
SONCC-SFER.1.2.43.1	*Implement recovery actions for Lower Eel/Van Duzen River population that address the target "Estuary"*					
SONCC-SFER.26.1.63	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2c
SONCC-SFER.26.1.63.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-SFER.14.2.14	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2c
SONCC-SFER.14.2.14.1	*Determine the effectiveness of various pikeminnow suppression techniques and develop experimental control methods. Develop a plan that identifies watersheds suitable for experimental pikeminnow suppression*					
SONCC-SFER.14.2.14.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					
SONCC-SFER.10.1.48	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	All streams where coho salmon would benefit immediately	2c
SONCC-SFER.10.1.48.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-SFER.10.1.48.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-SFER.10.1.48.3	*Increase riparian vegetation and shading at sources of cool water*					
SONCC-SFER.10.1.64	Water Quality	No	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Population wide	2d
SONCC-SFER.10.1.64.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-SFER.10.1.64.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-SFER.10.1.64.3	*Increase riparian vegetation and shading at sources of cool water*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFER.7.1.45	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	Population wide	2d
SONCC-SFER.7.1.45.1	*Identify and cease all unauthorized land clearing and grading associated with marijuana cultivation*					
SONCC-SFER.3.1.12	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3c
SONCC-SFER.3.1.12.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-SFER.3.1.13	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3c
SONCC-SFER.3.1.13.1	*Establish a comprehensive groundwater permit process*					
SONCC-SFER.5.1.9	Passage	No	Improve access	Remove dam	South Fork Eel River at Benbow	3c
SONCC-SFER.5.1.9.1	*Develop a plan to remove Benbow Dam*					
SONCC-SFER.5.1.9.2	*Remove Benbow Dam*					
SONCC-SFER.8.1.18	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	All streams where coho salmon would benefit immediately	3c
SONCC-SFER.8.1.18.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-SFER.8.1.18.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-SFER.8.1.77	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-SFER.8.1.77.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-SFER.8.1.77.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-SFER.8.1.50	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	All streams where coho salmon would benefit immediately	3c
SONCC-SFER.8.1.50.1	*Identify and cease unauthorized road building or grading*					
SONCC-SFER.8.1.78	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	Population wide	3d
SONCC-SFER.8.1.78.1	*Identify and cease unauthorized road building or grading*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SFER.8.1.15	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All streams where coho salmon would benefit immediately, prioritize Red Mountain Management Area, Redwood, Sproul, Salmon, Indian, and Cedar Creeks	3c
SONCC-SFER.8.1.15.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-SFER.8.1.15.2		*Decommission roads, guided by assessment*				
SONCC-SFER.8.1.15.3		*Upgrade roads, guided by assessment*				
SONCC-SFER.8.1.15.4		*Maintain roads, guided by assessment*				
SONCC-SFER.8.1.76	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-SFER.8.1.76.1		*Assess and prioritize road-stream connection, and identify appropriate treatments*				
SONCC-SFER.8.1.76.2		*Decommission roads, guided by assessment*				
SONCC-SFER.8.1.76.3		*Upgrade roads, guided by assessment*				
SONCC-SFER.8.1.76.4		*Maintain roads, guided by assessment*				
SONCC-SFER.10.2.19	Water Quality	No	Reduce pollutants	Remove pollutants	All streams where coho salmon would benefit immediately	3c
SONCC-SFER.10.2.19.1		*Remove hazardous materials from streams*				
SONCC-SFER.10.2.65	Water Quality	No	Reduce pollutants	Remove pollutants	Population wide	3d
SONCC-SFER.10.2.65.1		*Remove hazardous materials from streams*				
SONCC-SFER.10.7.62	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-SFER.10.7.62.1		*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*				
SONCC-SFER.10.7.62.2		*Supply marine-derived nutrients to streams guided by the plan*				
SONCC-SFER.10.7.66	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-SFER.10.7.66.1		*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*				
SONCC-SFER.10.7.66.2		*Supply marine-derived nutrients to streams guided by the plan*				
SONCC-SFER.3.1.4	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-SFER.3.1.4.1		*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-SFER.7.1.23	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve regulatory mechanisms	Population wide	3d
SONCC-SFER.7.1.23.1		*Develop planning guidelines or ordinances that protect riparian stands*				
SONCC-SFER.7.1.24	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
SONCC-SFER.7.1.24.1		*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan).*				
SONCC-SFER.7.1.21	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3d
SONCC-SFER.7.1.21.1		*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*				
SONCC-SFER.7.1.21.2		*Thin, or release conifers, guided by the plan*				
SONCC-SFER.7.1.21.3		*Plant conifers, guided by the plan*				
SONCC-SFER.7.1.22	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce fire hazard	Population wide	3d
SONCC-SFER.7.1.22.1		*Identify forested stands for fire hazard reduction*				
SONCC-SFER.7.1.22.2		*Apply appropriate management techniques (e.g. thinning, burning) to reduce risks of high severity fire*				
SONCC-SFER.16.1.28	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SFER.16.1.28.1		*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*				
SONCC-SFER.16.1.28.2		*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*				

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-SFER.16.1.29	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SFER.16.1.29.1	*Determine actual fishing impacts*					
SONCC-SFER.16.1.29.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-SFER.16.2.30	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SFER.16.2.30.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-SFER.16.2.30.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-SFER.16.2.31	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-SFER.16.2.31.1	*Determine actual impacts of scientific collection*					
SONCC-SFER.16.2.31.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-SFER.8.1.17	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3d
SONCC-SFER.8.1.17.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-SFER.8.1.16	Sediment	No	Reduce delivery of sediment to streams	Reduce erosion	Hermitage Road	3d
SONCC-SFER.8.1.16.1	*Install gates to control vehicle access*					

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42. Mainstem Eel River Population

Interior Eel River Stratum

Core, Potentially Independent Population

High Extinction Risk

Population likely below depensation threshold

2,600 Spawners Required for ESU Viability

521 mi^2 watershed (8% Federal ownership)

68 IP-km (42 mi) (13% High)

Dominant Land Uses are Timber Production and Agriculture

Key Limiting Stresses are ‘Impaired Water Quality’ and ‘Lack of Floodplain and Channel Structure’

Key Limiting Threats are ‘Invasive Non-native/Alien Species’ and ‘Dams/Diversions’

Highest Priority Recovery Actions

• Reduce abundance of Sacramento pikeminnow • Improve regulatory mechanisms that avoid over-allocating water diversions • Increase instream flows by providing incentives to reduce diversions in the summer, or implementing a forbearance program	• Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows • Increase and protect existing cool water and thermal refugia • Identify and enhance non-natal rearing sites

42.1 History of Habitat and Land Use

Historically, timber harvest was the dominant land-use in the Mainstem Eel River and timber harvest has had a large impact on the landscape. Late-seral stands of conifers are largely absent and historic timber harvest and fire suppression caused the change from conifer-dominated stands to stands with high proportions of oak and shrub species. Erosion from poorly constructed roads in the highly erosive Franciscan geology has contributed to increased sediment loads in the region's rivers, leaving streams shallower, warmer, and more prone to flooding (Bodin et al. 1982). Sediment production from the 1955 and 1964 floods choked the channels with sediment and most channels are still recovering from these large flood events. Many areas which were cleared by timber harvest have since been farmed or grazed.

U.S. Forest Service (USFS) land occurs in the headwaters of tributaries in the northeast portion of the population - primarily the Dobbyn Creek and Kekawaka Creek watersheds (see Figure 42-1). USFS land in the Mainstem Eel River is currently used for grazing and recreation. BLM land occurs in a number of areas throughout the Mainstem Eel River, including several smaller watersheds that contain high IP reaches. These include Woodman, White Rock, Drewry, Charlton, Bell Springs, and Chamise Creeks. The dominant land uses on BLM land are primarily recreation and timber production.

The Mainstem Eel River is isolated and predominantly rural. Small population centers of less than 200 to 500 residents occur throughout the drainage, primarily along the Eel River itself. With the establishment of rural residences and smaller ranches, the need for water has increased. In addition, marijuana cultivation results in significant water demands in Mainstem Eel River tributaries. Currently, much of this demand is accommodated through in-stream diversions or shallow wells, which have influenced stream flows during summer low-flow periods.

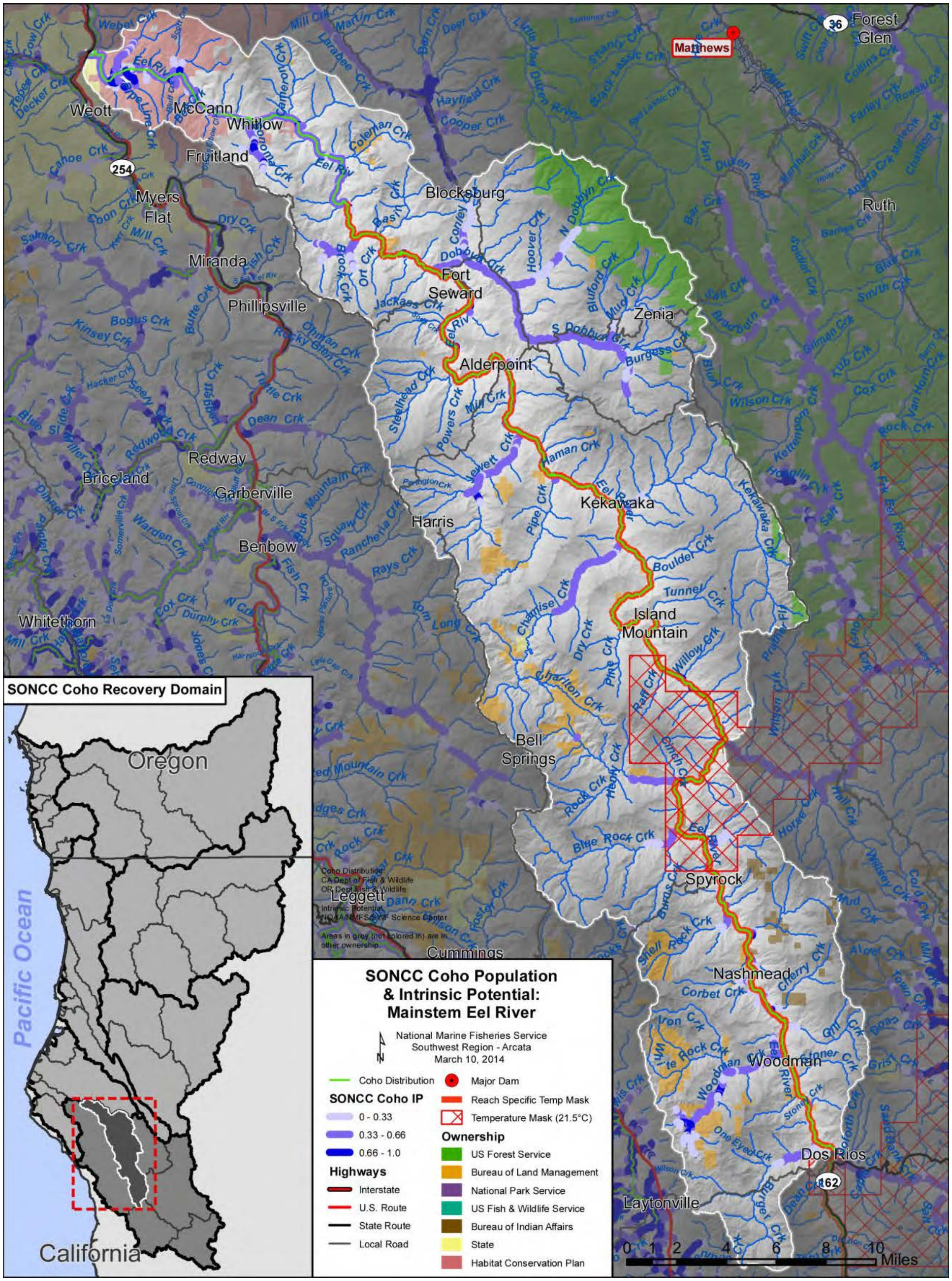

Figure 42-1. The geographic boundaries of the Mainstem Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Eel River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

42.2 Historic Fish Distribution and Abundance

No estimates of the size of the historical (or current) coho salmon population in the Mainstem Eel River are available. Brown and Moyle (1991) documented historical coho salmon presence in Jewett and Kekawaka Creeks, but recent surveys have not documented coho salmon presence in these Mainstem Eel River tributaries (California Department of Fish and Game (CDFG) 2002a).

Table 42-1. Tributaries with high IP reaches (IP >0.66) (Williams et al. 2006).

Sub-basin	Stream Name	Sub-basin	Stream Name
Sequoia	Coleman Creek	Spy Rock	Bell Springs Creek
	Drewry Creek		Chamise Creek
	Jewett Creek		Charlton Creek
	Pipeline Creek		Pipe Creek
	Poison Oak Creek		Pipe Creek
	Sonoma Creek		White Rock Creek
	Thompson Creek		Woodman Creek

42.3 Status of Mainstem Eel River Coho Salmon

Spatial Structure and Diversity

The more restricted and fragmented the distribution of individuals are within a population, and the more spatial distribution and habitat access diverge from historical conditions, the greater the extinction risk. Williams et al. (2008) determined that at least 33 coho salmon per-IP-km of habitat are needed (4,800 spawners total) to approximate the historical distribution of Mainstem Eel River coho salmon and habitat. The current distribution of spawners is unknown and observations are few, but it is expected to be very limited because most of the habitat is extremely degraded. As a result, spatial structure and diversity are limited.

Population Size and Productivity

Williams et al. (2008) determined at least 68 coho salmon must spawn in the Mainstem Eel River each year to avoid depensation effects of extremely low population size.

The Mainstem Eel River coho salmon population size is likely to be extremely reduced compared to historic levels. Breeding groups may have been lost or severely depressed in some Mainstem Eel River streams. The population growth rate is unknown, but it is expected to be negative in most years given the low numbers of fish observed. Observations of coho salmon in the Mainstem Eel River and its tributaries have been steadily declining, and no coho salmon have been observed in some years. Therefore, the Mainstem Eel River coho salmon population is at high risk of extinction.

Extinction Risk

The Mainstem Eel River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Mainstem Eel River population is a core, Potentially Independent population within the Interior Eel River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, but strongly influenced by immigration from other populations such that they did not exhibit independent dynamics (Williams et al. 2006). To contribute to stratum and ESU viability, the Mainstem Eel River core population should have at least 2,600 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Mainstem Eel River population may serve as a source of spawner strays for nearby coastal populations. At present, the capacity of the Mainstem Eel River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Conversely, recruits straying from the nearby South Fork Eel River may enhance recovery of the Mainstem Eel River population.

42.4 Plans and Assessments

Environmental Protection Agency

Total Maximum Daily Loads for the Eel River

In January 2006, the USEPA published the final Total Maximum Daily Loads (TMDLs) for temperature and sediment for the Middle Main Eel River and tributaries. The North Coast Regional Water Quality Control Board is required to develop measures which will result in implementation of the TMDLs in accordance with the requirements of 40 CFR 130.6.

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The Recovery Strategy includes analyses and recommendations regarding coho salmon recovery in the Mainstem Eel River.

Eel River Salmon and Steelhead Restoration Action Plan

In 1997, the California Department of Fish and Game assessed the Eel River watershed and provided recommendations for restoration of salmonid stocks. Primary recommendations include removing barriers, reducing sediment inputs, improving riparian forest conditions, reducing water withdrawals, enhancing habitat, and suppressing Sacramento pikeminnow.

42.5 Stresses

Table 42-2. Severity of stresses affecting each life stage of coho salmon in the Mainstem Eel River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Sediment Supply	Very High	Very High	Very High	High	Very High	Very High
2	Lack of Floodplain and Channel Structure[1]	Medium	High	Very High[1]	Very High	Very High	Very High
3	Impaired Water Quality[1]	Low	High	Very High[1]	High	Medium	High
4	Degraded Riparian Forest Conditions	-	High	High	High	High	High
5	Increased Disease/Predation/Competition	Low	High	High	High	Low	High
6	Altered Hydrologic Function	Medium	High	Very High	High	Medium	High
7	Impaired Estuary/Mainstem Function	-	Low	High	High	Medium	Medium
8	Barriers	-	Medium	Medium	Medium	Medium	Medium
9	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Medium	Low
10	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are a lack of floodplain and channel structure and impaired water quality. Based on the type and extent of stresses and threats affecting the population as well as the limiting factors influencing productivity, it is likely that the juvenile life stage is the most limited. Juvenile summer and winter rearing success is most limited by unsuitable habitat resulting from high water temperatures and excessive sedimentation. Channel complexity is low due to a lack of deep pools and structure. Low summer flows and warm water temperatures support the non-native Sacramento pikeminnow by providing ideal low-flow warm conditions for this predator. In addition, channel complexity and a diverse estuary are important to juvenile coho salmon, increasing their size and fitness prior to ocean entry and overall marine survival success.

Complex stream channels with deep pools and woody structure as well as tidally influenced wetlands with off channel ponds are important refuge areas for juvenile coho. Properly functioning rearing habitat would provide buffers against some of the other stresses affecting the population. Juvenile coho salmon would be more protected against predation, competition, and warm mainstem water temperatures if there were additional cool water refugia areas. Small reaches in streams that could provide a combination of suitable habitat and water temperatures may exist, but these have not been identified and likely possess lower IP values.

Altered Sediment Supply

Excessive sediment was rated as a very high stress to nearly all life stages of coho salmon. The USEPA recognized this by listing the Mainstem Eel River as sediment-impaired. The Eel River has the highest natural sediment load in the United States due to the highly erodible soils in the area (Brown and Ritter 1971), and anthropogenic impacts in the Mainstem Eel River have exacerbated these high loads such that pools have filled and substrate quality is poor. High sediment loads, especially fine sediment, have the potential to decrease the amount of suitable habitat by filling in pools, decrease food availability and impair feeding, increase physiological stress, and ultimately reduce the reproductive success and viability of coho salmon.

Lack of Floodplain and Channel Structure

Floodplain and channel structure relates to the depth, substrate, riparian vegetation, and large wood structures found in the floodplain and channels, which create functioning adult and juvenile coho salmon habitat. Where data are available, pool depths, pool frequencies, and substrate embeddedness indicate poor channel structure. The lack of floodplain and channel structure in the Mainstem Eel River is primarily due to the excessive sediment loads, coupled with the paucity of large wood and riparian vegetation. Roads and the railroad constrict the channel where they occur parallel to the stream.

Water Quality

Water temperature is rated as a high stress to fry, juveniles, and smolts. Where water temperature has been measured, many of the moderate to high IP reaches throughout the watershed exceed 17 ºC. Water temperature is affected by lack of riparian vegetation, a high width to depth ratio, and flow quantity. Water temperature in the Mainstem Eel River approaches lethal levels in a number of stream reaches and is stressful in most others, and severely limits the amount of habitat available to juvenile coho salmon. Other water quality issues, including toxins and nutrients, are not known to be a widespread problem.

Riparian Forest Conditions

Late-seral conifer stands no longer occur along most of the riparian zone of the Mainstem Eel River. Their absence causes a loss of shade, decreased wood delivery to streams, and reduced sediment filtration and retention on banks, all of which affect the quality of habitat for coho salmon. Riparian stands are currently dominated by willows, alders, and hardwoods. Large flood events which occurred in the 1950s and 1960s have significantly impacted riparian areas due to sedimentation and damage to riparian trees.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in the population area and upstream of the population area. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate.

Increased Disease/Predation/Competition

The non-native Sacramento pikeminnow preys upon all coho life stages except adults, and also competes with juveniles for limited food and habitat. Sacramento pikeminnow are successful in the Eel River because the severely impacted habitat which is less favorable for salmonids, is suitable for the Sacramento pikeminnow, and confers a competitive advantage to this species.

Altered Hydrologic Function

The amount of water available and the altered flow regime reduce the amount of available habitat for fry and juveniles as well as the migration timing of adults. Scott Dam on the Upper Mainstem Eel River alters the amount and timing of water available to the Mainstem Eel River which affects adult upstream migration and may influence juvenile migration. Summer base flows in tributaries to the Mainstem Eel River are further affected by rural and urban water withdrawals. Altered hydrology due to impervious areas and changes to the drainage network results in higher peak flows and lower base flows. Marijuana is the primary agricultural crop grown in the population area and water diversions to support marijuana growing operations have significantly reduced summer base flows leading to dry and disconnected stream channels. Although the extent of marijuana production is unknown, the water diversion required to support these plants appears to be placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Impaired Estuary/Mainstem Function

All salmon and steelhead that originate from the Mainstem Eel River population migrate to and from the ocean through the Eel River estuary. The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon. The degraded function of the Eel River estuary and mainstem migratory corridor is a high stress for this population. The Eel River estuary is severely impaired because of past diking and filling of wetlands for agriculture and flood protection. Approximately 60 percent of the estuary has been lost through the construction of levees and dikes (CDFG 2010b). There is evidence that the estuary once supported a high degree of estuarine habitat and rearing potential, but very little of that historic function still exists. The estuary provides rearing, refugia, and ocean transition habitat for coho salmon that originate in the Mainstem Eel River population. This habitat is very important given the degraded habitat conditions and predation and competition with Sacramento pikeminnow in the Mainstem Eel River sub-basin. Juveniles, smolts, and adults occupying estuarine habitat are stressed by the degraded conditions in these habitats and suffer from the lost opportunity for increased growth and survival.

