Klamath Basin Fish Monitoring Review & Strategy

DRAFT

June 14, 2026

CONTENTS

INTRODUCTION

The Klamath Basin, historically one of the most significant producers of Pacific Coast salmon and other native fishes, has been subject to a long history of competing resource use, often with severe impacts on aquatic ecosystems and people that rely on those resources. The basin has entered a new era of resource management following the largest dam removal and river restoration in history. A complex of interests and entities are currently involved in funding and conducting monitoring, research and evaluation of aquatic resources throughout the Klamath Basin.

This report compiles and documents baseline and critical monitoring activities that are needed to inform progress towards healthy and harvestable fish populations and implementation of restoration activities. This work will facilitate coordination of fish and aquatic resource monitoring and research activities throughout the Klamath Basin by documenting existing efforts, informing shared management and research questions, and identifying gaps that may be addressed through collaboration among monitoring partners. The compilation considers the scope of activities performed by tribes, federal and state agencies, councils, associations, NGOs, and others in the Klamath Basin who are represented directly or by their partners in the Klamath Basin Collaborative Monitoring Plan Technical Steering Committee and participants in a series of workshops (also referred to as the Collaborative group).

This information will also provide the basis for a cohesive and integrated monitoring plan that will guide collaborative activities over the next five years while acknowledging that individual entities continue to have needs for additional monitoring. This plan will identify near-term monitoring activities that should be put forward for funding consideration as a collaborative recommendation, as well as the initial list of priority activities identified by the collaborative group for FY26-28 funding.

This report draws upon a complex of related planning and regulatory documents including the 2023 Klamath Basin Integrated Fisheries Restoration and Monitoring Plan (IFRMP 2023). The IFRMP identifies a watershed functional process hierarchy in the Klamath Basin, focal fish species of particular concern, and goals, objectives, core performance indicators and monitoring priorities for watershed process tiers. This report also leverages and connects to other related plans and regulatory documents that address aspects of functional watershed restoration and recovery for native fish populations in the basin (summarized in Appendix B).

The scope of this report includes the entire Klamath system including the lower-middle Klamath River and tributaries downstream from the Iron Gate Damsite, the Trinity River and tributaries, the “upper” Klamath River and tributaries from the Iron Gate Damsite upstream to Keno Dam, and the Klamath Headwaters from Keno Dam upstream in the Klamath River, Lake & tributaries (Figure 1). Ten focal fish species identified in the IFRMP are addressed by this report. These include Chinook Salmon (Spring and Fall Runs), Steelhead, Lost River Sucker, Shortnose Sucker, Bull Trout, Redband Trout, Pacific Lamprey, Green Sturgeon and Eulachon.

This report is organized into three parts:

- Part 1 describes key questions which drive the need for fish monitoring information in the Klamath Basin.
- Part 2 inventories fish monitoring activities by monitoring type, species and area included related references.
- Part 3 describes a fish monitoring plan framework of tasks and activities organized by basin area and species focus, based on the inventory of current monitoring activities in the basin.

The report also includes appendices describing key entities engaged in fish monitoring (Appendix A) and related plans that address fish monitoring in the basin (Appendix B).