Barriers

Barriers to fish passage are not a significant impediment to restoration and viability of the Mainstem Eel River coho salmon population. Barriers known to impede access to all life stages of coho salmon in the Mainstem Eel River population are described in Table 42-3. Most of the barriers will not greatly influence the ability of the population to achieve viability because of the minimal habitat present upstream of the barriers.

Table 42-3. Complete barriers in the Mainstem Eel River basin.

Stream Name	Road Name
Bloyd Creek	Dyerville Loop Rd
Jackass Creek	Railroad
Line Gulch	Alderpoint Rd
McCann Creek	Dyerville Loop Rd
Sequoia Creek	Whitlow Rd
Soda Creek	Railroad
Unnamed tributary	McCann Rd

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Adverse Hatchery-Related Effects

There are no operating hatcheries in the Mainstem Eel River population area or anywhere in the Eel River basin. Hatchery-origin coho salmon may stray into the Mainstem Eel River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

42.6 Threats

Table 42-4. Severity of threats affecting each life stage of coho salmon in the Mainstem Eel River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads	Very High	Very High	Very High	High	Medium	Very High
3	Dams/Diversions[1]	High	High	Very High[1]	High	High	High
5	Invasive Non-Native/Alien Species[1]	Low	Medium	High[1]	High	-	High
2	Timber Harvest	High	High	High	High	Medium	High
4	High Severity Fire	High	High	High	Medium	High	High
6	Climate Change	Low	Low	High	High	Medium	High
7	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
8	Channelization/Diking	Medium	Medium	Medium	Medium	Medium	Medium
9	Mining/Gravel Extraction	Medium	Medium	Medium	Medium	Medium	Medium
10	Urban/Residential/Industrial Dev.	Medium	Medium	Medium	Medium	Medium	Medium
11	Road-Stream Crossing Barriers	-	Medium	Medium	Medium	Medium	Medium
12	Fishing and Collecting	-	-	Low	Low	Medium	Low
13	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are dams/diversions and invasive non-native/alien species.

Roads

Roads constitute a very high threat across all life stages in most parts of the watershed. Road density is high in the limited area containing high IP habitat. Most roads in the watershed are dirt or gravel, and prone to deliver sediment to waterways, especially given the unstable geologic types in the population area. Unregulated road construction associated with marijuana cultivation contributes to the very high threat rankings of roads in this population.

Dams/Diversions

Scott Dam and the Potter Valley Project have altered the volume and timing of water discharge and changed the hydrologic regime that Mainstem Eel River coho salmon have evolved with. In addition, localized water diversions for rural residential and agricultural use reduce stream flow during critical juvenile rearing and adult migrating periods. Marijuana cultivation has become abundant and is likely the primary agricultural crop in the area. Although the extent of marijuana production is unknown, the water diversion required to support these plants appears to be placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Invasive Non-Native/Alien Species

The non-native Sacramento pikeminnow competes with and preys on young coho salmon. The warm water temperatures in the Eel River and Lake Pillsbury create ideal conditions for this predator. The presence of the Sacramento pikeminnow in Lake Pillsbury makes eradication of this species extremely difficult. Any effort to remove this species in the Eel River without treating the lake will only be temporary because the lake will continue to be a major source population for the Eel River. Once the volume and timing of instream flows are restored to conditions more favorable to coho salmon, there should be more habitats available for juveniles to seek refuge from predation. Further, to the extent that water becomes cooler due to restoration activities, conditions will become less ideal for the pikeminnow.

Timber Harvest

Timber harvest was ranked as a high threat given the percentage of the watershed that is managed for timber production. Future timber harvest activities will continue to exacerbate the stresses caused by legacy timber harvest activities. In addition, timber harvest is likely in some of the few areas of high IP located in the western portion of the population area. Forest lands in the population area are being cleared and graded to create new marijuana cultivation sites. In many cases the land disturbance and clearing of trees is not regulated, and likely contributes fine sediment to channels already burdened by sediment problems. Land clearing for marijuana operations also may result in a loss of shade and wood recruitment.

High Severity Fire

The altered vegetation characteristics throughout the watershed make high severity fires more likely than they were historically. Such fires alter sedimentation processes, as well as riparian vegetation characteristics, and ultimately degrade coho salmon habitat. Historically, Native American vegetation management and natural fire cycles created a mosaic of fire resistant vegetation that lessened catastrophic fires. However, vegetation management and prescribed fires are no longer common and this management has contributed to the future threat of high severity fires.

Climate Change

Climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate is generally warm. The modeled regional average temperature is projected to increase by up to 2.6 °C in the summer and by up to 1.2 °C in the winter over the next 50 years (see Appendix B for modeling methods). Annual precipitation in this area is predicted to change little over the next century. However, snowpack in the upper elevations of the Eel River basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009).

The Eel River estuary is vulnerable to sea level rise (CDFG 2010b). Juvenile rearing and migratory habitat are most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Rising sea level may also impact the quality and extent of freshwater wetland rearing habitat in the estuary. Adults will likely be negatively affected by ocean acidification and changes in ocean conditions and prey availability (Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Agricultural Practices

Marijuana cultivation has become abundant in many areas of the SONCC coho salmon recovery domain, and marijuana may be the primary crop cultivated in the population area. Although the intensity of marijuana production is unknown each season, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality in coho salmon streams. Water withdrawals for agricultural uses, which can be significant, are considered in the “Dams/Diversions” threat above. Grazing occurs throughout the watershed and contributes to increased sediment generation and delivery where animals have access to waterways.

Channelization/Diking

Channelization and diking of the Mainstem Eel River and its tributaries is primarily associated with road building and a defunct rail line that parallels the Mainstem Eel River. See the estuarine function section for information on the effects of channelization and diking upon the estuarine environment.

Mining/Gravel Extraction

Gravel extraction occurs in some areas in the Mainstem Eel River and is conducted with state and Federal oversight. The medium ranking for this threat reflects the sensitivity of the channel to additional disturbances (lack of floodplain and channel structure). Even with regulatory oversight, there is potential for adverse impacts as gravel extraction can influence habitat for great distances.

Urban/Residential/Industrial Development

Future rural residential development is likely if large agricultural holdings are subdivided into smaller ranches. However, the isolation of the area and limited infrastructure development may limit population growth. Rural development would lead to more road building, land clearing, well drilling, septic system construction, and other development, with the associated increase in stresses.

Road-Stream Crossing Barriers

The 5 Counties Program identified several barriers in the lower watershed which have not been resolved. Such barriers would prevent coho access to their respective tributaries. Although these barriers preclude fish access to available habitat, they are not likely to pose a significant impediment to recovery because of the limited extent of habitat available upstream of the barriers.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Mainstem Eel River population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

42.7 Recovery Strategy

The degraded condition of the Mainstem Eel River habitat, combined with the very low coho salmon population size and its restricted distribution, increases the risk of extinction of this inland coho salmon population. One of the strategies which may be necessary to achieve viability would require transfer of coho salmon from nearby populations once sufficient habitat is available to sustain such transferred fish. Identification of long-term restoration actions is also imperative to prevent further habitat degradation and reduce the impacts of past activities. Restoration activities that increase and protect cold water refugia, reduce sediment inputs, increase the complexity of the channel, increase floodplain connectivity, increase riparian vegetation, increase summer instream flows, and reduce the abundance of Sacramento pikeminnow should be immediately implemented to secure the population and protect it from the effects of low population size. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 42-5 on the following page lists the recovery actions for the Mainstem Eel River population.

Table 42-5. Recovery action implementation schedule for the Mainstem Eel River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.2.1.37	Floodplain and Channel Structure	Yes	Increase channel complexity	Identify and enhance non natal rearing sites	All streams where coho salmon would benefit immediately, including lower reaches of tributaries and mainstem confluences	2a
SONCC-MER.2.1.37.1	*Investigate coho salmon non-natal rearing and refugia use in lower reaches of tributaries and mainstem confluences. Develop a plan to enhance identified locations*					
SONCC-MER.2.1.37.2	*Implement plan to enhance refugia areas*					
SONCC-MER.2.1.62	Floodplain and Channel Structure	Yes	Increase channel complexity	Identify and enhance non natal rearing sites	Population wide	2b
SONCC-MER.2.1.62.1	*Investigate coho salmon non-natal rearing and refugia use in lower reaches of tributaries and mainstem confluences. Develop a plan to enhance identified locations*					
SONCC-MER.2.1.62.2	*Implement plan to enhance refugia areas*					
SONCC-MER.2.1.9	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2a
SONCC-MER.2.1.9.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MER.2.1.9.2	*Place instream structures, guided by assessment results*					
SONCC-MER.2.1.63	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2b
SONCC-MER.2.1.63.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MER.2.1.63.2	*Place instream structures, guided by assessment results*					
SONCC-MER.10.3.36	Water Quality	Yes	Protect cold water	Protect existing or potential cold water refugia	All streams where coho salmon would benefit immediately	2a
SONCC-MER.10.3.36.1	*Protect cold water refugia through water conservation efforts (e.g. California Water Code Section 1707, storage, forbearance, etc.)*					
SONCC-MER.10.3.60	Water Quality	Yes	Protect cold water	Protect existing or potential cold water refugia	Population wide	2b
SONCC-MER.10.3.60.1	*Protect cold water refugia through water conservation efforts (e.g. California Water Code Section 1707, storage, forbearance, etc.)*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.2.2.8	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2a
SONCC-MER.2.2.8.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MER.2.2.8.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MER.2.2.64	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2b
SONCC-MER.2.2.64.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MER.2.2.64.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MER.14.2.2	Invasive, Non-native Species	Yes	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2a
SONCC-MER.14.2.2.1	*Determine the effectiveness of various pikeminnow suppression techniques and develop experimental control methods. Develop a plan that identifies watersheds suitable for experimental pikeminnow suppression*					
SONCC-MER.14.2.2.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					
SONCC-MER.10.1.35	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	All streams where coho salmon would benefit immediately	2a
SONCC-MER.10.1.35.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-MER.10.1.35.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-MER.10.1.35.3	*Increase riparian vegetation and shading at sources of cool water*					
SONCC-MER.10.1.59	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Population wide	2b
SONCC-MER.10.1.59.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-MER.10.1.59.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-MER.10.1.59.3	*Increase riparian vegetation and shading at sources of cool water*					
SONCC-MER.1.2.31	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	2a
SONCC-MER.1.2.31.1	*Implement recovery actions for Lower Eel/Van Duzen River population that address the target "Estuary"*					
SONCC-MER.3.1.53	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2a
SONCC-MER.3.1.53.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-MER.3.1.53.2	*Implement water dedications to increase instream flows using the streamlined process*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.3.1.58	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2a
SONCC-MER.3.1.58.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-MER.3.1.58.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-MER.3.1.67	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-MER.3.1.67.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-MER.3.1.67.2	*Reduce diversions using a combination of incentives and enforcement measures*					
SONCC-MER.5.1.33	Passage	No	Improve access	Remove barrier	Woodman Creek	2b
SONCC-MER.5.1.33.1	*Remove barrier on Woodman Creek*					
SONCC-MER.5.1.13	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately, especially: Soda, Jackass, Sequoia, McCann, Bloyd, Line Gulch creeks, and unnamed tributary on McCann Road	2b
SONCC-MER.5.1.13.1	*Evaluate and prioritize barriers for removal*					
SONCC-MER.5.1.13.2	*Remove barriers, based on evaluation*					
SONCC-MER.5.1.68	Passage	No	Improve access	Remove barriers	Population wide	2d
SONCC-MER.5.1.68.1	*Evaluate and prioritize barriers for removal*					
SONCC-MER.5.1.68.2	*Remove barriers, based on evaluation*					
SONCC-MER.3.1.39	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2b
SONCC-MER.3.1.39.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-MER.3.1.39.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-MER.3.1.39.3	*Implement plan*					
SONCC-MER.3.1.5	Hydrology	No	Improve flow timing or volume	Increase instream flows	All areas where coho salmon would benefit immediately	2b
SONCC-MER.3.1.5.1	*Provide incentives and education to landowners to reduce water consumption and reduce groundwater pumping and surface water diversion by utilizing conservation and storage*					
SONCC-MER.3.1.6	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2b
SONCC-MER.3.1.6.1	*Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow*					
SONCC-MER.3.1.6.2	*Monitor forbearance compliance and flow*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.3.1.56	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2b
SONCC-MER.3.1.56.1	*Identify and cease unauthorized water diversions*					
SONCC-MER.3.1.65	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-MER.3.1.65.1	*Provide incentives and education to landowners to reduce water consumption and reduce groundwater pumping and surface water diversion by utilizing conservation and storage*					
SONCC-MER.3.1.66	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	2d
SONCC-MER.3.1.66.1	*Identify and cease unauthorized water diversions*					
SONCC-MER.3.1.4	Hydrology	No	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	2b
SONCC-MER.3.1.4.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-MER.3.1.4.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-MER.3.1.4.3	*Implement coho salmon instream flow needs plan.*					
SONCC-MER.26.1.1	Low Population Dynamics	No	Increase population abundance	Develop a rearing enhancement program to increase population abundance	Population wide	2b
SONCC-MER.26.1.1.1	*Assess impacts and benefits associated with different enhancement programs such as captive broodstock, rescue rearing, and conservation hatcheries*					
SONCC-MER.26.1.1.2	*Obtain a permit, and develop a facility to rear fish*					
SONCC-MER.26.1.1.3	*Operate enhancement program as a temporary strategy to increase population abundance*					
SONCC-MER.26.1.1.4	*Monitor fish populations at all life stages including juvenile snorkel counts, downstream migrant counts, spawning surveys, and Passive Integrated Transponder (PIT) tagging*					
SONCC-MER.26.1.57	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-MER.26.1.57.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-MER.3.1.54	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3b
SONCC-MER.3.1.54.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-MER.3.1.55	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3b
SONCC-MER.3.1.55.1	*Establish a comprehensive groundwater permit process*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.3.1.34	Hydrology	No	Improve flow timing or volume	Increase instream flows	Woodman Creek	3b
SONCC-MER.3.1.34.1	*Evaluate diversions and water use. Develop a plan to reduce diversions*					
SONCC-MER.3.1.34.2	*Reduce diversions, guided by the plan*					
SONCC-MER.7.1.12	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3b
SONCC-MER.7.1.12.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan)*					
SONCC-MER.8.1.16	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	All streams where coho salmon would benefit immediately	3b
SONCC-MER.8.1.16.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-MER.8.1.16.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-MER.8.1.70	Sediment	No	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	3d
SONCC-MER.8.1.70.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-MER.8.1.70.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-MER.8.1.14	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All streams where coho salmon would benefit immediately	3b
SONCC-MER.8.1.14.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MER.8.1.14.2	*Decommission roads, guided by assessment*					
SONCC-MER.8.1.14.3	*Upgrade roads, guided by assessment*					
SONCC-MER.8.1.14.4	*Maintain roads, guided by assessment*					
SONCC-MER.8.1.69	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MER.8.1.69.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MER.8.1.69.2	*Decommission roads, guided by assessment*					
SONCC-MER.8.1.69.3	*Upgrade roads, guided by assessment*					
SONCC-MER.8.1.69.4	*Maintain roads, guided by assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.8.1.17	Sediment	No	Reduce delivery of sediment to streams	Work with willing landowners to reduce the effects of timber harvesting	Population wide	3b
SONCC-MER.8.1.17.1	*Identify landowners with active NTMPs, THPs, and HCPs where there may be opportunities to reduce the effects of timber harvesting*					
SONCC-MER.8.1.17.2	*Offer incentives and technical support to reduce timber harvesting impacts and incorporate recovery objectives utilizing grant funds*					
SONCC-MER.10.7.52	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3c
SONCC-MER.10.7.52.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MER.10.7.52.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MER.10.7.61	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MER.10.7.61.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MER.10.7.61.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MER.3.1.7	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	3d
SONCC-MER.3.1.7.1	*Provide educational materials describing how to most efficiently use water*					
SONCC-MER.3.1.3	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	3d
SONCC-MER.3.1.3.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-MER.7.1.10	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide	3d
SONCC-MER.7.1.10.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MER.7.1.10.2	*Thin, or release conifers, guided by the plan*					
SONCC-MER.7.1.10.3	*Plant conifers, guided by the plan*					
SONCC-MER.16.1.19	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MER.16.1.19.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MER.16.1.19.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MER.16.1.20	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MER.16.1.20.1	*Determine actual fishing impacts*					
SONCC-MER.16.1.20.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-MER.16.2.21	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MER.16.2.21.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-MER.16.2.21.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-MER.16.2.22	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MER.16.2.22.1	*Determine actual impacts of scientific collection*					
SONCC-MER.16.2.22.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-MER.8.1.15	Sediment	No	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3d
SONCC-MER.8.1.15.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-MER.7.1.11	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Population wide	BR
SONCC-MER.7.1.11.1	*Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime*					
SONCC-MER.7.1.11.2	*Carry out fuel reduction or modification projects such as thinning, prescribed burning, and piling, guided by the plan*					

43. North Fork Eel River Population

Interior Eel River Stratum

Non-Core 2, Potentially Independent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

283 mi^2 watershed (52% Federal ownership)

54 IP-km (34 IP-miles) (9% high)

Dominant Land Uses are Ranching and Timber Harvest

Key Limiting Stresses are ‘Impaired Water Quality’ and ‘Altered Sediment Supply’

Key Limiting Threats are ‘Roads’ and ‘High Severity Fire’

High Priority Recovery Actions

• Increase instream flows by establishing a forbearance program • Increase riparian vegetation • Increase cool water refugia	• Improve grazing practices • Re-establish a natural fire regime • Manage riparian vegetation to reduce evapotranspiration and recharge groundwater

43.1 History of Habitat and Land Use

Historic land use of the North Fork Eel River consisted primarily of episodic timber harvest and intense livestock grazing. Euro-American Settlers first arrived in 1854 and by the 1870s approximately 60,000 sheep were grazing within the watershed (USFS-BLM 1996). Intensive timber harvest on private lands occurred in the 1950s and 1960s, predominately removed by tractor-hauling which commonly occurred on slopes greater than 70-percent (USFS-BLM 1996). Timber harvest on public lands peaked on USFS lands during the 1970s, with approximately 1,200 acres clear cut during that time (USFS-BLM 1996).

Stream habitat in the North Fork Eel River has been significantly modified by both human and natural causes. Floods in 1955 and 1964 severely modified the stream channel and riparian vegetation. A local resident indicated that the "channel was so heavily filled with soil and debris that the river bed was level and vehicles could drive for miles up the river bed" (Keter 1995). USFS (2002) noted that approximately 90% of the mainstem North Fork Eel River riparian canopy was removed by the 1964 flood. Large landslides continued to fill in the stream bed years after the flood, severely aggrading the channel (USFS 2002).

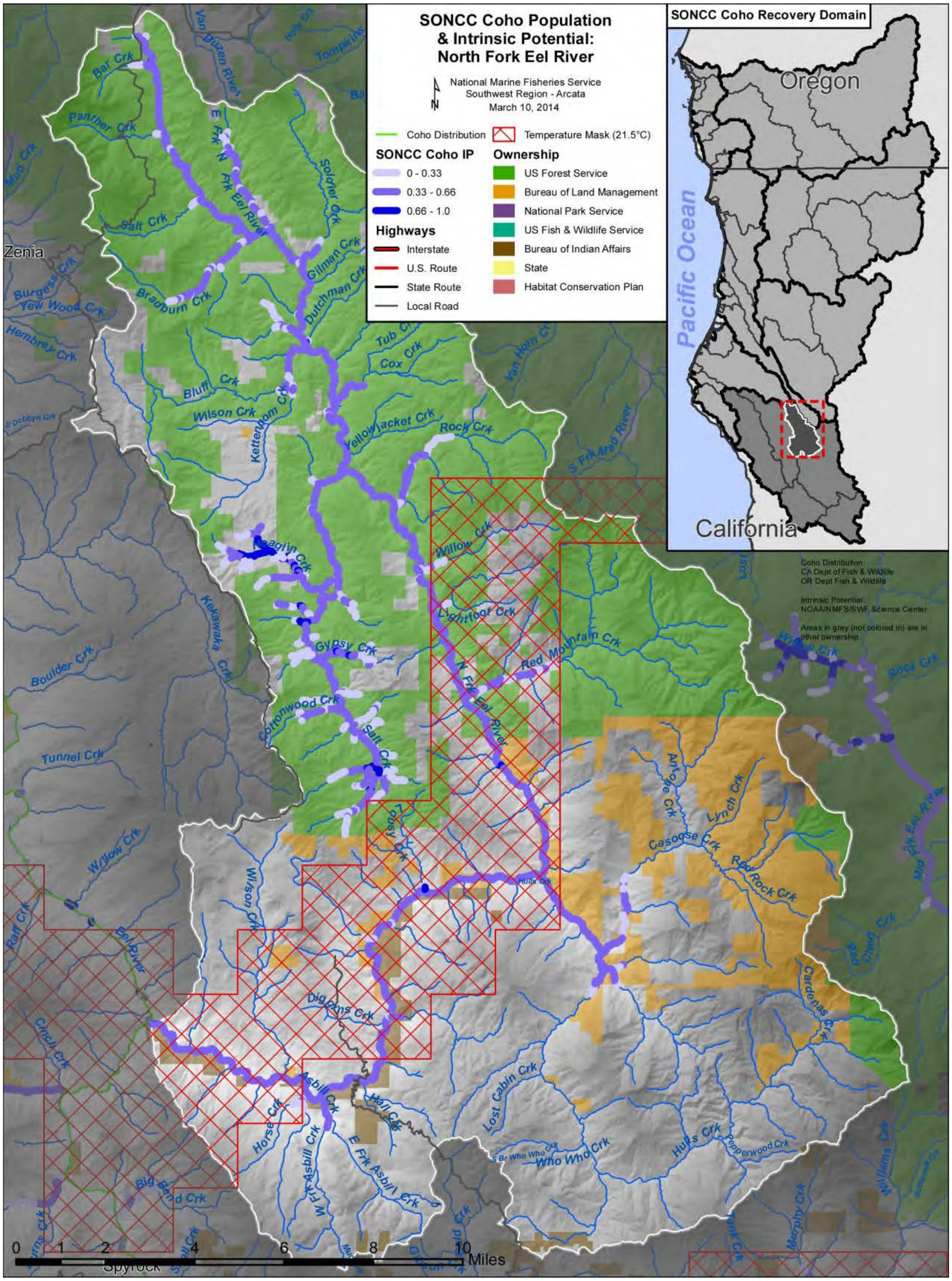

Figure 43-1. The geographic boundaries of the North Fork Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Eel River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

43.2 Historic Fish Distribution and Abundance

Brown and Moyle (1991) determined the coho population in North Fork Eel River was likely extirpated based on stream surveys and reports from CDFW files. Other reports (CDFG 1994, CDFG 2004b) also state the population is likely extirpated. A few (USFS-BLM 1996, USEPA 2002) suggest the North Fork Eel was never occupied by coho salmon; however, the CDFG (2004b) claim coho salmon were once present in the North Fork Eel River and its tributary Bluff Creek. The IP model shows potential for coho production throughout the watershed, indicating the North Fork Eel could have been used by coho salmon.

A boulder-built barrier is located approximately 5 miles upstream of the confluence with the mainstem. The barrier, referred to as Split Rock, did not exist prior to 1964 when a flood moved the boulder into its current location. A large scale snorkel survey did not document juvenile coho salmon following several years of high flows, further confirming Split Rock as a total barrier (BLM 2002). The permanence of Split Rock is uncertain, and passage for coho salmon may become possible in the future if conditions at the site change.

43.3 Status of North Fork Eel River Coho Salmon

Spatial Structure and Diversity

Except for occasional strays, the current distribution of spawners is extremely limited if present at all, and due to the paucity of individuals, diversity is assumed to be extremely low.

Williams et al. (2008) determined at least 54 coho salmon must spawn in the North Fork Eel River each year to avoid extinction resulting from extremely low population sizes. The North Fork Eel River coho salmon population size is unknown and is presumed to be extirpated. Until passage is possible at the Split Rock barrier, the population will only have access to the lower portion of the watershed.

Extinction Risk

The North Fork Eel River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). However, because it is a non-core 2 population, the recovery target for the population is not to reduce the risk of extinction; rather, 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival.

Role in SONCC Coho Salmon ESU Viability

The North Fork Eel River population is considered to be a non-core 2 “Potentially Independent” population within the Interior Eel River diversity stratum meaning that it has a high likelihood of persisting in isolation over a 100-year time scale, but is too strongly influenced by immigration from other populations to exhibit independent dynamics. The demographic target for recovery is juvenile occupancy. Because the North Fork Eel River population may be functionally extinct, source populations such as the South Fork Eel River are needed to provide a source of straying individuals that could recolonize the available habitat in the North Fork Eel River population area.

43.4 Plans and Assessments

Environmental Protection Agency

Total Maximum Daily Loads for the Eel River

In December 2002, the USEPA published the final Total Maximum Daily Loads (TMDL) for temperature and sediment for the North Fork Eel River. The North Coast Regional Water Quality Control Board is required to develop measures which will result in implementation of the TMDLs in accordance with the requirements of 40 CFR 130.6.

State of California

Recovery Strategy for California Coho Salmon

http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The Recovery Strategy includes analyses and recommendations regarding coho salmon recovery in the North Fork Eel River.

Eel River Salmon and Steelhead Restoration Action Plan

In 1997, the California Department of Fish and Game completed its assessment of the Eel River basin and provided recommendations for restoration of salmonid stocks. Primary recommendations included removing barriers, reducing sediment inputs, improving riparian forest conditions, reducing water withdrawals, enhancing habitat, and suppressing Sacramento pikeminnow.

U.S. Forest Service and U.S. Bureau of Land Management

Watershed Analysis

The U.S. Forest Service and U.S. Bureau of Land Management completed a watershed analysis for the North Fork Eel River in 1996 (USFS and BLM 1996). Coho salmon were described as having never occupied the watershed and were not further discussed in the analysis.

43.5 Stresses

Table 43-1. Severity of stresses affecting each life stage of coho salmon in the North Fork Eel River population. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Sediment Supply[1]	Very High	High	High[1]	High	High	Very High
2	Impaired Water Quality[1]	Low	Medium	Very High[1]	High	Medium	High
3	Altered Hydrologic Function	Medium	Medium	Very High	Medium	Medium	High
4	Degraded Riparian Forest Conditions	Low	High	High	High	High	High
5	Increased Disease/Competition/Predation	Low	High	High	High	Low	High
6	Lack of Floodplain and Channel Structure	Low	Low	High	High	High	High
7	Impaired Estuary/Mainstem Function	-	Low	High	High	Medium	High
8	Barriers	-	Medium	Medium	Medium	High	Medium
9	Adverse Fishery- and Collection-Related Effects	-	-	Low	Low	Low	Low
10	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are impaired water quality and altered hydrologic function, as they have the greatest impact on the population's ability to recover. The juvenile life stage is likely the most limited due to the lack of habitat resulting from high water temperatures and inadequate summer base flows.

Altered Sediment Supply

Altered sediment supply is a very high stress to the egg life stage. The North Fork Eel watershed is highly confined in many areas with steep slopes and highly erodible Franciscan soil. Excessive sedimentation can have severe effects on fish and their habitat through widening the channel, filling in pools, increasing gravel embeddedness, and ultimately raising water temperature through the shallowing of the channel. Hulls Creek and Bluff Creek were rated as having poor conditions related to embeddedness which degrades spawning gravel quality and decreases survival of eggs. Although gravel quality is currently poor, improved management on federal lands combined with natural passive recovery from the 1964 flood should produce more suitable gravels in the future.

Impaired Water Quality

Impaired water temperature is a very high stress for juveniles. The naturally hot climate, combined with excess sediment, low summer base flows, and a lack of riparian vegetation results in near-lethal or lethal water temperature in many parts of the population area. A thermal infrared and color videography snapshot of stream temperatures on the entire stretch of the mainstem North Fork Eel during July 2001 showed the mainstem North Fork Eel to be over 20 °C (considered inadequate for coho salmon) for its entire 35.3 mile extent, with many sections over 24 °C (USEPA 2002).

Potential summer juvenile distribution would likely be limited to those areas of the watershed with cold spring upwelling or cold tributary inflow. It is likely that under current conditions summer rearing juveniles would have to leave the North Fork Eel River prior to onset of summer base flow to take advantage of more suitable conditions in the coastally influenced climate of the lower mainstem Eel River and Eel River estuary.

Altered Hydrologic Function

Altered hydrologic function is a high stress to juveniles. Due to changes in land uses following settlement, the extent of Douglas-fir forests in the North Fork Eel River population area has increased, resulting in a corresponding loss of the oak-woodland vegetation type and the increase in the density of brush and understory species (Keter 1995). This change from historic conditions has resulted in an increased loss of ground water (and therefore summer base flow) through interception and evapotranspiration (Keter 1995). The southern portion of the watershed is primarily privately owned and has many water rights diversions.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions is as a high stress for the population. In the few surveys that have been completed, the percent canopy cover in Hulls Creek and parts of Bluff Creek were rated as fair to poor and in the upper watershed, riparian corridor canopy cover was listed as fair. The lack of riparian vegetation has reduced large wood recruitment to the stream and is not providing adequate shade to maintain cool water temperatures.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in population areas downstream of the population, in which coho salmon must migrate through. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area and adjacent populations are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate.

Increased Disease, Competition, and Predation

The non-native Sacramento pikeminnow is a high stress to coho salmon fry, juveniles, and smolts and also competes with juveniles for limited food and habitat. The pikeminnow is successful in the lower portion of the North Fork Eel River because it thrives in severely impacted habitat that is less favorable for salmonids.

Floodplain and Channel Structure

Lack of floodplain and channel structure is a high stress for juveniles, smolts, and adults. The combination of decreased large wood and aggraded channel conditions has simplified the stream habitat. Pool depths are rated as fair in the few places where surveys were conducted, and pool frequency is rated as poor. The overall simplified stream habitat lacks places of refuge for juvenile fish such as deep pools and side channels during high flow events or times of low water. It is likely the system is still recovering from the channel aggradation after the 1964 flood and would benefit from large wood to facilitate pool scouring.

Impaired Estuary/Mainstem Function

All salmon that originate from the North Fork Eel River migrate to and from the ocean through the mainstem Eel River and the Eel River estuary. The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon populations. The degraded function of the Eel River estuary and mainstem migratory corridor today constitutes a high stress for this population. The Eel River estuary is severely impaired because of past diking and filling of wetlands for agriculture and flood protection. Approximately 60 percent of the estuary has been lost through the construction of levees and dikes (CDFG 2010b). There is evidence that the estuary once supported a high degree of estuarine habitat and rearing potential, but very little of that historic function still exists. Mainstem conditions contribute to this stress because of water quality issues, predation pressure, and degraded habitat. Juveniles, smolts, and adults suffer from lost opportunities for increased growth and survival in formerly extensive and now degraded estuarine and mainstem rearing and migratory habitats.

Barriers

Barriers represent a high stress to adults. Most barriers are upstream of Split Rock where there is currently no effect on coho salmon. Although composed of natural materials, the relatively recently formed boulder falls at Split Rock is a complete barrier to adult coho salmon, preventing them from accessing the majority of the North Fork Eel watershed. Modifications to Split Rock could potentially provide passage for coho salmon.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into the North Fork Eel River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

43.6 Threats

Table 43-2. Severity of threats affecting each life stage of coho salmon in the North Fork Eel River population. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	Very High	Very High	High[1]	High	High	Very High
2	High Severity Fire[1]	High	High	High[1]	High	High	High
3	Climate Change	Medium	Medium	High	High	High	High
4	Invasive Non-Native/Alien Species	Low	High	High	High	Low	High
5	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
6	Dams/Diversions	Low	Medium	High	Medium	Medium	Medium
7	Agricultural Practices	Medium	Medium	Low	Low	Medium	Medium
8	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
9	Fishing and Collecting	-	-	Low	Low	Low	Low
10	Channelization/Diking	Low	Low	Low	Low	Low	Low
11	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
12	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.
[2]Gravel Mining/Gravel Extraction is not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and high severity fire.

Roads

Roads represent the most significant threat across all life stages of coho salmon. Road density is rated as very high throughout the watershed. There are approximately 1.7 miles of road/square mile of land on the Forest Service land, which is only a moderate road density; however, Louisiana Pacific Timber Company estimated there were between 4 and 5 miles of road/square mile on the private lands in the southern watershed (USEPA 2002). The high density of unpaved roads is the most significant driver to increased sediment within the river. Roads are often built within the riparian corridor and actively erode surface gravel and sediment into waterways, requiring continual maintenance which creates additional disturbance. Roads also interfere with hydraulic connectivity through water diversion along inboard ditches. Additionally, the high densities of roads often lead to an increase in road/stream crossings and associated barriers. In the last decade, effort has been directed toward disconnecting the road system from hydrologic function and decommissioning and storm-proofing roads on public land. The extent to which these problems persist on private lands is unknown and, if significant, could impact coho salmon recovery.

High Severity Fire

High severity fire is a high threat to the population. Past timber harvest practices coupled with decades-long fire-suppression efforts have rendered understory forest fuel loads excessive. High severity fires regularly result from these excessive forest fuel loads and are likely to continue in this sub-basin. Such high severity fires negatively affect coho salmon because they remove vegetation and plant litter that protects or minimizes soil erosion, gullying, and mass wasting that contributes to high sediment loads within coho salmon habitats. High sediment loads embed spawning gravel, making it less suitable for spawning or burying redds and alevins. Lastly, high severity fires remove riparian trees, thus increasing solar radiation in the mainstem and tributaries and resulting in elevated water temperatures.

Climate Change

Climate change will have the greatest impact upon juveniles, smolts, and adults. The current climate is generally warm and regional average temperature models indicate average temperatures could increase by up to 3 °C in the summer and by up to 1 °C in the winter (see Appendix B for modeling methods). Annual precipitation in this area is predicted to change little over the next century. However, snowpack in upper elevations of the Eel River basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009). The vulnerability of the Eel River estuary to sea level rise is very high. Juvenile and smolt rearing and migratory habitats are most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Rising sea level may also impact the quality and extent of wetland rearing habitat in the estuary. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. As with all populations in the ESU, adults will be negatively impacted by ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Invasive Non-Native/Alien Species

The non-native Sacramento pikeminnow is a high threat to fry, juveniles, and smolts because they compete with and prey upon young coho salmon. Sacramento pikeminnow were introduced in Lake Pillsbury in 1979 (Brown and Moyle 1997) and have spread throughout the entire Eel River basin. The warm water temperatures in the Eel River and Lake Pillsbury allow this voracious predator to thrive in this system. The Sacramento pikeminnow's presence in Lake Pillsbury makes eradication of this species extremely difficult. Any effort to remove this species in the Eel River without treating the lake will only be temporary because the lake will continue to be the source population for the rest of the Eel River basin.

Road-stream Crossing Barriers

Road/stream crossing barriers are a low threat. Access to most of the tributaries in the watershed is prevented by natural conditions rather than man-made barriers. Because of their position in the watershed, road/stream crossing barriers do not pose significant threats to the population.

Dams/Diversions

Diversions are a high threat to coho salmon. Approximately 29 water diversions are scattered throughout the watershed, with the majority concentrated in the southern portion of the basin. These diversions are mainly on private land where small communities and ranches draw water for irrigation. The total withdrawal of water from these diversions is unknown; however, they may contribute to lower flows which have the potential to increase water temperature. There has been no assessment of the adequacy of water quantity and flow regime on the private lands dominating the lower portions of the watershed. These areas likely have more significant water withdrawals that could be contributing to low flows.

Although no assessment has been conducted, it is likely that marijuana cultivation has become increasingly abundant in the North Fork Eel River. Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Agricultural Practices

Agricultural practices present a medium threat to adults, eggs, and fry. Agriculture, primarily grazing, is scattered throughout the basin with the majority of the agricultural land located in the southern portion of the watershed on privately owned lands and the Round Valley Reservation. Many of the local ranches have grazing livestock with no exclusion from the riparian zone. Grazing pressure removes much of the bank-stabilizing vegetation on the upslope, which contributes to landslides and erosion as well as degrading overhanging banks along the stream. This results in poor water quality through the delivery of excess sediment and nutrients into the stream. Because these activities are confined to a small portion of the watershed and do not affect a large area, they are considered a medium threat

Urban/Residential/Industrial Development

Development is a low threat to the North Fork Eel River due to its remote location. The population has not significantly increased over the past 10 years; however, there is a trend developing for residents to buy land for vacation or retirement homes. Larger tracts of land may be sub-divided and sold as smaller parcels. Sub-division has the potential to increase road densities, impervious surfaces, and further fragment the landscape from its currently large undeveloped tracts.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Channelization/Diking

Because the lower watershed is dominated by private land with light agricultural use, some channelization likely exists on the lands that contain tributaries to the North Fork Eel River. The level of these activities is believed to be small in scope and therefore a low threat to coho salmon. The North Fork itself is confined by bedrock in many places and is difficult to manipulate through channelization and diking.

Timber Harvest

Timber harvest is a medium threat to the population. Many of the changes that have occurred to instream and riparian conditions in the North Fork Eel River reflect legacy effects of more intensive harvest from previous decades. Some small scale timber harvest occurs on private lands watershed, particularly in the Long Ridge region. However, most of the timberlands in the population area are owned by the USFS and are managed for the conservation of salmonids.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the North Fork Eel River population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

43.7 Recovery Strategy

The North Fork Eel River coho salmon population faces significant challenges due to poor habitat quality and a very limited amount of accessible habitat. Although the North Fork Eel River may not support a coho salmon population at this time, watershed restoration would improve conditions in the mainstem Eel River and benefit other coho salmon populations utilizing the mainstem. Instream habitat restoration efforts in the North Fork Eel River should be focused in the mainstem and tributaries downstream of Split Rock, and overall watershed restoration should focus on decreasing water temperatures, improving flows, reducing sediment supply, and decreasing the likelihood of catastrophic fire. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 43-3 on the following page lists the recovery actions for the North Fork Eel River population.

Table 43-3. Recovery action implementation schedule for the North Fork Eel River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NFER.8.1.9	Sediment	Yes	Reduce delivery of sediment to streams	Improve grazing practices	Private ranchlands along streams where coho salmon would benefit immediately (mainstem and tributaries downstream of Split Rock)	3b
SONCC-NFER.8.1.9.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-NFER.8.1.9.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-NFER.8.1.9.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-NFER.8.1.36	Sediment	Yes	Reduce delivery of sediment to streams	Improve grazing practices	Population wide	3c
SONCC-NFER.8.1.36.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-NFER.8.1.36.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-NFER.8.1.36.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-NFER.8.1.1	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately	3b
SONCC-NFER.8.1.1.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-NFER.8.1.1.2	*Decommission roads, guided by assessment*					
SONCC-NFER.8.1.1.3	*Upgrade roads, guided by assessment*					
SONCC-NFER.8.1.1.4	*Maintain roads, guided by assessment*					
SONCC-NFER.10.1.11	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	All streams where coho salmon would benefit immediately (mainstem and tributaries downstream of Split Rock)	3b
SONCC-NFER.10.1.11.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-NFER.10.1.11.2	*Implement techniques aimed to protect and/or improve cool water habitat*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NFER.10.1.30	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Population wide	3c
SONCC-NFER.10.1.30.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-NFER.10.1.30.2	*Implement techniques aimed to protect and/or improve cool water habitat*					
SONCC-NFER.10.7.29	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately (mainstem and tributaries downstream of Split Rock)	3b
SONCC-NFER.10.7.29.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-NFER.10.7.29.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-NFER.10.7.31	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-NFER.10.7.31.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-NFER.10.7.31.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-NFER.3.1.3	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately (mainstem and tributaries downstream of Split Rock)	3c
SONCC-NFER.3.1.3.1	*Establish and implement a forbearance program, using water storage tanks to decrease diversion during periods of low flow*					
SONCC-NFER.3.1.3.2	*Monitor forbearance compliance and flow*					
SONCC-NFER.3.1.34	Hydrology	No	Improve flow timing or volume	Increase instream flows	Population wide	3d
SONCC-NFER.3.1.34.1	*Establish and implement a forbearance program, using water storage tanks to decrease diversion during periods of low flow*					
SONCC-NFER.3.1.34.2	*Monitor forbearance compliance and flow*					
SONCC-NFER.3.1.4	Hydrology	No	Improve flow timing or volume	Recharge groundwater	All streams where coho salmon would benefit immediately (mainstem and tributaries downstream of Split Rock)	3c
SONCC-NFER.3.1.4.1	*Assess watershed for areas where conifers have replaced oak woodlands*					
SONCC-NFER.3.1.4.2	*Manage riparian vegetation to reduce evapotranspiration and recharge groundwater*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NFER.3.1.35	Hydrology	No	Improve flow timing or volume	Recharge groundwater	Population wide	3d
SONCC-NFER.3.1.35.1	*Assess watershed for areas where conifers have replaced oak woodlands*					
SONCC-NFER.3.1.35.2	*Manage riparian vegetation to reduce evapotranspiration and recharge groundwater*					
SONCC-NFER.7.1.6	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase riparian vegetation	Population wide	3c
SONCC-NFER.7.1.6.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-NFER.7.1.6.2	*Plant conifers, guided by the plan*					
SONCC-NFER.7.1.6.3	*Thin, or release conifers, guided by the plan*					
SONCC-NFER.7.1.10	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Population wide	3c
SONCC-NFER.7.1.10.1	*Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime*					
SONCC-NFER.7.1.10.2	*Carry out fuel reduction projects such as thinning and prescribed burning, guided by the strategic plan*					
SONCC-NFER.2.1.2	Floodplain and Channel Structure	No	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately (mainstem and tributaries downstream of Split Rock)	3c
SONCC-NFER.2.1.2.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-NFER.2.1.2.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-NFER.2.1.32	Floodplain and Channel Structure	No	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	3d
SONCC-NFER.2.1.32.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-NFER.2.1.32.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-NFER.2.1.7	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately (mainstem and tributaries downstream of Split Rock)	3c
SONCC-NFER.2.1.7.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-NFER.2.1.7.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-NFER.2.1.33	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	3d
SONCC-NFER.2.1.33.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-NFER.2.1.33.2	*Place instream structures, guided by assessment results*					
SONCC-NFER.1.2.5	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River estuary	3d
SONCC-NFER.1.2.5.1	*Implement recovery actions for Lower Eel/Van Duzen River population that address the target "Estuary"*					
SONCC-NFER.14.2.8	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	3d
SONCC-NFER.14.2.8.1	*Determine the effectiveness of various pikeminnow suppression techniques and develop experimental control methods. Develop a plan that identifies watersheds suitable for experimental pikeminnow suppression*					
SONCC-NFER.14.2.8.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					

44. Middle Fork Eel River Population

Interior Eel River Stratum

Non-Core 2, Potentially Independent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

753 mi^2 watershed (64% Federal ownership)

78 IP-km (48 IP-mi) (13% High)

Dominant Land Uses are Agriculture and Recreation

Key Limiting Stresses are 'Impaired Water Quality' and 'Lack of Floodplain and Channel Structure'

Key Limiting Threats are 'Roads' and 'Channelization/Diking'

Highest Priority Recovery Actions

• Improve grazing practices • Reduce stream bank erosion • Increase large woody debris (LWD), boulders, and other instream structure	• Determine the effects of marijuana cultivation and minimize if necessary • Reduce abundance of Sacramento pikeminnow • Reduce road-stream hydrologic connection

44.1 History of Habitat and Land Use

Historic land use activities in the Middle Fork Eel River include grazing, agriculture, timber harvest, and residential development. In the early 1900s, Round Valley streams in the area near Covelo were extensively channelized for agriculture and residential development, which resulted in incision that disconnected streams from their floodplains. Overgrazing in the early 1900s resulted in soil erosion and altered vegetation (California Department of Water Resources (DWR) 1982). In 1862, small-scale timber harvest began near Covelo and continued until after World War II. An estimated 46 percent of the timbered land in the population area, which is approximately 23 percent of the overall land in the population area, was logged by either clear cut or partial cut methods from 1950 to 1981 (DWR 1982).

USFS Watershed Analyses for the Middle Fork Eel River (USFS 1994c) and Black Butte River (USFS 1996d) watersheds concluded that, "human activities contributed to conditions that resulted in increased erosion and sedimentation, direct removal of riparian vegetation, and secondary impacts resulting from bank erosion and decreased vegetation in the watershed." The Watershed Analyses also indicated that fish habitat conditions appear to be improving at the time the documents were being drafted (1994 and 1996) and were projected to continue to improve over time. Past timber harvest practices along intermittent and perennial streams contributed to increases in stream temperatures. Floods in 1955 and 1964, as well as high densities of dirt roads, are responsible for excessive sedimentation that is especially apparent in the Round Valley watershed.

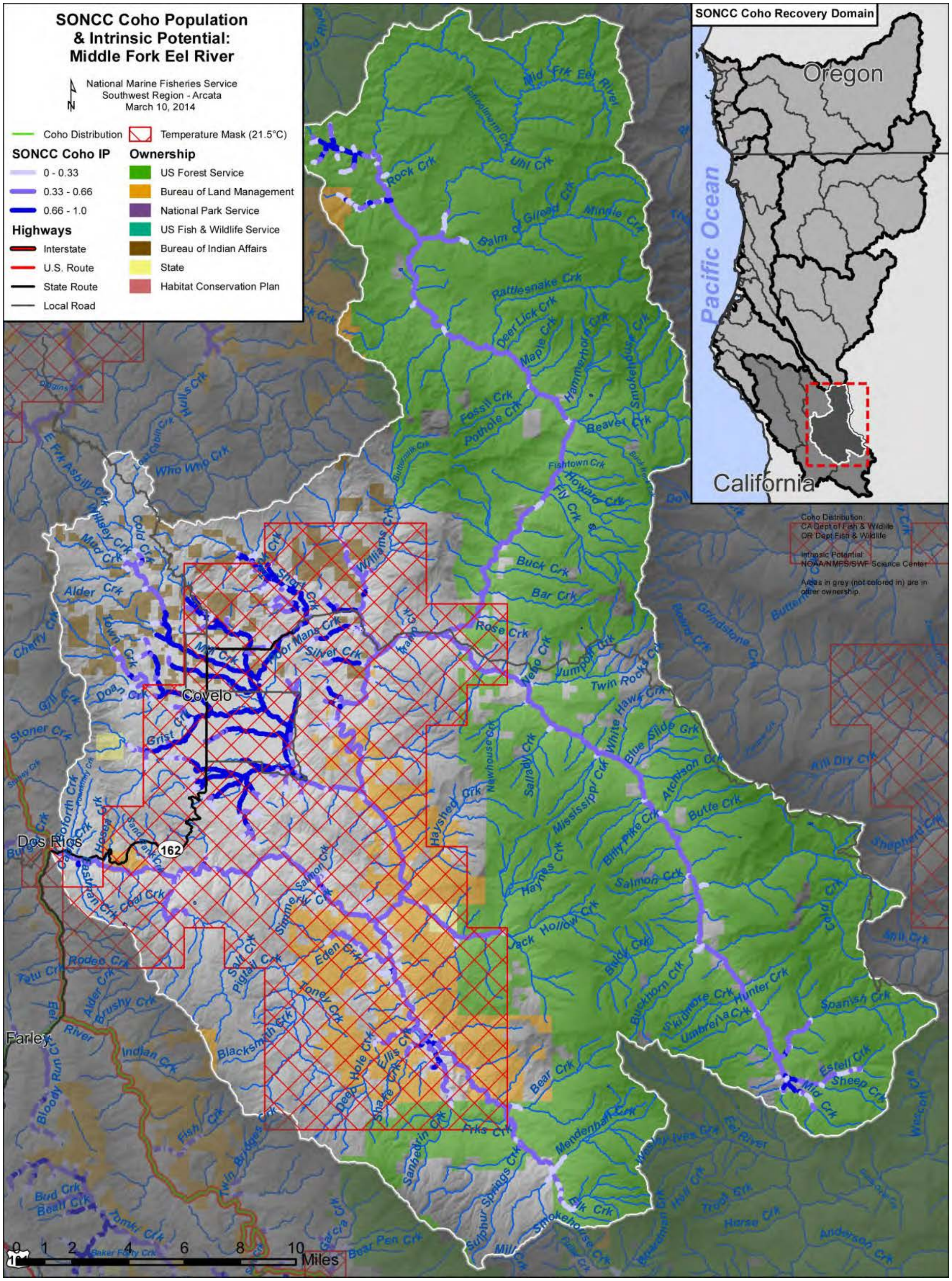

Figure 44-1. The geographic boundaries of the Middle Fork Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Eel River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

44.2 Historic Fish Distribution and Abundance

Middle Fork Eel River historic coho salmon population size estimates are not available. Coho salmon are believed to have historically inhabited the Middle Fork Eel River and its tributaries Rattlesnake, Mill, Grist, and Rock creeks (Brown and Moyle 1991). However, coho salmon have not been documented in the Middle Fork Eel River or its tributaries since annual summer surveys began in 1979 (Garwood 2012).

Table 44-1. Tributaries with high IP reaches (IP >0.66). Many of these tributaries occur under the temperature mask (Williams et al. 2006).

Sub-basin	Stream Name	Sub-basin	Stream Name
Round Valley	Grist Creek	**Black Butte River**	Basin Creek
	Little Salt Creek		Estell Creek
	Little Valley Creek		Middle Creek
	Mill Creek		Spanish Creek
	Poor Man's Creek	**Eden Valley**	Bennett Creek
	Short Creek		Elk Creek
	Silver Creek		Ellis Creek
	Tank Creek		Sanhedrin Creek
	Town Creek		Shake Creek
	Turner Creek	**Wilderness**	Willow Creek
	Williams Creek		unnamed tributary of the North Fork Middle Fork Eel River

44.3 Status of Middle Fork Eel River Coho Salmon

Spatial Structure and Diversity

Except for occasional strays, the current distribution of spawners is extremely limited or non-existent in most years. Due to extremely low number of individuals, diversity is also extremely low.

Population Size and Productivity

The Middle Fork Eel River coho salmon population size is unknown and all three cohorts are presumed to be absent. Under the current climate, some speculation exists as to whether the Middle Fork Eel River may have ever sustained a coho salmon population (U.S. Forest Service (USFS) 2009d). Areas with the highest intrinsic potential are primarily in the Round Valley; however, most of the tributaries in the Round Valley are under the temperature mask and are usually dry in the summer (U.S. Environmental Protection Agency (EPA) 2003b), which likely restricts juvenile distribution.

Extinction Risk

The Middle Fork Eel River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). However, because it is a non-core 2 population, the recovery target for the population is not to reduce the risk of extinction; rather, 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival.

Role in SONCC Coho Salmon ESU Viability

The Middle Fork Eel River population is considered to be a non-core 2 "Potentially Independent" population within the Interior Eel River diversity stratum meaning that it has a high likelihood of persisting in isolation over a 100-year time scale, but is too strongly influenced by immigration from other populations to exhibit independent dynamics. The demographic target for recovery is juvenile occupancy. Because the Middle Fork Eel River population may be functionally extinct, source populations such as the South Fork Eel River are needed to provide a source of straying individuals that could recolonize the Middle Fork Eel population area.

44.4 Plans and Assessments

Environmental Protection Agency

Total Maximum Daily Loads for the Eel River

In December 2003, the USEPA published the final Total Maximum Daily Loads (TMDL) for temperature and sediment for the Middle Fork Eel River. The North Coast Regional Water Quality Control Board is required to develop measures which will result in implementation of the TMDLs in accordance with the requirements of 40 CFR 130.6.

State of California

Eel River Salmon and Steelhead Restoration Action Plan

In 1997, the California Department of Fish and Game completed its assessment of the Eel River basin and provided recommendations for restoration of salmonid stocks. Primary recommendations included removing barriers, reducing sediment inputs, improving riparian forest conditions, reducing water withdrawals, enhancing habitat, and suppressing Sacramento pikeminnow.

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The specific restoration recommendations developed by the Coho Recovery Team and CDFG for the Middle Fork Eel River (for Subareas Eden Valley, Round Valley, Black Butte River, and Wilderness) have been considered and incorporated into the table of population-specific recovery actions.

U.S. Forest Service

Watershed Analysis

The U.S. Department of Agriculture Forest Service completed watershed analyses for the Upper Middle Fork Eel River and the Black Butte River in 1994 and 1996, respectively.

44.5 Stresses

Table 44-2. Severity of stresses affecting each life stage of coho salmon in the Middle Fork Eel River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Lack of Floodplain and Channel Structure[1]	Low	High	High[1]	High	Medium	High
2	Impaired Water Quality[1]	Low	Medium	Very High[1]	Medium	Medium	High
3	Altered Sediment Supply	High	High	High	High	Medium	High
4	Degraded Riparian Forest Conditions	Low	High	High	High	Medium	High
5	Increased Disease/Competition/Predation	Low	High	High	High	Low	High
6	Impaired Estuary/Mainstem Function	-	Low	High	High	Medium	High
7	Barriers	-	Medium	Medium	Medium	Medium	Medium
8	Altered Hydrologic Function	Medium	Medium	Medium	Medium	Medium	Medium
9	Adverse Fishery-Related Effects	-	-	Low	Low	Low	Low
10	Adverse Hatchery- and Collection-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are lack of floodplain and channel structure and impaired water quality, as they have the greatest impact on the population's ability to recover. The juvenile life stage is likely the most limited, and quality summer and winter rearing habitat is lacking due to high water temperatures and a lack of adequate pool and off-channel habitat.

Floodplain and Channel Structure

Habitat complexity, including presence of pools, large wood cover, and floodplains, is essential for juvenile coho salmon to optimize forage, avoid predation, and access thermal and velocity refuges. Inadequate floodplain and channel structure presents a high stress for fry, juveniles, and smolts. Pool frequency is poor throughout the population area, and pool depth varies from good to poor. In the early 1900s, Round Valley streams were extensively modified which resulted in significant stream incision throughout the valley that disconnected the streams from their floodplains. Although almost all of the streams in Round Valley are under the temperature mask, they may have potential to provide winter refugia habitat.

Impaired Water Quality

Suitable water quality, especially appropriate temperature, is essential for juvenile coho salmon growth and survival. Impaired water quality is a very high stress for juveniles and a medium stress for fry, smolts, and adults. Although benthic macroinvertebrate metrics are rated very good (indicating little to no water quality contamination and good dissolved oxygen levels), summer rearing stream temperature is poor throughout most of the population area. Most of the exposed main channels are close to lethal stream temperatures during the hottest part of the summer (USEPA 2003). However, the headwaters of Black Butte River may have thermal refugia, and the upper Middle Fork Eel River has many stratified pools that support other salmonids.

Altered Sediment Supply

Excessive sediment presents a high stress for most of the life stages of coho salmon. Sediment delivery resulted in a high percentage of embeddedness in the Middle Fork Eel River and a number of its tributaries. Measurements in the upper sub-basin show limited sediment deposition in pools, where the median particle size is good to fair. The USEPA (2003b) estimated that 95 percent (574 tons/mi^2/year) of the sediment load is due to the natural, highly erosive geology of the upper sub-basin, and the remaining 5 percent (29 tons/mi^2/year) of the sediment load is management related. High sediment loads embed spawning gravel, rendering spawning beds less suitable, bury redds, and fill-in pools.

Degraded Riparian Forest Conditions

Degraded riparian forest conditions are a high stress for the fry, juvenile, and smolt life stages. Riparian shade is generally fair in the valleys while the upper sub-basin has fair to good shade cover. Streamside areas are dominated by the early seral conditions of either open or hardwood canopies. The lack of mature riparian vegetation and an insufficient forest canopy results in inadequate water temperatures for juvenile rearing.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in population areas downstream of the population, in which coho salmon must migrate through. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area and adjacent populations are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate.

Increased Disease, Competition, and Predation

The non-native Sacramento pikeminnow poses a high threat to coho salmon fry, juveniles, and smolts and also competes with juveniles for limited food and habitat. The pikeminnow is successful in the Middle Fork Eel River because it thrives in degraded habitat that is less favorable for salmonids.

Impaired Estuary/Mainstem Function

All coho salmon that originate from the Middle Fork Eel River migrate to and from the ocean through the mainstem Eel River and the Eel River estuary. The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon populations. The degraded function of the Eel River estuary and mainstem migratory corridor today constitutes a high stress for this population. The Eel River estuary is severely impaired because of past diking and filling of wetlands for agriculture and flood protection. Approximately 60 percent of the estuary has been lost through the construction of levees and dikes (CDFG 2010b). There is evidence that the estuary once supported a high degree of estuarine habitat and rearing potential, but very little of that historic function still exists. Mainstem conditions contribute to this stress because of water quality issues, predation pressure, and degraded habitat. Juveniles, smolts, and adults suffer from lost opportunities for increased growth and survival in formerly extensive and now degraded estuarine and mainstem rearing and migratory habitats.

Barriers

Barriers are a medium stress for all life stages. Some dams and natural barriers block access to high IP habitats, such as on Cutfinger Creek. A barrier on Willow Creek may also partially or completely block access to high IP habitat.

Altered Hydrologic Function

Altered hydrologic function is a medium stress for all life stages. Most of the tributaries in the Round Valley and Elk/Thatcher areas are dry or intermittent in the summer, except in their uppermost portions (USEPA 2003). Water quantities in the upper sub-basin are believed to be very good. Flow data for the lower sub-basin wherein most of the high IP areas occur does not exist.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into the Middle Fork Eel River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

44.6 Threats

Table 44-3. Severity of threats affecting each life stage of coho salmon in the Middle Fork Eel River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Roads[1]	High	High	High[1]	High	High	High
2	Channelization/Diking[1]	Medium	High	High[1]	High	High	High
3	High Severity Fire	High	High	High	High	High	High
4	Climate Change	Medium	Medium	High	High	High	High
5	Invasive Non-Native/Alien Species	Low	High	High	High	Low	High
6	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
7	Dams/Diversions	Low	Medium	Medium	Medium	Medium	Medium
8	Agricultural Practices	Medium	Medium	Low	Low	Medium	Medium
9	Urban/Residential/Industrial Dev.	Low	Medium	Low	Low	Medium	Medium
10	Fishing and Collecting	-	-	Low	Low	Low	Low
11	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
12	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key Limiting Threats and limited life stage.
[2]Gravel Mining/Gravel Extraction is not considered a threat to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are roads and channelization/diking.

Roads

Roads are a significant threat to coho salmon in this population. Road density is very high in Round Valley, overlapping the highest concentration of high IP habitat in the population area, albeit under the temperature mask. Road-related landsliding rates are highest in Black Butte, Elk Creek and Round Valley subareas, with rates as high as 9 to 13 tons per square mile per year (USEPA 2003). With few road decommissioning and upgrading projects in the population area and the likelihood of more road building, this threat is likely to continue in the future.

Channelization/Diking

Tributaries to the Middle Fork Eel River in the Round Valley area have been channelized for residential and agricultural purposes. Channelization significantly degrades juvenile coho salmon rearing habitat by increasing flow velocities, reducing creek meanders, and impeding the creeks' abilities to access floodplains during high flows.

High Severity Fire

High severity fire is a high threat to the population. Past timber harvest practices coupled with decades-long fire-suppression efforts have rendered understory forest fuel loads excessive. High severity fires regularly result from these excessive forest fuel loads and are likely to continue in this sub-basin. Such high severity fires negatively affect coho salmon because they remove vegetation and plant litter that protects or minimizes soil erosion, gullying, and mass wasting that contributes to high sediment loads within coho salmon habitats. High sediment loads embed spawning gravel, making it less suitable for spawning or burying redds and alevins. Lastly, high severity fires remove riparian trees, thus increasing solar radiation in the mainstem and tributaries and resulting in elevated water temperatures.

Climate Change

Climate change is a high threat to juveniles, smolts, and adults. The current climate is generally warm and regional average temperature models indicate average temperatures could increase by up to 3 °C in the summer and by up to 1 °C in the winter (see Appendix B for modeling methods). Annual precipitation in this area is predicted to change little over the next century. However, snowpack in upper elevations of the Eel River basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009). The vulnerability of the Eel River estuary to sea level rise is very high. Juvenile and smolt rearing and migratory habitats are most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Rising sea level may also impact the quality and extent of wetland rearing habitat in the estuary. Overall, the range and degree of variability in temperature and precipitation is likely to increase in all populations. As with all populations in the ESU, adults will be negatively impacted by ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

Invasive Non-Native/Alien Species

The non-native Sacramento pikeminnow is a high threat to fry, juveniles, and smolts because they compete with and prey upon young coho salmon. Sacramento pikeminnow were introduced in Lake Pillsbury in 1979 (Brown and Moyle 1997) and have spread throughout all suitable habitat in the Eel River basin. The warm water temperatures in the Eel River and Lake Pillsbury allow this voracious predator to thrive in this system. The Sacramento pikeminnow's presence in Lake Pillsbury makes eradication of this species extremely difficult. Any effort to remove this species in the Eel River without treating the lake will only be temporary because the lake will continue to be the source population for the rest of the Eel River basin.

Timber Harvest

Timber harvest poses a medium threat to the Middle Fork Eel River population. Many of the changes that have occurred to instream and riparian conditions in the Middle Fork Eel River reflect legacy effects of more intensive harvest from previous decades. Most of the timberlands in the population area are owned by the USFS and are managed for the conservation of salmonids.

Dams/Diversions

Diversions pose a medium threat to fry, juveniles, smolts, and adults and a low threat to eggs. Marijuana cultivation has become increasingly abundant in the Middle Fork Eel River. Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Agricultural Practices

Agricultural practices present a medium threat to adults, eggs, and fry and a low threat to the other life history stages. Grazing occurs throughout the lower sub-basin, and where exclusionary fencing has not been installed and maintained, may contribute to increased bank erosion and riparian vegetation degradation. Herbicides, pesticides, and fertilizers used for marijuana cultivation are likely impairing water quality in coho salmon streams.

Urban/Residential/Industrial Development

Urban, residential, and industrial development pose medium threats to adults and fry. The largest developed areas within the population area are located in the valley reaches near Covelo. However, this threat is not expected to change significantly because Covelo is not expected to significantly expand in the near future.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Road-stream Crossing Barriers

Road-related barriers are a low threat to coho salmon. There are six complete and three partial barriers resulting from road culverts in the population area. However, most of these barriers occur outside of high IP reaches.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Middle Fork Eel River population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

44.7 Recovery Strategy

The Middle Fork Eel River population has unique challenges in that most of the high IP habitat within its boundaries exists under the temperature mask and in areas with the greatest human impacts. Coho salmon abundance and distribution in the Middle Fork Eel River are currently minimal to nonexistent, making population recovery extremely difficult. Currently, excessively high water temperatures severely limit available juvenile coho salmon summer rearing habitat, and lack of floodplain connectivity limits winter rearing. Recovery activities in the population area should focus on the most limiting habitat, and occur only within the streams with the highest potential to support strays from other populations. An important area to recovery is the Round Valley sub-basin, in which most of the high IP habitat occurs. Although almost all of the streams in Round Valley are under the temperature mask, they likely have potential to provide winter and cold water refugia habitat. Although the Middle Fork Eel River may not support coho salmon at this time, watershed improvement would improve conditions in the mainstem Eel River and benefit the coho population utilizing the mainstem. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 44-4 on the following page lists the recovery actions for the Middle Fork Eel River population.

Table 44-4. Recovery action implementation schedule for the Middle Fork Eel River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MFER.2.1.2	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2b
SONCC-MFER.2.1.2.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MFER.2.1.2.2	*Place instream structures, guided by assessment results*					
SONCC-MFER.2.2.22	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2b
SONCC-MFER.2.2.22.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MFER.2.2.22.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MFER.2.2.3	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	All streams where coho salmon would benefit immediately	2b
SONCC-MFER.2.2.3.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees or dikes have been removed or set back*					
SONCC-MFER.2.2.3.2	*Remove or setback levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-MFER.10.1.29	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase conifer riparian vegetation	Population wide	2b
SONCC-MFER.10.1.29.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-MFER.10.1.29.2	*Plant conifers, guided by the plan*					
SONCC-MFER.10.1.29.3	*Thin, or release conifers, guided by the plan*					
SONCC-MFER.2.1.43	Floodplain and Channel Structure	Yes	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2c
SONCC-MFER.2.1.43.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MFER.2.1.43.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MFER.2.2.44	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2c
SONCC-MFER.2.2.44.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MFER.2.2.44.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MFER.2.2.45	Floodplain and Channel Structure	Yes	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Population wide	2c
SONCC-MFER.2.2.45.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees or dikes have been removed or set back*					
SONCC-MFER.2.2.45.2	*Remove or setback levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-MFER.3.1.25	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	3b
SONCC-MFER.3.1.25.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-MFER.3.1.25.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-MFER.3.1.25.3	*Implement plan*					
SONCC-MFER.10.7.41	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3b
SONCC-MFER.10.7.41.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MFER.10.7.41.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MFER.10.7.42	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MFER.10.7.42.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MFER.10.7.42.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MFER.7.1.5	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	All streams where coho salmon would benefit immediately	3c
SONCC-MFER.7.1.5.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-MFER.7.1.5.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MFER.7.1.5.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-MFER.7.1.46	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve grazing practices	Population wide	3d
SONCC-MFER.7.1.46.1	*Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement*					
SONCC-MFER.7.1.46.2	*If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition*					
SONCC-MFER.7.1.46.3	*Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon*					
SONCC-MFER.8.1.9	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All streams where coho salmon would benefit immediately	3c
SONCC-MFER.8.1.9.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MFER.8.1.9.2	*Decommission roads, guided by assessment*					
SONCC-MFER.8.1.9.3	*Upgrade roads, guided by assessment*					
SONCC-MFER.8.1.9.4	*Maintain roads, guided by assessment*					
SONCC-MFER.8.1.48	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MFER.8.1.48.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MFER.8.1.48.2	*Decommission roads, guided by assessment*					
SONCC-MFER.8.1.48.3	*Upgrade roads, guided by assessment*					
SONCC-MFER.8.1.48.4	*Maintain roads, guided by assessment*					
SONCC-MFER.8.1.8	Sediment	No	Reduce delivery of sediment to streams	Reduce stream bank erosion	All streams where coho salmon would benefit immediately, including Round Valley, Eden Valley, wilderness, and Black Butte River HSAs	3c
SONCC-MFER.8.1.8.1	*Inventory sediment sources, and prioritize for treatment*					
SONCC-MFER.8.1.8.2	*Treat priority sediment source sites, guided by assessment*					
SONCC-MFER.8.1.47	Sediment	No	Reduce delivery of sediment to streams	Reduce stream bank erosion	Population wide	3d
SONCC-MFER.8.1.47.1	*Inventory sediment sources, and prioritize for treatment*					
SONCC-MFER.8.1.47.2	*Treat priority sediment source sites, guided by assessment*					
SONCC-MFER.1.2.23	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	3d
SONCC-MFER.1.2.23.1	*Implement recovery actions for Lower Eel/Van Duzen population that address the target "Estuary"*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MFER.7.1.4	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve long-range planning	Population wide	3d
SONCC-MFER.7.1.4.1	*Review General Plan or City Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary*					
SONCC-MFER.7.1.4.2	*Develop watershed-specific guidance for managing riparian vegetation*					
SONCC-MFER.16.1.11	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MFER.16.1.11.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MFER.16.1.11.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-MFER.16.1.39	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	Tribal land	3d
SONCC-MFER.16.1.39.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MFER.16.1.39.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-MFER.16.1.12	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MFER.16.1.12.1	*Determine actual fishing impacts*					
SONCC-MFER.16.1.12.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-MFER.16.1.40	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	Tribal lands	3d
SONCC-MFER.16.1.40.1	*Determine actual fishing impacts*					
SONCC-MFER.16.1.40.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MFER.16.2.13	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MFER.16.2.13.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-MFER.16.2.13.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-MFER.16.2.14	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MFER.16.2.14.1	*Determine actual impacts of scientific collection*					
SONCC-MFER.16.2.14.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-MFER.8.1.7	Sediment	No	Reduce delivery of sediment to streams	Reduce risk of catastrophic fire	Population wide	3d
SONCC-MFER.8.1.7.1	*Identify forested stands for fire hazard reduction*					
SONCC-MFER.8.1.7.2	*Apply appropriate management techniques (e.g. thinning, burning) to reduce risks of high severity fire*					
SONCC-MFER.14.2.1	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	3d
SONCC-MFER.14.2.1.1	*Determine the effectiveness of various pikeminnow suppression techniques and develop experimental control methods. Develop a plan that identifies watersheds suitable for experimental pikeminnow suppression*					
SONCC-MFER.14.2.1.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					

45. Middle Mainstem Eel River Population

Interior Eel River Diversity Stratum

Core, Functionally Independent Population

High Extinction Risk

Population likely below depensation threshold

6,300 Spawners Required for ESU Viability

347 mi^2 watershed (11% Federal ownership)

232 IP-km (144 mi) (58% High)

Dominant Land Uses are Agriculture and Timber Production

Key Limiting Stresses are 'Altered Hydrologic Function' and 'Altered Sediment Supply'

Key Limiting Threats are 'Dams/Diversions' and 'Roads'

Highest Priority Recovery Actions

• Implement an enhancement program such as captive broodstock, rescue rearing, or conservation hatchery • Increase instream flows by reducing diversions and establishing a forbearance program • Minimize mass wasting	• Improve regulatory mechanisms to avoid over allocating water diversion • Remove, set back, or reconfigure levees and dikes • Reduce abundance of Sacramento pikeminnow

45.1 History of Habitat and Land Use

Agricultural and urban land development profoundly affected the landscape of the Middle Mainstem Eel River. Historically, Little Lake Valley was a large seasonal lake (Figure 45-2) that likely served as productive rearing habitat for coho salmon. In 1910, the lake was drained to repurpose the former lakebed for cattle grazing and potato production (LeDoux-Bloom and Downie 2007). During the same timeframe, the thalwegs through Little Lake were connected via dredging to Outlet Creek and the creek and its tributaries were channelized. Subsequent Highway 101 construction precipitated Outlet Creek's realignment. Erosion from poorly constructed roads in the highly erosive Franciscan geology contributed to increased sediment loading within the region's rivers, leaving streams shallower, warmer, and more prone to flooding (Bodin et al. 1982).

The 1955 and 1964 floods caused significant sedimentation in the Eel River and its tributaries, filled in many pools, destroyed riparian vegetation, and widened channels. Historic timber harvest contributed to significant erosion and sedimentation of stream channels. The current landscape is comprised of hardwood-dominated forest stands and pasture lands. Late seral stands are largely absent from the population area.

Rural residence and small ranch establishment, coupled with early 1990s agricultural intensification, has increased water supply demands. Currently, water users rely on in-stream diversions, shallow wells, or impoundments to satisfy their water demands, thereby reducing stream flows during summer low-flow periods. Prolific marijuana cultivation within the population area results in large quantities of water to be diverted, which has profoundly impacted the region's hydrology (LeDoux-Bloom and Downie 2007).

The Potter Valley Project's 1908-built Cape Horn and 1922-erected Scott hydropower production dams significantly altered Middle Mainstem Eel River coho salmon habitat. The Potter Valley Project diverts flows from the mainstem Eel River to areas outside of the basin (Russian River). Prior to 2004, summer instream flows recorded downstream of Cape Horn Dam typically measured between 2 and 3 cfs. Summer flow reductions degraded riparian vegetation, restricted coho salmon rearing habitat, and restricted coho salmon tributary access. In 2004, the Federal Energy Regulatory Commission (FERC) required Pacific Gas and Electric (PG&E) to implement an instream flow regime consistent with the Reasonable and Prudent Alternative in the National Marine Fisheries Service's (NMFS) 2002 Biological Opinion. The new flow requirement increased Cape Horn Dam's minimum water release volume, incorporated within-year and between-year variability, and replaced the formerly constant 2 cfs summer instream flow minimum.

In 1979, predatory Sacramento pikeminnow were introduced into Lake Pillsbury (California Department of Fish and Game (CDFG) 1997b), and have since colonized the entire Eel River watershed. This predator thrives in warmer waters like those in the mainstem Eel River. Increased sedimentation, dams, diversions, and degraded riparian forests have decreased the number of high-quality pool refugia that could have provided some protection for juvenile coho salmon.

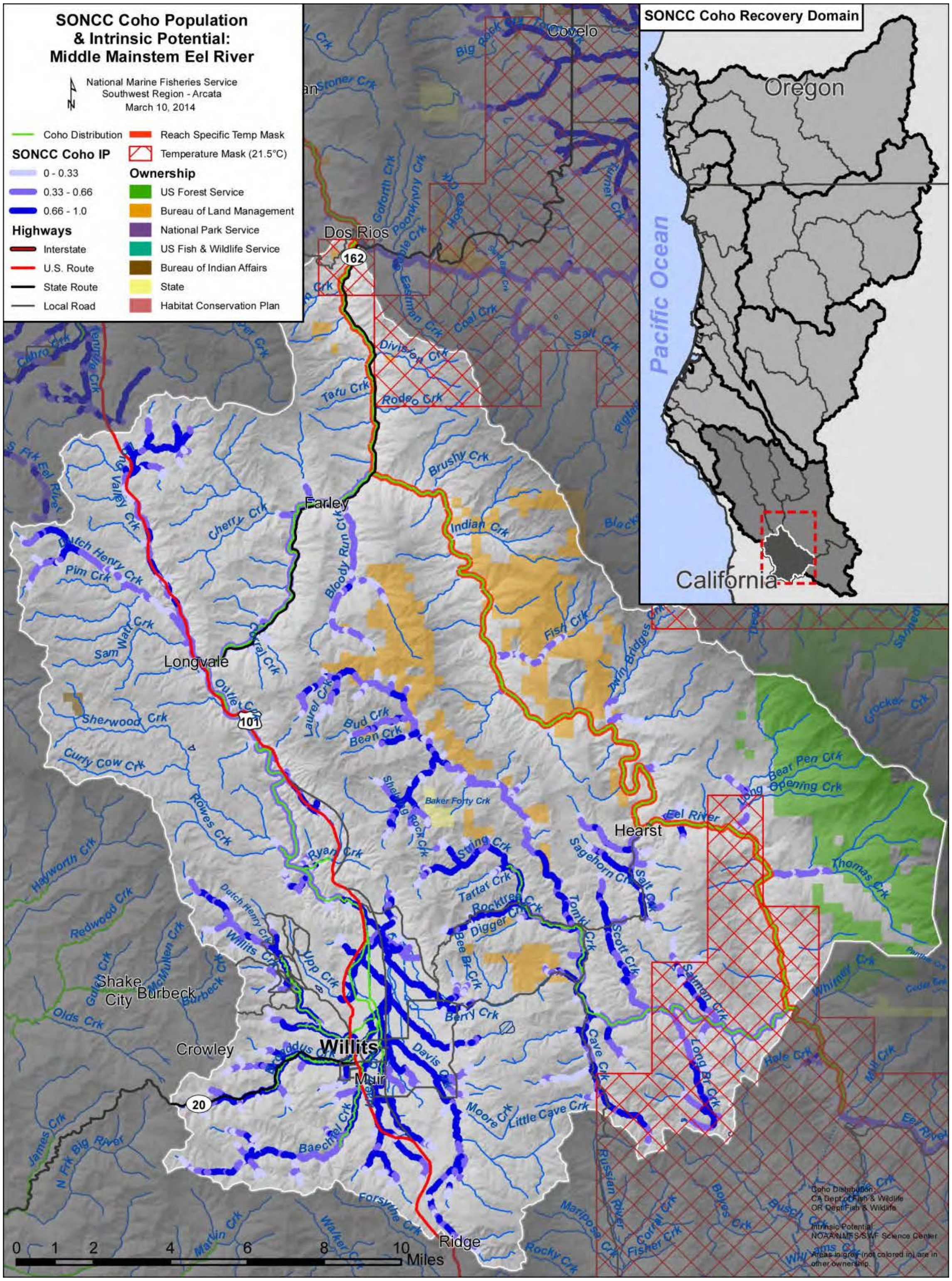

Figure 45-1. The geographic boundaries of the Middle Mainstem Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Eel River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

Figure 45-2. Little Lake Valley in 1905, prior to diking and draining for agriculture (photo source unknown).

45.2 Historic Fish Distribution and Abundance

While historic estimates of Middle Mainstem Eel River coho salmon population abundance do not exist, two major tributaries (Outlet and Tomki creeks) have been monitored in the past. Outlet Creek was historically the largest producer of coho salmon in the population area. In the 1989/1990 season there was an estimated 240 spawning adults in Outlet Creek (Brown and Moyle 1991). No population estimates for Tomki Creek have been made, and brood year surveys since 1979 in the Tomki Creek watershed have not confirmed any presence of coho salmon, except for one observation in Cave Creek. The entire Eel River basin was estimated to have supported 70,000 coho salmon spawners in 1900 (CDFG 1997b). By 1964, less than 500 coho salmon spawners were estimated to return to the Eel River above the South Fork (CDFG 1965).

Records from the late 1980s determined that coho salmon spawned in Long Valley, Reeves Canyon, Ryan, and Haehl creeks and several Outlet Creek tributaries, including Willits, Broaddus, and Baechtel creeks (Brown and Moyle 1991). Based upon recorded juvenile observations, the Indian, Bloody Run, Reeves, Rowes, Mill, Dutch Henry, Rocktree, String, and Tarter creek tributaries to Outlet Creek are believed to have also supported coho salmon (Brown and Moyle 1991, Downie and Gleason 2007). In 1949, approximately 16,815 juveniles were rescued from Tomki Creek and 5,629 juveniles were rescued from Baechtel Creek (Downie and

Gleason 2007). Tomki Creek presumably does not currently support coho salmon, Outlet Creek escapement is low, and two year classes are believed to be missing.

Table 45-1. Tributaries with high IP reaches (IP > 0.66). (Williams et al. 2006).

Subarea	Stream Name	Subarea	Stream Name
Outlet Creek	Baechtel Creek[1]	Tomki Creek	Bean Creek
	Berry Creek		Bud Creek
	Bloody Run Creek[1]		Cave Creek[2]
	Broaddus Creek[1]		Elk Creek
	Davis Creek		Laurel Creek
	Dutch Henry Creek		Long Branch Creek[2]
	Fulweiter Creek		Rocktree Creek
	Haehl Creek		Sagehorn Creek
	Long Valley Creek		Salmon Creek[2]
	Mill Creek[1]		Salt Creek
	Moore Creek		Scott Creek
	Outlet Creek[1]		Shelving Rock Creek
	Ryan Creek[1]		String Creek
	Upp Creek		Tarter Creek
	Willits Creek[1]		Tomki Creek
			Unnamed tributary to Garcia Creek
			Wheelbarrow Creek

[1] Denotes a "Key Stream" as identified in the State of California's Coho Recovery Strategy
2 Stream is under the temperature mask, as modeled by Williams et al. (2006)

45.3 Status of Middle Mainstem Eel River Coho Salmon

Spatial Structure and Diversity

Current spawner and juvenile distribution is unknown but is expected to be limited to the Outlet Creek watershed. The coho salmon in the Middle Mainstem Eel River population area have one of the longest migrations in the ESU, and therefore may maintain unique genetic diversity characteristics in the ESU.

Population Size and Productivity

Williams et al. (2008) determined at least 232 coho salmon must spawn in the Middle Mainstem Eel River population each year to avoid effects of extremely low population sizes. CDFG annual surveys of Outlet Creek have estimated the escapement ranges from 0 to 25 coho salmon annually (LeDoux-Bloom and Downie 2007); however, in 2007/08 over 40 spawners were observed during a survey of Willits and Mill creeks (tributaries of Outlet Creek)(Harris 2010) and in 2010/11 the spawner population was estimated to be approximately 298 individuals (Harris and Thompson 2011). However, of particular concern is that two year classes have been mostly absent. In all Middle Mainstem Eel River streams, breeding groups have been lost or severely depressed. The population growth rate is unknown but is likely negative in most years.

Extinction Risk

The Middle Mainstem Eel River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). NMFS' determination of population extinction risk is based on the viability criteria provided by Williams et al. 2008 (Table 3, pg. 17). These viability criteria reflect population size and rate of decline. As Williams et al. (2008) provided no viability criteria for assessing moderate and high risk based on spatial structure and diversity, spatial structure and diversity were not considered in NMFS' determination of population extinction risk.

Role in SONCC Coho Salmon ESU Viability

The Middle Mainstem Eel River population is a core, Functionally Independent population within the Interior Eel River diversity stratum; historically having had a high likelihood of persisting in isolation over 100-year time scales, and with population dynamics or extinction risk over a 100-year time period that are not substantially altered by exchanges of individuals with other populations (Williams et al. 2006). To contribute to stratum and ESU viability, the Middle Mainstem Eel River core population should have at least 6,300 spawners. Sufficient spawner densities are needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU. Besides its role in achieving demographic goals and objectives for recovery, as a core population the Middle Mainstem Eel River population may serve as a source of spawner strays for nearby coastal populations. At present, the capacity of the Middle Mainstem Eel River coho salmon population to provide recruits to adjacent independent populations is limited due to its low spawner abundance. Middle Mainstem Eel River coho salmon possess the "long run" life history as they must migrate long distances within the Eel River to reach their spawning grounds. Their life history strategy is unique to the Eel River basin and important to the long term survival and recovery of the SONCC coho salmon ESU as well as to the Interior Eel River Diversity Stratum.

45.4 Plans and Assessments

Environmental Protection Agency

Total Maximum Daily Loads
http://www.swrcb.ca.gov/northcoast/

In January 2006, the USEPA published the final Total Maximum Daily Loads (TMDLs) for temperature and sediment for the Middle Main Eel River and tributaries. The North Coast Regional Water Quality Control Board is required to develop measures which will result in implementation of the TMDLs in accordance with the requirements of 40 CFR 130.6.

State of California

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The Recovery Strategy includes analyses and recommendations regarding coho salmon recovery in the Middle Mainstem Eel River.

Eel River Salmon and Steelhead Restoration Action Plan

In 1997, the California Department of Fish and Game completed its assessment of the Eel River basin and provided recommendations for restoration of salmonid stocks. Primary recommendations included removing barriers, reducing sediment inputs, improving riparian forest conditions, reducing water withdrawals, enhancing habitat, and suppressing Sacramento pikeminnow.

Outlet Creek Basin Assessment

CDFG's The Outlet Creek Basin Assessment analyzed conditions for salmonids and developed watershed and habitat improvement activities for each of three identified sub-basins.

45.5 Stresses

Table 45-2. Severity of stresses affecting each life stage of coho salmon in the Middle Mainstem Eel River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Altered Sediment Supply[1]	Very High	High	High[1]	High	High	Very High
2	Altered Hydrologic Function[1]	Medium	Very High	Very High[1]	High	Low	Very High
3	Degraded Riparian Forest Conditions	-	High	High	High	Medium	High
4	Impaired Water Quality	Medium	High	Very High	High	Medium	High
5	Lack of Floodplain and Channel Structure	Medium	High	Very High	High	Medium	High
6	Increased Disease/Predation/Competition	Low	High	High	High	Low	High
7	Impaired Estuary/Mainstem Function	-	Low	High	High	Medium	High
8	Barriers	-	Low	Medium	Low	Medium	Medium
9	Adverse Fishery-and Collection-Related Effects	-	-	Low	Low	Medium	Low
10	Adverse Hatchery-Related Effects		Low	Low	Low	Low	Low

[1]Key limiting stresses and limited life stage

Key Limiting Stresses, Life Stages, and Habitat

The key limiting stresses for this population are altered hydrologic function and altered sediment supply, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. The juvenile life stage is most limited, primarily due to reductions in quality and quantity of summer and winter rearing habitat. Juvenile summer rearing habitat is impaired by low flow conditions exacerbated by water withdrawals and a reduced water table. The lack of flow results in dried stream reaches during the summer season, thereby reducing the extent of available habitat and nutrient transport through drift. High instream sediment loads from past and current land use and flood events have resulted in simplified habitat.

Altered Sediment Supply

High percentages of fine sediment (<1mm) and sand (<6.4mm) are observed in Willits Creek. Except for the lowest reach of Tomki Creek, all surveyed reaches have high or very high embeddedness. Sediment loading can be inferred from road density because the majority of sediment originates from unmaintained and legacy dirt and gravel roads. Road density is very high (>3 mi/sq. mi) throughout most of the population area. High road density areas result in higher sediment mobilization into adjacent waterways. Other sources of sedimentation include soils exposed to high severity fires, the 1955 and 1964 floods, highly erodible slopes, and historic timber harvest.

Excessive sedimentation reduces habitat diversity, embeds spawning gravel, and reduces channel stability. Such habitat changes hinder successful spawning and emergence; reduce pool frequency and depth; increase competition and predation; and reduce macroinvertebrate densities. Suspended sediment loads and high turbidity can negatively impact juvenile salmon by interfering with gill function as well as feeding and other behaviors.

Altered Hydrologic Function

Six dams have been constructed for water supply and recreation in the Outlet Creek watershed. The City of Willits operates two of these dams, which are located on Davis Creek. Morris Dam (constructed in 1924) and Centennial Dam (1989) store a combined total of 1,359 acre-feet (LeDoux-Bloom and Downie 2008). The Brooktrails Township Community Service also operates two dams, Lake Emily on Willits Creek and Lake Ada Rose, which is an off-channel reservoir. Lake Emily stores approximately 275 acre-feet and Lake Ada Rose stores 138 acre-feet. The largest impoundment is operated by the Boy Scouts of America, a reservoir impounding 800 acre-feet of water located on a tributary to Berry Creek. The smallest reservoir holds 45 acre-feet of water and is operated by Pine Mountain Mutual Water Company.

In the last 10 years there has been a dramatic increase in cultivation of marijuana in the Outlet Creek watershed. LeDoux-Bloom and Downie (2007) report juvenile salmonid stranding due to stream diversions from the large number of grow operations within the watershed. Bauer (2012) estimated that during the summer and fall marijuana cultivation uses approximately 150,000 gallons of water per day in the Outlet Creek watershed and over 23,000,000 gallons over the entire grow season. These diversions are on top of the estimated 594,825 gallons per day used by residences (Bauer 2012).

Potter Valley Project instream flow requirements incorporate within-year and between-year variability. Although in-stream flow remains less than that of un-impaired flow, the flow regime approximates a natural hydrograph. Eel River minimum in-stream flows have increased and the total water diverted out of the Eel River and into the East Fork Russian River has been reduced from up to 160,000 to between 60,000 to 138,000 acre-feet per year based on the water year.

Degraded Riparian Forest Conditions

Although Outlet Creek's upstream reach has good stream canopy cover, all other surveyed reaches of Broaddus, Tomki, and Long Valley creeks have either fair or poor canopy cover. The lack of canopy cover is likely due to a lack of mature riparian zones resulting from past timber harvest, agricultural clearing, grazing, urbanization, high severity fires, and the major floods in 1955 and 1964 that obliterated riparian areas' mature conifer trees. Riparian stands are currently dominated by willows, alders, and hardwoods. All surveyed reaches of Tomki, Long Valley, Outlet, and Broaddus creeks have at least 40 percent hardwood canopy. Lack of suitable riparian forests results in increased solar radiation that elevates water temperatures to stressful or lethal levels for juvenile coho salmon. Healthy and mature riparian forests stabilize banks, reduce and filter erosion, and contribute large wood to streams which create complex channel and floodplain structure.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in the population area and in adjacent population areas. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area and those mainstem segments in which coho salmon must migrate through are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate.

Impaired Water Quality

Benthic macroinvertebrate sampling within Willits, Broaddus, and Baechtel creeks revealed either fair or poor conditions. Summer rearing stream temperatures are poor with values exceeding 17 °C for the maximum weekly average temperature (MWAT) throughout most of the population area. Extensive water quality monitoring (Humboldt County Resource Conservation District (HCRCD) 1998) revealed that many Middle Mainstem Eel River tributary water temperatures were marginal, stressful, or lethal (19 °C to over 24 °C) to coho salmon. Excessively warm water temperatures can occur as early as late May during hot years with low flows, but more commonly occur during late June and early July. Elevated temperature is problematic throughout the population area, thus prompting the listing for temperature under the Clean Water Act Section 303(d). Temperature-induced stress can lead to decreased growth and survival of juveniles and increased mortality of adult coho salmon.

Lack of Floodplain and Channel Structure

The majority of surveyed reaches and tributaries have fair or poor pool depths (<2.0 ft.). The lower half of Tomki Creek has very poor pool frequency (<35 percent by length), whereas Outlet Creek and its tributaries have mostly good and very good pool frequencies (>50 percent by length). Between the mouth of String Creek and Cave Creek, 1952-dated photos indicate maximum channel widths of 200 feet; in 1983, the maximum width expanded to 400 feet, primarily resulting from gravel extraction during that time period (U.S. Environmental Protection Agency (EPA) 2004). Large woody debris data are lacking, but it is likely the Middle Mainstem Eel River's large wood volume is inadequate given current habitat conditions and disturbance history.

Channelization and routing of streams for roads, railroads, farming, ranching, and subdivisions have significantly diminished floodplain connectivity in the lower reaches of tributaries in the southern sub-basin of Outlet Creek (LeDoux-Bloom and Downie 2007).

Increased Disease/Predation/Competition

Sacramento pikeminnow thrive within the population area's warmer water temperatures, prey upon coho salmon, and displace coho salmon from other available habitats.

Impaired Estuary/Mainstem Function

All Middle Mainstem Eel River coho salmon migrate to and from the ocean through the mainstem Eel River and the Eel River estuary. The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon populations. Agriculture and flood protection-induced diking and wetland filling have resulted in severe impairment and a 60 percent reduction in the size of the Eel River estuary (CDFG 2010b). Mainstem conditions contribute to this stress because of the issues with water quality, predation, and degraded habitat. Juveniles, smolts, and adults transitioning through mainstem and estuarine habitat suffer from the lost opportunity for increased growth and survival.

Barriers

CDFW's Passage Assessment Database indicates that at least 15 road crossing barriers and 6 dams within the Middle Mainstem Eel River population area completely block fish passage. Except for one road crossing, all of these complete barriers are located within the Outlet Creek watershed, and several of these barriers block access to suitable rearing habitats, including high IP reaches.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium stress to adults and a low stress to juveniles and smolts.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into the Middle Mainstem Eel River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

45.6 Threats

Table 45-3. Severity of threats affecting each life stage of coho salmon in the Middle Mainstem Eel River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Dams/Diversions[1]	Low	High	Very High[1]	High	High	Very High
2	Roads[1]	High	High	High[1]	High	High	High
3	Climate Change	Low	Low	Very High	High	Medium	High
4	High Severity Fire	High	High	High	High	Medium	High
5	Timber Harvest	High	High	High	High	Medium	High
6	Agricultural Practices	Medium	High	High	High	Medium	High
7	Invasive Non-Native/Alien Species	Low	High	High	High	Low	High
9	Channelization/Diking	Medium	High	High	Medium	Medium	High
8	Urban/Residential/Industrial Dev.	Medium	Medium	High	Medium	Medium	Medium
10	Mining/Gravel Extraction	Medium	Medium	Medium	Medium	Medium	Medium
11	Road-Stream Crossing Barriers	-	Low	Medium	Low	Medium	Medium
12	Fishing and Collecting	-	-	Low	Low	Medium	Low
13	Hatcheries	Low	Low	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are dams/diversions and roads.

Roads

Throughout most of the population area, paved, gravel, and dirt road densities are very high (>3 mi/mi^2), especially in areas with high IP reaches. If not properly maintained, these extensive road networks can increase erosion and sediment availability and facilitate sediment transport into streams. Excessive stream sedimentation causes substrate embeddedness, smothers eggs, reduces pool depths, and results in habitat simplification. Roads can also influence peak flows and contribute to higher peak flows in areas with high paved road densities.

Road building for access to marijuana cultivation sites is common in many areas of the population area. It is likely that many of these roads are unpermitted and contribute excessive amounts of fine sediment to coho salmon streams.

Dams/Diversions

Within the Outlet Creek watershed, 6 dams completely block coho salmon migration. These dams are all located within 4 miles of the city of Willits. Localized residential and agricultural water diversions within the Tomki Creek and Outlet Creek watersheds reduce streamflows during critical juvenile rearing periods and restrict fish passage.

Marijuana cultivation has become abundant in many areas of the population area. Although the number of plants grown each year is unknown, the water diversion required to support these plants is placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Climate Change

Climate change will have the greatest impact upon coho salmon juveniles, smolts, and adults. The current climate is generally warm and regional average temperature models indicate average temperatures could increase by up to 2.6 °C in the summer and by up to 1.2 °C in the winter over the next 50 years (see Appendix B for modeling methods). Area annual precipitation is already low and is predicted to decrease over the next century. In upper elevations of the Eel River basin, snowpack will decrease with temperature and precipitation changes (California Natural Resources Agency 2009).

Juvenile and smolt rearing and migratory habitat are most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Rising sea level may also impact the quality and extent of wetland rearing habitat for smolts in the estuary. Overall, the range and degree of variability in temperature and precipitation are likely to increase in all populations. As with all populations in the ESU, adults will be negatively impacted by ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

High Severity Fire

Past timber harvest practices coupled with fire-suppression efforts over the past century have resulted in excessive understory forest fuel loads. High severity fires result from these excessive forest fuel loads and often mobilize sediment downslope into streams. The altered vegetation in the population area increases High severity fire potential that presents a high threat to all coho salmon life stages. Until upland regions undergo fuel reduction, high severity fires are expected to occur in the future and will continue to alter sedimentation processes and riparian vegetation characteristics.

Timber Harvest

Timber harvest poses a high threat to the Middle Mainstem Eel River population. Many of the changes that have occurred to instream and riparian conditions in the Middle Mainstem Eel River reflect legacy effects of more intensive harvest from previous decades. Although the majority of the effects to habitat were the result of legacy timber harvesting, the landscape is privately owned timberlands that may be harvested in the future.

Forest lands are being cleared and graded to create new marijuana cultivation sites. In many cases the land disturbance is not regulated, and likely contributes excessive amounts of fine sediment to coho salmon streams.

Agricultural Practices

Agriculture is predominantly low within this population area with the exception of Little Lake Valley. The gentle slopes of Little Lake Valley accommodate various agricultural uses such as pastures for livestock and growing crops. Unfortunately, several high IP reaches are located in and around Little Lake Valley. During the summer and fall low-flow periods, the upper reach of Outlet Creek may be impacted by nutrients and bacteria from livestock (LeDoux-Bloom and Downie 2007). Local watershed groups are working with landowners to exclude cattle from riparian areas. Agriculture-induced lack of riparian vegetation exacerbates negative water quality and habitat conditions.

Marijuana cultivation has become abundant in many areas of the population area. Although the number of plants grown each year is unknown, the herbicides, pesticides, and fertilizers used to support these plants are likely impairing water quality in coho salmon streams.

Invasive Non-Native/Alien Species

The warm water in the Eel River and Lake Pillsbury create ideal conditions for the non-native Sacramento pikeminnow, a voracious predator. The presence of the Sacramento pikeminnow in Lake Pillsbury makes eradication of this species extremely difficult. Any effort to remove this species from the Eel River without treating the lake will only be temporary because the lake will continue to be a source population for the Eel River basin. As more water is released into the mainstem Eel River, more refuge habitat should become available. Moreover, to the extent that restoration activities restore cooler water temperatures, habitat conditions will become less ideal for the pikeminnow.

Urban/Residential/Industrial Development

The majority of high IP habitat reaches are located within or near the city of Willits. Future urbanization is likely as transportation infrastructure improves and northerly migration from San Francisco Bay Area metropolitan areas increases. In addition, increased rural residential development is likely as large agricultural holdings are subdivided into smaller ranches. These land use changes will culminate in increased road building, land clearing, and other development activities.

Channelization/Diking

Channelization is especially prominent in the Little Lake Valley, where many of the highest potential tributaries in the population area are channelized for agricultural production. Within the city of Willits, tributaries are channelized along roads and other urban infrastructures. Because the city of Willits is expected to expand, the threat of channelization and diking could potentially increase.

Mining/Gravel Extraction

Very little gravel mining occurs in the Middle Mainstem Eel River. In the past, four gravel mining operations were permitted to operate near Dos Rios, but these operations have ceased.

Road-Stream Crossing Barriers

CDFW's Passage Assessment Database reports 15 road crossings are complete barriers to coho salmon migration. Most of these fish passage barriers are in the Outlet Creek watershed and result from either Hwy 101 or 20. Most of these road crossing barriers block high IP reaches, especially in the Willits area.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a medium threat to adults and a low stress to juveniles and smolts.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Middle Mainstem Eel River population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

45.7 Recovery Strategy

Current Middle Mainstem Eel River habitat conditions, combined with a severely depressed coho salmon population with restricted distribution, significantly increase the extinction risk of this important, long-run coho salmon population. To ensure recovery of the population, the remnant coho salmon run in Outlet Creek must be stabilized, grown, and expanded to other tributaries, most notably Tomki Creek. Currently, the lack of adequate flow in the summer is likely most limiting coho salmon survival; therefore, immediate action must be taken to ensure summer baseflow is guaranteed. Due to the lack of a source population in the vicinity of the population area, the likelihood of straying spawners rebuilding the two missing year classes is very low. Therefore, it may be necessary to take enhancement measures such as rescue and relocation of juveniles during summer months or population supplementation through a well-thought out program.

Considering that most of the population area is privately owned, much of the highest potential habitat is located within developed areas; therefore, actions must be taken to educate and motivate local landowners to support recovery efforts. Activities that increase summer flows, increase connectivity to the floodplain, reduce sediment input, increase riparian vegetation, and reduce the abundance of Sacramento pikeminnow should be immediately implemented. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 45-4 on the following page lists the recovery actions for the Middle Mainstem Eel River population.

Table 45-4. Recovery action implementation schedule for the Middle Mainstem Eel River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MMER.3.1.10	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Mainstems and tributaries of Outlet and Tomki creeks, and all streams where coho salmon would benefit immediately	1
SONCC-MMER.3.1.10.1	*Provide incentives to reduce water use by reducing diversion during summer*					
SONCC-MMER.3.1.10.2	*Establish and implement a forbearance program to reduce diversions during summer*					
SONCC-MMER.3.1.10.3	*Monitor forbearance compliance and flow*					
SONCC-MMER.3.1.39	Hydrology	Yes	Improve flow timing or volume	Increase instream flows	Population wide	1
SONCC-MMER.3.1.39.1	*Identify and cease unauthorized water diversions*					
SONCC-MMER.3.1.38	Hydrology	Yes	Improve flow timing or volume	Provide adequate instream flow for coho salmon	Population wide	1
SONCC-MMER.3.1.38.1	*Conduct study to determine instream flow needs of coho salmon at all life stages.*					
SONCC-MMER.3.1.38.2	*If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.*					
SONCC-MMER.3.1.38.3	*Implement coho salmon instream flow needs plan.*					
SONCC-MMER.26.1.1	Low Population Dynamics	No	Increase population abundance	Implement an enhancement program	Population wide	1
SONCC-MMER.26.1.1.1	*Assess impacts and benefits associated with different enhancement programs such as captive broodstock, rescue rearing, and conservation hatcheries*					
SONCC-MMER.26.1.1.2	*If enhancement is determined to be beneficial, obtain a permit and develop a facility to rear fish*					
SONCC-MMER.26.1.1.3	*Operate enhancement program as a temporary strategy to prevent extirpation*					
SONCC-MMER.26.1.1.4	*Monitor fish populations at all life stages including juvenile snorkel counts, downstream migrant counts, spawning surveys, and Passive Integrated Transponder (PIT) tagging*					
SONCC-MMER.8.1.17	Sediment	Yes	Reduce delivery of sediment to streams	Minimize mass wasting	All streams where coho salmon would benefit immediately	2a
SONCC-MMER.8.1.17.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-MMER.8.1.17.2	*Implement plan to stabilize slopes and revegetate areas*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MMER.8.1.60	Sediment	Yes	Reduce delivery of sediment to streams	Minimize mass wasting	Population wide	2b
SONCC-MMER.8.1.60.1	*Assess and map mass wasting hazard, prioritize treatment of sites most susceptible to mass wasting, and determine appropriate actions to deter mass wasting*					
SONCC-MMER.8.1.60.2	*Implement plan to stabilize slopes and revegetate areas*					
SONCC-MMER.3.1.40	Hydrology	Yes	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2b
SONCC-MMER.3.1.40.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-MMER.3.1.40.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-MMER.3.1.40.3	*Implement plan*					
SONCC-MMER.3.1.12	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-MMER.3.1.12.1	*Work with partners to streamline the process needed for the dedication of water to fish and wildlife resources under CA Water Code section 1707*					
SONCC-MMER.3.1.12.2	*Implement water dedications to increase instream flows using the streamlined process*					
SONCC-MMER.3.1.13	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-MMER.3.1.13.1	*Establish a categorical exemption under CEQA for water leasing to increase instream flows*					
SONCC-MMER.3.1.14	Hydrology	Yes	Improve flow timing or volume	Improve regulatory mechanisms	Population wide	2b
SONCC-MMER.3.1.14.1	*Establish a comprehensive groundwater permit process*					
SONCC-MMER.5.1.7	Passage	No	Improve access	Remove barriers	All streams where coho salmon would benefit immediately	2b
SONCC-MMER.5.1.7.1	*Evaluate and prioritize barriers for removal*					
SONCC-MMER.5.1.7.2	*Remove barriers, based on evaluation*					
SONCC-MMER.5.1.8	Passage	No	Improve access	Remove barriers	Ryan Creek	2b
SONCC-MMER.5.1.8.1	*Remediate culverts that have been identified as high priority for fish passage*					
SONCC-MMER.5.1.58	Passage	No	Improve access	Remove barriers	Population wide	2d
SONCC-MMER.5.1.58.1	*Evaluate and prioritize barriers for removal*					
SONCC-MMER.5.1.58.2	*Remove barriers, based on evaluation*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MMER.1.2.34	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	2b
SONCC-MMER.1.2.34.1	*Implement recovery actions for Lower Eel/Van Duzen River population that address the target "Estuary"*					
SONCC-MMER.2.1.2	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	2b
SONCC-MMER.2.1.2.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MMER.2.1.2.2	*Place instream structures, guided by assessment results*					
SONCC-MMER.2.1.55	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	2d
SONCC-MMER.2.1.55.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-MMER.2.1.55.2	*Place instream structures, guided by assessment results*					
SONCC-MMER.26.1.52	Low Population Dynamics	No	Increase population abundance	Rescue and relocate stranded juveniles	Population wide	2b
SONCC-MMER.26.1.52.1	*Survey coho-bearing tributaries and relocate juveniles stranded in drying pools*					
SONCC-MMER.2.2.53	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2b
SONCC-MMER.2.2.53.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MMER.2.2.53.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MMER.2.2.57	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-MMER.2.2.57.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-MMER.2.2.57.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-MMER.2.2.37	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	All streams where coho salmon would benefit immediately, including Mainstem Outlet Creek and its tributaries	2b
SONCC-MMER.2.2.37.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-MMER.2.2.37.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MMER.2.2.56	Floodplain and Channel Structure	No	Reconnect the channel to the floodplain	Remove, set back, or reconfigure levees and dikes	Population wide	2d
SONCC-MMER.2.2.56.1	*Assess feasibility and develop a plan to remove or set back levees and dikes that includes restoring the natural channel form and floodplain connectivity once the levees and dikes have been removed or set back*					
SONCC-MMER.2.2.56.2	*Remove or set back levees and dikes and restore channel form and floodplain connectivity, guided by the plan*					
SONCC-MMER.14.2.9	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2b
SONCC-MMER.14.2.9.1	*Determine the effectiveness of various pikeminnow suppression techniques and develop experimental control methods. Develop a plan that identifies watersheds suitable for experimental pikeminnow suppression*					
SONCC-MMER.14.2.9.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					
SONCC-MMER.3.1.11	Hydrology	Yes	Improve flow timing or volume	Educate stakeholders	Population wide	3a
SONCC-MMER.3.1.11.1	*Develop an educational program about water conservation programs and instream leasing programs*					
SONCC-MMER.8.1.16	Sediment	Yes	Reduce delivery of sediment to streams	Improve regulatory mechanisms	Population wide	3b
SONCC-MMER.8.1.16.1	*Develop grading ordinance for maintenance and building of private roads that minimizes the effects to coho*					
SONCC-MMER.8.1.15	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Tomki and Outlet Creek watersheds, and all streams where coho salmon would benefit immediately	3b
SONCC-MMER.8.1.15.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MMER.8.1.15.2	*Decommission roads, guided by assessment*					
SONCC-MMER.8.1.15.3	*Upgrade roads, guided by assessment*					
SONCC-MMER.8.1.15.4	*Maintain roads, guided by assessment*					
SONCC-MMER.8.1.59	Sediment	Yes	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	Population wide	3d
SONCC-MMER.8.1.59.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-MMER.8.1.59.2	*Decommission roads, guided by assessment*					
SONCC-MMER.8.1.59.3	*Upgrade roads, guided by assessment*					
SONCC-MMER.8.1.59.4	*Maintain roads, guided by assessment*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MMER.7.1.4	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase regulatory oversight	Population wide	3b
SONCC-MMER.7.1.4.1	*Ensure channel modifications are permitted and reviewed*					
SONCC-MMER.7.1.3	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Revegetate riparian areas	Mainstems and tributaries of Outlet and Tomki creeks	3b
SONCC-MMER.7.1.3.1	*Identify and prioritize locations for planting*					
SONCC-MMER.7.1.3.2	*Plant conifers and other native species in riparian areas, guided by assessment results*					
SONCC-MMER.10.7.51	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3b
SONCC-MMER.10.7.51.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MMER.10.7.51.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MMER.10.7.54	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-MMER.10.7.54.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-MMER.10.7.54.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-MMER.7.1.5	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
SONCC-MMER.7.1.5.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan).*					
SONCC-MMER.7.1.6	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reestablish natural fire regime	Population wide	3d
SONCC-MMER.7.1.6.1	*Identify areas prone to high severity fire and develop a plan to reestablish a natural fire regime*					
SONCC-MMER.7.1.6.2	*Carry out fuel reduction or modification projects such as thinning, prescribed burning, and piling, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-MMER.16.1.19	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MMER.16.1.19.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-MMER.16.1.19.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					
SONCC-MMER.16.1.20	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MMER.16.1.20.1	*Determine actual fishing impacts*					
SONCC-MMER.16.1.20.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-MMER.16.2.21	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MMER.16.2.21.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-MMER.16.2.21.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-MMER.16.2.22	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-MMER.16.2.22.1	*Determine actual impacts of scientific collection*					
SONCC-MMER.16.2.22.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					
SONCC-MMER.10.2.36	Water Quality	No	Reduce pollutants	Improve regulatory mechanisms	Population wide	3d
SONCC-MMER.10.2.36.1	*Develop a pesticide management plan*					
SONCC-MMER.10.2.36.2	*Implement pesticide management plan and technical assistance program*					

46. Upper Mainstem Eel River Population

Interior Eel River Diversity Stratum

Non-Core 2, Potentially Independent Population

Recovery criteria: 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

361 mi^2 watershed (82% Federal ownership)

54 IP-km (34 IP-mi.) (27% High)

Dominant Land Uses are Recreation and Agriculture

Key Limiting Stresses are 'Barriers' and 'Altered Hydrologic Function'

Key Limiting Threats are 'Dams/Diversions' and 'Roads'

Highest Priority Recovery Actions

• Screen all water diversions • Reduce abundance of Sacramento pikeminnow • Increase large woody debris (LWD), boulders, and other instream structure	• Identify and enhance non-natal rearing sites for juvenile coho salmon • Reduce road-stream hydrologic connection • Determine the effects of marijuana cultivation and minimize if necessary

46.1 History of Habitat and Land Use

Land use activities in the Upper Mainstem Eel River include timber harvest, hydropower production, agriculture, recreation, limited livestock operations, and residence construction.

The Potter Valley Project's 1908-built Cape Horn and 1922-erected Scott hydropower production dams represent the most significant Upper Mainstem Eel River coho salmon habitat alterations and precipitated the loss of most of this population's historic habitat.

Built without a fish ladder, Scott Dam blocks a significant amount of potential anadromous salmonid habitat. Estimates of the extent of habitat lost by construction of Scott Dam were made by both VTN (1982) and Lee and Baker (1975). VTN conducted detailed stream surveys that documented 35.7 miles of major channels in and above Lake Pillsbury that would have been historically suitable for Chinook salmon or steelhead spawning and rearing. An additional 22.7 miles of minor channels were considered suitable for steelhead, resulting in a total of 58.4 miles for that species. Lee and Baker (1975) reported "as much as 50 miles" for Chinook spawning, and "more than 75 miles" for steelhead spawning. Most likely, the extent of habitat lost for coho salmon is most similar to the extent of habitat lost for Chinook salmon. The 1922-built Cape Horn Dam fish ladder was ineffective until more recent renovations in 1987. With an approximate 75,000 acre-feet (AF) capacity, Lake Pillsbury is situated upon, and restricts access to, most of the high IP reaches present in the population area.

From 1992 to 2004, up to approximately 160,000 acre-feet of Eel River water was annually diverted into the East Fork of the Russian River for hydropower production and agricultural uses. From 2007-2012 the Potter Valley Project annually diverted approximately 22% of the estimated unimpaired flow at the point of diversion (i.e., Cape Horn Dam), with an average diversion of 77,000 acre-feet (Kubicek 2013). Until 2004, flows released downstream of Cape Horn Dam were approximately 3 cubic feet per second (cfs) during most of the summer. In 2004, the Federal Energy Regulatory Commission issued an order requiring Pacific Gas and Electric (PG&E) to implement an instream flow regime consistent with the Reasonable and Prudent Alternative in the NMFS 2002 Biological Opinion. The new flow requirement increased the minimum Cape Horn Dam release flows and incorporated within-year and between-year variability. Project releases generally approximate unimpaired flows during the summer and fall, but may deviate from the natural hydrograph during the winter and early spring as runoff is impounded to fill the Lake Pillsbury reservoir. Minimum flows are dependent on a number of factors and formulas, including cumulative inflow into Lake Pillsbury and classification (e.g., wet, dry) of the current and previous water year.

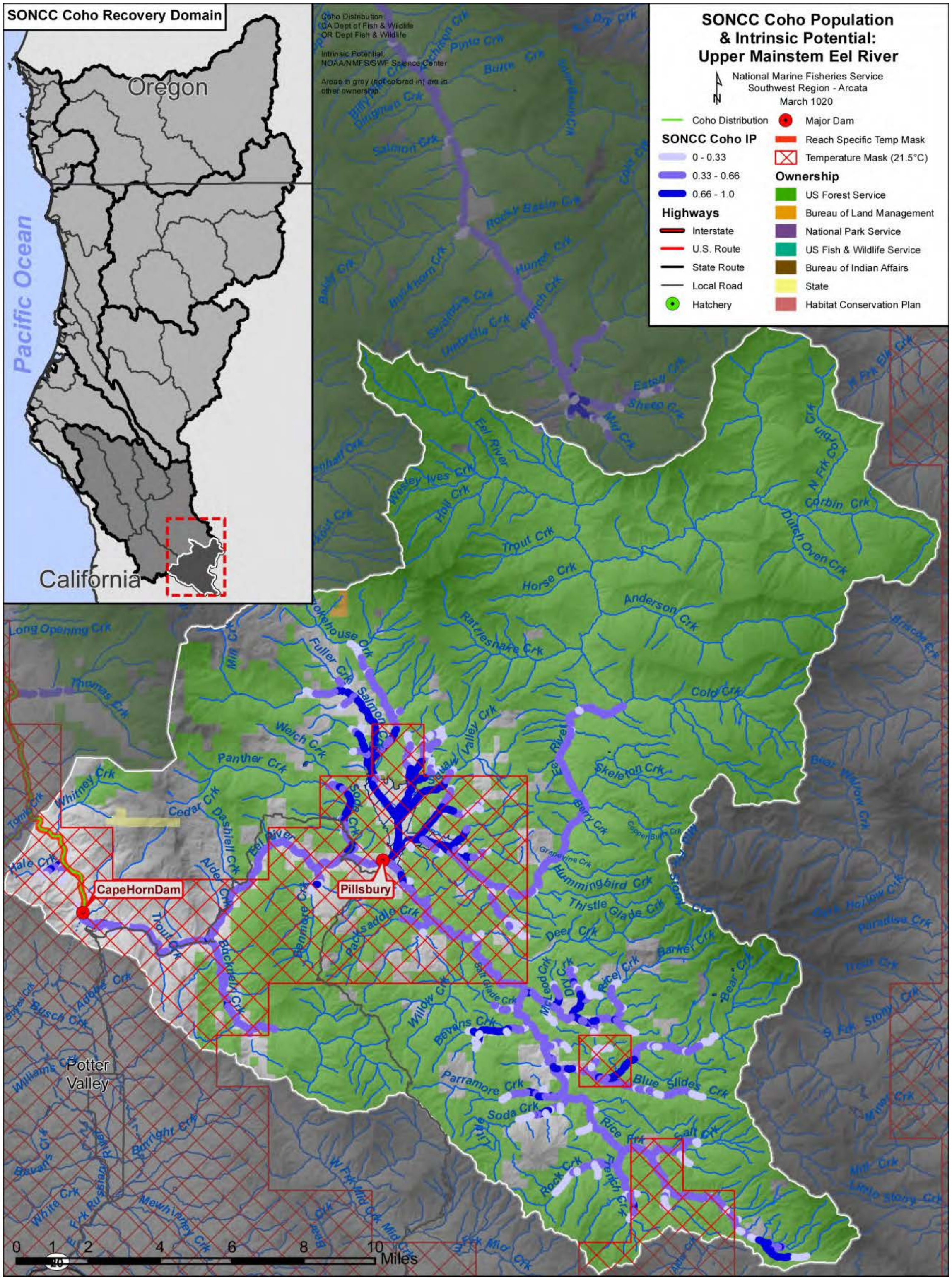

Figure 46-1. The geographic boundaries of the Upper Mainstem Eel River coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), a temperature mask (indicating areas that are inherently too warm for rearing coho salmon), land ownership, coho salmon distribution (CDFG 2012a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Interior Eel River diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

The 1964 flood caused significant sedimentation within the Eel River and its tributaries, by filling in many pools, destroying riparian vegetation, and widening channels. Timber harvest activities were widespread and resulted in sediment transport into creeks. The preponderance of unstable landforms, high road densities, and past timber harvest have contributed to the poor habitat quality evident throughout the population area.

In 1979, predatory Sacramento pikeminnow were introduced into Lake Pillsbury (California Department of Fish and Game (CDFG) 1997b), and now occupy the entirety of the Eel River basin's accessible habitat. This predator thrives in the warmer waters created by degraded riparian forest conditions and low flow conditions. Pools which were formerly high quality refugia which had large woody debris have decreased because of increased sedimentation and degraded riparian forests. These pools and large woody structures would have provided juveniles some protection from predators.

More recently, marijuana production has become the dominant agricultural activity in the area. David Ferrell, the U.S. Forest Service's director of law enforcement offered these comments on environmental degradation brought about in Northern California by the marijuana industry. In December of 2011, Ferrell testified before the Senate Caucus on International Narcotics Control that "growers clear native vegetation, use harsh pesticides, herbicides and rodenticides and divert large amounts of water from streams and rivers", noting an average marijuana plot with 1,000 plants requires up to 5,000 gallons of water a day.

46.2 Historic Fish Distribution and Abundance

Information on historic coho salmon use of the population area is limited. Over the past half century, coho salmon have been intermittently observed, and surveys were rarely conducted. During the 1946/1947 spawning season, 47 adults were observed at the Cape Horn Dam's Van Arsdale Fisheries Station and since that time, adults have been observed on only four other occasions, including a 2010/2011 season observation (Jahn 2011). There have been no scientific or anecdotal coho salmon observations for the areas above Lake Pillsbury. Spawning habitat on the 12 mile reach between Scott and Cape Horn dams was and continues to be suitable because cool water flows out of Scott Dam. By 1964, less than 500 coho salmon were estimated to return to the Eel River above the South Fork (CDFG 1965). The current Eel River population above the South Fork is estimated to be less than 100 based upon 1989 to 1999 NMFS estimates.

Downstream of the dams, water temperature further restricts coho salmon distribution within the population area. The temperature mask data contained in Williams et al. (2006) suggests that portions of IP habitat may be too warm during the summer to support coho salmon.

Table 46-1. Tributaries with high IP reaches (IP > 0.66). (Williams et al. 2006).

Subarea	Stream Name	Subarea	Stream Name
Lake Pillsbury	Bear Creek[2]	Lake Pillsbury	North Fork Corbin Creek[2]
	Bevans Creek[2]		Packsaddle Creek[2]
	Bucknell Creek[1]		Perramore Creek[2]
	Dry Creek[2]		Rice Creek[2]

	French Creek[2]		Rice Fork[2]
	Hale Creek		Salmon Creek (and tribs.)[2]
	Little Soda Creek[2]		Salt Spring Creek[2]
	McLeod Creek[2]		Soda Creek[1]
[1] Denotes a "special tributary" as identified in the 1995 watershed analysis for this area given their relatively large size and current accessibility to anadromous salmonids. [2] Denotes a stream that lies above Lake Pillsbury and is currently inaccessible to coho salmon.			

46.3 Status of Upper Mainstem Eel River Coho Salmon

Spatial Structure and Diversity

Williams et al. (2008) determined that at least 39 coho salmon per-IP habitat km are needed (2,100 spawners total) to approximate the historical distribution of Upper Mainstem Eel River coho salmon. Currently, coho salmon are restricted to the lowermost portions downstream of Lake Pillsbury, totaling 12 IP-km (7 IP-mi) of habitat. It is important to note that all of the 12 IP-km of habitat downstream of Lake Pillsbury are covered by the temperature mask identified in Williams et al. (2006). This means the area is naturally too warm to support rearing coho salmon. Scott Dam precludes access to most of the historic population area. Downstream of Scott Dam, coho salmon are restricted to tributaries with degraded habitat and water quality. Coho salmon genetic and life history diversity is likely low due to the presumed low number of individuals.

Population Size and Productivity

Few coho salmon have been observed at the Van Arsdale Fisheries Station. As of 2011, coho salmon have been recorded only five times since the 1940s, including a high count of 47 adults in 1947 (Jahn 2011). Of the five occurrences of coho salmon at Van Arsdale, four occurrences were within the most recent decade. Coho salmon abundance within the tributaries below the dams is unknown but is presumed to be low. Coho salmon are likely present in numbers well below this high risk threshold. Scott dam limits coho salmon access to much of the population area and the remaining tributaries located downstream of the dam have degraded habitat. As a result, coho salmon productivity has been diminished. Given the extremely low population size and presumed negative population growth rate, the Upper Mainstem Eel River coho salmon population may be functionally extinct.

Extinction Risk

The Upper Mainstem Eel River population is at high risk of extinction because NMFS estimates the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is less than one, the criterion described by Williams et al. (2008). However, because it is a non-core 2 population, the recovery target for the population is not to reduce the risk of extinction; rather, 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival.

Role in SONCC Coho Salmon ESU Viability

The Upper Mainstem Eel River population historically was a Potentially Independent population within the ESU meaning that it had a high likelihood of persisting in isolation over a 100-year time scale but was too strongly influenced by immigration from other populations to exhibit independent dynamics (Williams et al. 2006). As a Non-Core 2 population, the recovery target for the Upper Mainstem Eel River population is to ensure that the population supports offspring of adults expected to stray into the area during years of good marine survival (see Chapter 4). Support of stray adults and their offspring is needed to maintain connectivity and diversity within the stratum and continue to represent critical components of the evolutionary legacy of the ESU.

46.4 Plans and Assessments

Environmental Protection Agency

Total Maximum Daily Loads for the Eel River

In January 2006, the USEPA published the final Total Maximum Daily Loads (TMDLs) for temperature and sediment for the Middle Main Eel River and tributaries. The North Coast Regional Water Quality Control Board is required to develop measures which will result in implementation of the TMDLs in accordance with the requirements of 40 CFR 130.6.

State of California

Eel River Salmon and Steelhead Restoration Action Plan

In 1997, the California Department of Fish and Game completed its assessment of the Eel River basin and provided recommendations for restoration of salmonid stocks. Primary recommendations included removing barriers, reducing sediment inputs, improving riparian forest conditions, reducing water withdrawals, enhancing habitat, and suppressing Sacramento pikeminnow.

Recovery Strategy for California Coho Salmon
http://www.dfg.ca.gov/fish/Resources/Coho/SAL_CohoRecoveryRpt.asp

The Recovery Strategy for California Coho Salmon was adopted by the California Fish & Game Commission in February 2004. The Recovery Strategy includes analyses and recommendations regarding coho salmon recovery in the Upper Mainstem Eel River.

U.S. Forest Service and Bureau of Land Management

Watershed Analysis Report for the Upper Main Eel River Watershed (USFS and BLM 1995b)

46.5 Stresses

Table 46-2. Severity of stresses affecting each life stage of coho salmon in the Upper Mainstem Eel River. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

	Stresses	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Stress Rank
1	Barriers	-	Very High	Very High	Very High	Very High	Very High
2	Impaired Water Quality[1]	Low	Very High	Very High[1]	Very High	High	Very High
3	Altered Sediment Supply	Very High	Very High	High	Low	Very High	Very High
8	Altered Hydrologic Function[1]	Low	Medium	High[1]	High	Low	High
4	Lack of Floodplain and Channel Structure	High	Low	High	High	High	High
5	Degraded Riparian Forest Conditions	-	High	High	High	High	High
6	Increased Disease/Predation/Competition	Low	High	High	High	Low	High
7	Impaired Estuary/Mainstem Function	-	Low	Very High	High	Medium	High
9	Adverse Fishery- and Collection-Related Effects		-	Low	Low	Low	Low
10	Adverse Hatchery-Related Effects	Low	Low	Low	Low	Low	Low

[1] Key limiting stresses and limited life stage.

Key Limiting Stresses, Life Stages, and Habitat

Based upon the type and extent of stresses and threats affecting the population as well as the limiting factors influencing productivity, it is likely that the juvenile life stage is the most limited. The limiting stresses are impaired water quality and altered hydrologic function. Water temperatures in the area are excessive and limit rearing success for all anadromous species. Diversions for marijuana production have exacerbated this problem and resulted in disconnected habitat in tributaries. Access to the most suitable juvenile summer and winter rearing habitat is currently blocked by Scott Dam, and habitat downstream of Cape Horn Dam is limited by high water temperatures and excessive sedimentation. Scott Dam also prevents adult passage, resulting in 35 to 150 miles of potential spawning habitat loss, depending on the source of information being considered. High road densities affect water quality throughout the population area by transporting excess sediment into streams. Channel complexity and a diverse estuary are important to juvenile coho salmon and are crucial for increasing the size and fitness of smolts prior to ocean entry, and improving overall marine survival success.

Complex stream channels with deep pools and woody structure as well as tidally influenced wetlands with off channel ponds are important refuge areas for juvenile coho salmon. Juvenile coho salmon would be more protected against predation, competition, and warm mainstem water temperatures if there were additional refugia areas. Available information regarding habitat conditions in the Upper Mainstem Eel River indicates that none of the streams accessible to coho salmon currently are able to function as refugia. Soda Creek data suggest a number of stresses prevent it from serving as a refugia area. While Bucknell Creek may have refugia potential, such designation would be based upon 1990s-dated measurements. Small reaches in other streams that could provide a combination of suitable habitat and water temperatures may exist, but these have not been identified. Marijuana production has diminished flows in most tributaries in the population area.

Barriers

Barriers pose a very high stress for all coho salmon life stages. Scott Dam (Lake Pillsbury) precludes access to more than 80 percent of the historic population area, resulting in an estimated loss of 35 to 150 miles of potential anadromous salmonid habitat depending on the information considered. Most tributary habitats in the population area downstream of the dam may become seasonally inaccessible due to a lack of water, channel aggradation, braiding, and high temperatures. Data from Soda Creek quantifying the amount of dry channel length reveal that dry stream reaches are problematic within the lower portion of this sub-basin. There are very few known road stream crossing barriers in the population area; this stress was rated very high due to Scott Dam and the amount of habitat that is no longer accessible.

Impaired Water Quality

Impaired water quality is a high or very high stress for most life stages. Although the benthic macroinvertebrate (IBI) score is rated as good to very good in the upper sub-basin (indicating little or no water quality contamination and good dissolved oxygen levels), stream temperature for summer rearing is poor throughout most of the population area. Extensive water quality monitoring by the Humboldt County Resource Conservation District (HCRCD 1998) confirms that water temperature in many tributaries is marginal, stressful, or lethal (19 °C to >24 °C). Excessively warm water temperatures can occur as early as late May during hot years with low flows, but more commonly occur during late June and early July. Elevated temperatures are problematic throughout the population area. High temperature- induced stress can lead to decreased growth and survival of juveniles and also increase the mortality rate of returning adults.

Altered Sediment Supply

Altered sediment supply poses a high or very high stress to all life stages. Adults, eggs, and fry are most affected by fine sediment prevalence in gravel. Sediment data are limited, but given EPA-reported observations (USEPA 2004), sediment is a key stress throughout the population area. Increased sediment delivery has resulted in a high embeddedness percentage within Soda Creek, which is where the majority of accessible, high IP habitat exists. Sediment supplies have reduced habitat and channel complexity in most of the tributaries and mainstem reaches of the population.

Hydrologic Function

Altered hydrologic function poses a high stress for juveniles and smolts, a medium stress for fry, and a low stress for eggs and adults. Significant reductions in hydrologic function can degrade entire instream and riparian communities. Stream flows affect important ecosystem linkages, including food web interactions among salmonids, their predators, and their prey; nutrient cycles; and overall habitat diversity and quantity (National Research Council 1996).

More recent instream flow requirements increased the minimum Cape Horn Dam release flow from the former 3 cfs constant summer rate and incorporated within-year and between-year variability. Although overall water quantity remains less than that of unimpaired flows, this new flow regime better approximates a more natural hydrograph. As the result of NMFS (2002) Biological Opinion, mainstem Eel River minimum instream flows have increased, and the total water diverted out of the Eel River and into the East Fork Russian River was reduced from 160,000 to between 60,000 and 138,000 acre-feet per year (based on the water year). It is important to note that the reach between the two dams has artificially cold water due to releases from the bottom of Lake Pillsbury. This reach is known to provide good rearing habitat given the cold water releases.

Marijuana cultivation has become abundant in the population area. Although the extent of marijuana production is unknown, the water diversion required to support these plants appears to be placing a high demand on a limited supply of water (Bauer 2013a). Most diversions for marijuana cultivation occur at headwater springs and streams, thereby removing the coldest, cleanest water at the most stressful time of the year for coho salmon (Bauer 2013b). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per growing season (HGA 2010).

Diversions for marijuana growing are significant in the area and are resulting in dry and disconnected stream channels. Disconnected habitat further exacerbates already stressful conditions and prevents fish from migrating into more preferred habitats, often times leaving the summer rearing life stages stranded in warm isolated pools where they are subject to being preyed upon or having to compete with the Sacramento pikeminnow.

Lack of Floodplain and Channel Structure

Floodplain and channel structure evaluations were based upon floodplain connectivity, pool frequency, and pool depth information. Based on this information, the lack of floodplain and channel structure is a high stress for all coho salmon life stages, except for fry. Although it contains approximately 80 percent of the currently accessible historic high IP habitat, Soda Creek lacks adequate pools and pool depths. Immediately below Scott Dam, floodplain connectivity is fair while floodplain connectivity within the upper sub-basin is believed to be very good. Although data on large wood are limited, wood recruitment to the mainstem is presumably low because dams block most wood transport. Moreover, low in-stream flows cannot facilitate wood mobilization and transport downstream. Pools, large wood cover, and floodplains are essential to juvenile rearing because they provide habitat complexity that facilitates forage optimization, predation avoidance, and permits access to thermal and velocity refuges.

Degraded Riparian Forest Conditions

Degraded riparian areas pose a high stress for all coho salmon life stages. Stream corridor vegetation is believed to be very good throughout most of the population area. However, Soda Creek, the tributary containing the majority of accessible, high IP habitat, has poor riparian shade and is dominated by the early seral conditions characteristic of either open or hardwood canopies. Although the steep canyon terrain provides some shading to Soda Creek, it is limited in its spatial extent and results in only certain reaches having adequate temperature regimes.

Sudden oak death (SOD) is an exotic pathogen affecting almost all native species of plants, shrubs, and trees. SOD is in epidemic stages in population areas downstream of the population, in which coho salmon from this population must migrate through. Because the SOD pathogen is water borne and can travel downstream in watercourses, the likelihood of SOD outbreaks in the population area and adjacent populations are high. One of the largest areas infected by SOD occurs near Redway and is growing at a very fast rate. It is likely that SOD will continue to infect native species throughout the Eel River watershed into the future.

Increased Disease/Predation/Competition

Increased disease, predation, and competition are high stresses for fry, juveniles, and smolts. The warm water temperatures in the Eel River and Lake Pillsbury allow Sacramento pikeminnow to thrive. Sacramento pikeminnow prey upon almost all life stages of all salmonids in the Eel River basin. Pikeminnow not only directly kill coho salmon, but they also displace and compete with the juvenile and smolt life stages. Increased competition in an already stressful environment presents a difficult situation for juveniles. The Sacramento pikeminnow's presence in Lake Pillsbury and widespread presence in almost all accessible habitats makes eradication of this species extremely difficult. Any effort to remove this species in the Eel River without successful removal from the lake will only be temporary because the lake will continue to be the source population for the rest of the Eel River basin.

Impaired Estuary/Mainstem Function

All coho salmon that originate from the Upper Mainstem Eel River migrate to and from the ocean through the mainstem Eel River and the Eel River estuary. The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River coho salmon populations. The degraded function of the Eel River estuary and mainstem migratory corridor today constitutes a high stress for this population. The Eel River estuary is severely impaired because of diking and filling of wetlands for agriculture and flood protection. Levees and dikes reduced the size of the estuary by over 60 percent (CDFG 2010b). The estuary once supported a high degree of estuarine habitat and rearing potential but very little of that historic function still exists. Mainstem conditions contribute to coho salmon population stress because of water quality degradation, increased predation, and degraded habitat issues impacting this population area. The long migrations that this population must take through the mainstem Eel River makes the loss of mainstem functions a high to very high stress. Fitness of juveniles, smolts, and adults migrating through estuarine and mainstem habitat is reduced by the degraded conditions.

Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into the Upper Mainstem Eel River; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

46.6 Threats

Table 46-3. Severity of threats affecting each life stage of coho salmon in the Upper Mainstem Eel River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats[2]	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Dams/Diversions[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
2	Roads[1]	Very High	Very High	Very High[1]	Very High	Very High	Very High
3	Invasive Non-Native/Alien Species	Medium	Very High	Very High	Very High	Low	Very High
4	Climate Change	Low	Low	Very High	Very High	Medium	Very High
5	High Severity Fire	High	High	Medium	Medium	High	High
6	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium
7	Fishing and Collecting	-	-	Low	Low	Low	Low
8	Timber Harvest	Low	Low	Low	Low	Low	Low
9	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
10	Road-Stream Crossing Barriers	-	Low	Low	Low	Low	Low
11	Hatcheries	Low	Low	Low	Low	Low	Low

[1] Key Limiting Threats and Limited Life Stage
[2] Mining/Gravel Extraction and Channelization/Diking are not considered threats to this population.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are dams/diversions and roads.

Dams/Diversions

Dams and diversions pose a very high stress to all life history stages. Further rationale for these ratings may be found in the Altered Hydrologic Function Section. Diversions for marijuana growing along with PG&E's Potter Valley Project dams and diversion are the most significant threats to the Upper Mainstem Eel River coho salmon population. Unscreened diversions for marijuana operations may impinge juveniles seeking shelter in the few pools deep enough to draft water from during the summer season. While Cape Horn Dam possesses a fish ladder, Scott Dam completely blocks access to 35 to 100 miles of potential habitat. Approximately 80 percent of this population's high IP reaches as identified by Williams et al. (2006) are located upstream of Scott Dam.

Near Cape Horn Dam, approximately 60,000 to 138,000 acre-feet of Eel River water has been annually diverted out of the basin and into the East Fork of the Russian River since 2004. Although the NMFS 2002 biological opinion and the 2004 FERC order require PG&E to release more water from both Cape Horn and Scott dams, increased flows in the upper mainstem Eel River are still lower relative to unimpaired flows during certain times of the year. Downstream of the dams, a subdivision along the Upper Mainstem Eel River diverts water for domestic use. The quantity of water diverted for the subdivision and whether there is an adequate fish screen is not known at this time. As human populations expand in Sonoma and Mendocino counties, there may be more demands for Eel River water.

Roads

Roads constitute a very high threat to all the population's life history stages. There are over 175 miles of trails (including about 100 miles of designated off-highway vehicle trails), more than 760 miles of road, and approximately 3900 road/stream crossings. Downstream of Scott Dam, road density is mostly very high (>3 mi/sq. mi). These road and trail networks facilitate sediment transport into streams and increase erosion and sediment availability, especially if the roads and trail networks are not properly maintained. Scott Dam and Lake Pillsbury block most fine particulate matter originating upstream of the dam from traveling into the mainstem Eel River. Unregulated road construction associated with marijuana cultivation contributes to the very high threat rankings of roads in this population.

Invasive Non-Native/Alien Species

Sacramento pikeminnow are a very high threat to fry, juveniles, and smolts and are a medium threat to eggs because they compete with and prey upon young coho salmon. Further rationale for these ratings can be found in the Increased Predation/Disease/Competition discussion above.

Climate Change

Climate change will have the greatest impact upon juveniles, smolts, and adults. The current climate is generally warm and modeled regional average temperature models indicate average temperatures could increase by up to 3 °C in the summer and by up to 1 °C in the winter (see Appendix B for modeling methods). Average annual precipitation is already very low and is predicted to decrease over the next century. Snowpack in upper elevations of the Eel River basin will decrease with changes in temperature and precipitation (California Natural Resources Agency 2009).

The vulnerability of the downstream Eel River estuary to sea level rise is very high. Juvenile and smolt rearing and migratory habitat are most at risk to climate change. Increasing temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Rising sea level may also impact the quality and extent of wetland rearing habitat for smolts in the estuary. Overall, the range and degree of variability in temperature and precipitation are likely to increase in all population areas. As with all populations in the ESU, adults will be negatively impacted by ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Portner and Knust 2007, Feely et al. 2008).

High Severity Fire

High severity fire poses a high threat to most of the life history stages, and a medium threat to juveniles and smolts. Past timber harvest practices coupled with decades-long fire-suppression efforts have rendered understory forest fuel loads excessive. High severity fires may affect coho salmon populations by removing vegetation and litter that protect or minimize soil erosion, leading to increased gullying, and mass wasting events that contribute to high sediment loads and degrade coho salmon habitats. High sediment loads embed spawning gravel, making it less suitable for spawning and bury redds and alevins.

Agricultural Practices

Because of the steepness of the headwaters of the Mainstem Eel River, most agricultural activities are uncommon. However, the area's remoteness has facilitated marijuana cultivation within the Mendocino National Forest. Marijuana may be the primary crop cultivated in the area, and it has been implicated as a source of excessive nutrient inputs to streams. Agricultural activities divert water away from Lake Pillsbury and the Upper Mainstem Eel River. The Mendocino National Forest currently does not allow grazing on their Lake Pillsbury and Ericson Ridge Management Areas; however, there is a grazing allotment in the Pine Mountain Management Area south of the Mainstem Eel River (Stewardship Council 2007). Grazing effects upon the Upper Mainstem Eel River are currently unknown. Vineyard production is expected to expand within Potter Valley which may result in more demand for water diverted from the Eel River.

Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low threat to juveniles, smolts, and adults.

Timber Harvest

Timber harvest is a low threat to this population. Timber harvest primarily occurs on National Forest land and recently has been minimal. Timber harvest is not expected to intensify in the near future because of current management practices and administrative and court challenges.

Forest lands in the population area are being cleared and graded to create new marijuana cultivation sites. In many cases the land disturbance and clearing of trees is not regulated, and likely contributes fine sediment to channels already burdened by sediment problems. Land clearing for marijuana operations also may result in a loss of shade and wood recruitment.

Urban/Residential/Industrial Development

Limited small and remote communities exist within the Upper Mainstem Eel River population area. Residential growth is not expected because of the remoteness of this area. The threat of future residential, urban or industrial development is low.

Road-Stream Crossing Barriers

Road-stream crossing barriers pose a low threat to all coho salmon life stages. CDFG's CalFish website shows that a National Forest road culvert crossing on the M-3 Road is the only complete road-stream crossing barrier (CalFish 2009). However, this culvert is not accessible to coho salmon, even if Scott Dam did not exist.

Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Upper Mainstem Eel River population area. The rationale for these ratings is described under the "Adverse Hatchery-Related Effects" stress.

46.7 Recovery Strategy

The amount of currently inaccessible IP habitat combined with elevated water temperatures present throughout most of the Upper Mainstem Eel River population area limit the opportunities for restoration. The recovery criterion for this population is that 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival. Key habitat in areas downstream of Scott Dam where elevated water temperatures are not limiting coho salmon should be improved to facilitate some level of population persistence. Improvements such as establishing and/or protecting cold water refugia and improving channel complexity will be critical for summer rearing juvenile coho salmon. Key components to achieving this population's recovery include: ensuring in-stream flows closely mimic the natural hydrograph; reducing unpermitted water diversions; creating and protecting cold water refugia; suppressing Sacramento pikeminnow abundance and spatial distribution; increasing floodplain connectivity and channel structure; and enhancing the quality and size of the Eel River estuary. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 46-4 on the following page lists the recovery actions for the Upper Mainstem Eel River population.

Table 46-4. Recovery action implementation schedule for the Upper Mainstem Eel River population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.5.2.7	Passage	Yes	Decrease mortality	Screen all diversions	All streams where coho salmon would benefit immediately	2b
SONCC-UMER.5.2.7.1	*Assess diversions and develop a screening program*					
SONCC-UMER.5.2.7.2	*Screen all diversions*					
SONCC-UMER.5.2.59	Passage	Yes	Decrease mortality	Screen all diversions	Population wide	2c
SONCC-UMER.5.2.59.1	*Assess diversions and develop a screening program*					
SONCC-UMER.5.2.59.2	*Screen all diversions*					
SONCC-UMER.10.1.33	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	All streams where coho salmon would benefit immediately	2b
SONCC-UMER.10.1.33.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-UMER.10.1.33.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-UMER.10.1.52	Water Quality	Yes	Reduce water temperature, increase dissolved oxygen	Increase cool water and thermal refugia	Population wide	2d
SONCC-UMER.10.1.52.1	*Assess sources of cool water and develop techniques to protect and/or improve cool water habitat*					
SONCC-UMER.10.1.52.2	*Add LWD, boulders, or sources of structure as guided by assessment to augment habitat at cool water sources*					
SONCC-UMER.1.2.29	Estuary	No	Improve estuarine habitat	Improve estuary condition	Eel River Estuary	2b
SONCC-UMER.1.2.29.1	*Implement recovery actions for Lower Eel/Van Duzen River population that address the target "Estuary"*					
SONCC-UMER.3.1.39	Hydrology	No	Improve flow timing or volume	Determine effects of marijuana cultivation	Population wide	2b
SONCC-UMER.3.1.39.1	*Assess cumulative effects (e.g., flow, water quality) of marijuana cultivation*					
SONCC-UMER.3.1.39.2	*If needed, develop plan to reduce effects of marijuana cultivation*					
SONCC-UMER.3.1.39.3	*Implement plan*					
SONCC-UMER.3.1.4	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-UMER.3.1.4.1	*Complete comprehensive flow study activities, and use them to educate water managers on how to reduce impacts to coho salmon*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.3.1.5	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-UMER.3.1.5.1	*Provide incentives to landowners to reduce water consumption*					
SONCC-UMER.3.1.6	Hydrology	No	Improve flow timing or volume	Educate stakeholders	Population wide	2b
SONCC-UMER.3.1.6.1	*Provide education and training on water diversion practices and facilitate compliance with pertinent laws and regulations (e.g., FGC §1600 et seq., CFPR 14 CCR 916.9, California water rights law)*					
SONCC-UMER.3.1.3	Hydrology	No	Improve flow timing or volume	Improve regulatory mechanisms	Mainstem and tributaries downstream of Scott Dam	2b
SONCC-UMER.3.1.3.1	*Ensure water diversions are within their water rights*					
SONCC-UMER.3.1.34	Hydrology	No	Improve flow timing or volume	Increase instream flows	All streams where coho salmon would benefit immediately	2b
SONCC-UMER.3.1.34.1	*Identify diversions in tributaries that have subsurface or low flow barrier conditions during the summer*					
SONCC-UMER.3.1.34.2	*Increase flows during low flow periods, as described in the program*					
SONCC-UMER.2.1.32	Floodplain and Channel Structure	No	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	All streams where coho salmon would benefit immediately	2b
SONCC-UMER.2.1.32.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-UMER.2.1.32.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-UMER.2.1.55	Floodplain and Channel Structure	No	Increase channel complexity	Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows	Population wide	2d
SONCC-UMER.2.1.55.1	*Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat*					
SONCC-UMER.2.1.55.2	*Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results*					
SONCC-UMER.2.1.10	Floodplain and Channel Structure	No	Increase channel complexity	Identify and enhance non natal rearing sites	Tributaries and their confluences with mainstem where coho salmon would benefit immediately	2b
SONCC-UMER.2.1.10.1	*Investigate coho salmon non-natal rearing and refugia use in lower reaches of tributaries and mainstem confluences. Develop a plan to enhance identified locations*					
SONCC-UMER.2.1.10.2	*Improve rearing locations, guided by the plan*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.8.1.14	Sediment	No	Reduce delivery of sediment to streams	Reduce road-stream hydrologic connection	All areas where coho salmon would benefit immediately (downstream of Scott Dam)	2b
SONCC-UMER.8.1.14.1	*Assess and prioritize road-stream connection, and identify appropriate treatments*					
SONCC-UMER.8.1.14.2	*Decommission roads, guided by assessment*					
SONCC-UMER.8.1.14.3	*Upgrade roads, guided by assessment*					
SONCC-UMER.8.1.14.4	*Maintain roads, guided by assessment*					
SONCC-UMER.14.2.8	Invasive, Non-native Species	No	Reduce predation and competition	Reduce abundance of Sacramento pikeminnow	Population wide	2b
SONCC-UMER.14.2.8.1	*Determine the effectiveness of various pikeminnow suppression techniques and develop experimental control methods. Develop a plan that identifies watersheds suitable for experimental pikeminnow suppression*					
SONCC-UMER.14.2.8.2	*Suppress Sacramento pikeminnow, guided by the suppression plan*					
SONCC-UMER.3.1.1	Hydrology	No	Improve flow timing or volume	Manage flow	Cape Horn and Scott Dams	2c
SONCC-UMER.3.1.1.1	*Conduct assessments to identify areas of improvement for water management and diversions*					
SONCC-UMER.3.1.1.2	*Make improvements to water management and diversions, based on the assessment*					
SONCC-UMER.5.1.2	Passage	Yes	Improve access	Assess fish passage	Scott Dam	3b
SONCC-UMER.5.1.2.1	*Assess benefits of passage above Scott Dam for coho salmon*					
SONCC-UMER.5.1.2.2	*If passage is determined to be beneficial, develop plan to provide passage*					
SONCC-UMER.5.1.2.3	*Implement plan to provide passage*					
SONCC-UMER.7.1.11	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Increase conifer riparian vegetation	Population wide (downstream of Scott Dam)	3b
SONCC-UMER.7.1.11.1	*Develop an appropriate timber harvest management plan for benefits to coho salmon habitat*					
SONCC-UMER.7.1.11.2	*Thin, or release conifers, guided by the plan*					
SONCC-UMER.7.1.11.3	*Plant conifers, guided by the plan*					
SONCC-UMER.2.1.38	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	All streams where coho salmon would benefit immediately	3b
SONCC-UMER.2.1.38.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UMER.2.1.38.2	*Place instream structures, guided by assessment results*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID	*Step Description*					
SONCC-UMER.2.1.57	Floodplain and Channel Structure	No	Increase channel complexity	Increase LWD, boulders, or other instream structure	Population wide	3d
SONCC-UMER.2.1.57.1	*Assess habitat to determine beneficial location and amount of instream structure needed*					
SONCC-UMER.2.1.57.2	*Place instream structures, guided by assessment results*					
SONCC-UMER.10.7.51	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	All streams where coho salmon would benefit immediately	3b
SONCC-UMER.10.7.51.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-UMER.10.7.51.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-UMER.10.7.53	Water Quality	No	Restore nutrients	Add marine-derived nutrients to streams	Population wide	3d
SONCC-UMER.10.7.53.1	*Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)*					
SONCC-UMER.10.7.53.2	*Supply marine-derived nutrients to streams guided by the plan*					
SONCC-UMER.3.1.35	Hydrology	No	Improve flow timing or volume	Measure flow	Upstream of Lake Pillsbury	3d
SONCC-UMER.3.1.35.1	*Maintain flow gage annually*					
SONCC-UMER.7.1.12	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Improve timber harvest practices	Population wide	3d
SONCC-UMER.7.1.12.1	*Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan).*					
SONCC-UMER.7.1.13	Riparian	No	Improve wood recruitment, bank stability, shading, and food subsidies	Reduce fire hazard	Upland areas adjacent to	3d
SONCC-UMER.7.1.13.1	*Identify forested stands for fire hazard reduction*					
SONCC-UMER.7.1.13.2	*Apply appropriate management techniques (e.g. thinning, burning) to reduce risks of high severity fire*					
SONCC-UMER.16.1.16	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating salmonid fishery management plans affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UMER.16.1.16.1	*Determine impacts of fisheries management on SONCC coho salmon in terms of VSP parameters*					
SONCC-UMER.16.1.16.2	*Identify level of fishing impacts that does not limit attainment of population-specific viability criteria*					

Action ID	Target	KLS/T	Strategy	Action Description	Area	Priority
Step ID		*Step Description*				
SONCC-UMER.16.1.17	Fishing/Collecting	No	Manage fisheries consistent with recovery of SONCC coho salmon	Reduce fishing impacts to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UMER.16.1.17.1	*Determine actual fishing impacts*					
SONCC-UMER.16.1.17.2	*If actual fishing impacts limit attainment of population-specific viability criteria, modify management so that fishing does not limit attainment of population-specific viability criteria*					
SONCC-UMER.16.2.18	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Incorporate SONCC coho salmon VSP delisting criteria when formulating scientific collection authorizations affecting SONCC coho salmon	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UMER.16.2.18.1	*Determine impacts of scientific collection on SONCC coho salmon in terms of VSP parameters*					
SONCC-UMER.16.2.18.2	*Identify level of scientific collection impact that does not limit attainment of population-specific viability criteria*					
SONCC-UMER.16.2.19	Fishing/Collecting	No	Manage scientific collection consistent with recovery of SONCC coho salmon	Reduce impacts of scientific collection to levels that do not limit recovery	SONCC recovery domain plus ocean; from shore to 200 miles off coasts of California and Oregon	3d
SONCC-UMER.16.2.19.1	*Determine actual impacts of scientific collection*					
SONCC-UMER.16.2.19.2	*If actual scientific collection impacts limit attainment of population-specific viability criteria, modify collection so that impacts do not limit attainment of population-specific viability criteria*					

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