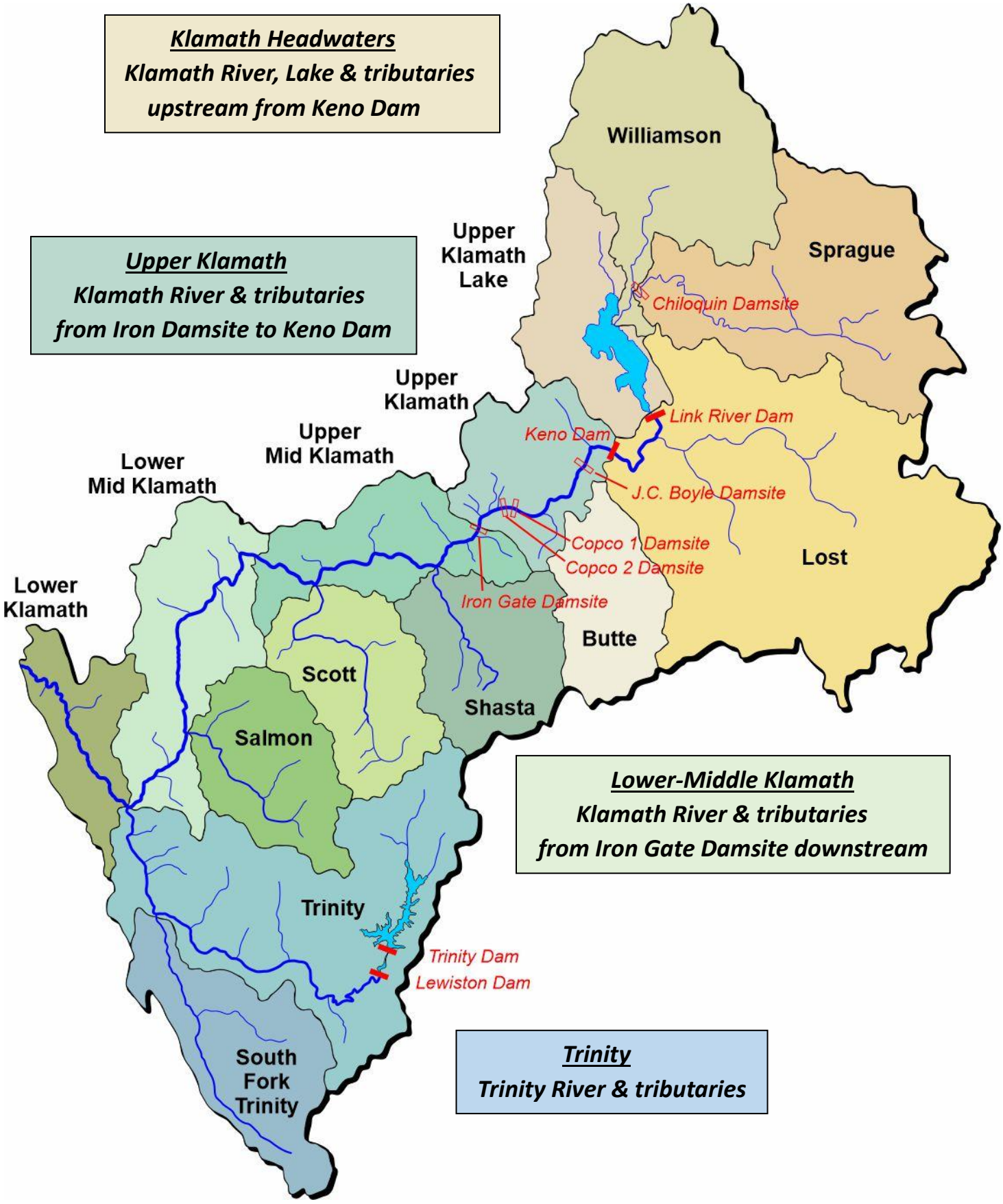

Figure 1. Map of the Klamath Basin showing sub-basin labels used throughout this assessment.

PART 1 - KEY MONITORING QUESTIONS

This section describes key questions which drive the need for fish monitoring information in the Klamath Basin. Monitoring is carried out by many different agencies, Tribes, and organizations to address a complex of purposes specific to their individual authorities and obligations. Specific monitoring and evaluation activities often inform multiple management and research questions.

For the purposes of this plan, we have defined monitoring broadly to include:

Status and Trend Monitoring identify current conditions and tracks changes over time. Status and trends monitoring may focus directly on the fish themselves or on habitat, ecosystem or other factors which affect or limit fish status. It may be used to assess status relative to specific objectives or criteria as in the case of Endangered Species Act listing criteria and recovery goals, for instance. It may also be used more generally to assess status relative to baseline conditions or goals for long-term health and sustainability.

Action Effectiveness Monitoring in the context of this plan identifies the response to specific actions or activities intended to produce a desired outcome. For instance, action effectiveness monitoring might be used to determine whether habitat improvement projects result in intended increases in fish production. Action effectiveness monitoring is widely applied to evaluate and adjust actions aimed at fish conservation, restoration, mitigation and management.

Research in the context of this plan is the systematic investigation of uncertainties and unknowns in our understanding of ecological relationships including hypothesized cause and effect relationships between conditions and limiting factors. Research is generally distinguished from monitoring in that it aims to generate new knowledge and understanding through systematic inquiry, while monitoring more generally focuses on tracking progress, performance, or conditions against established standards or goals. However, the distinctions between research and monitoring can be somewhat arbitrary and many investigations can have elements of both.

We identified nine general applications for fish-related monitoring or research activities in the Klamath system (Figure 2). This chapter reviews each of these.

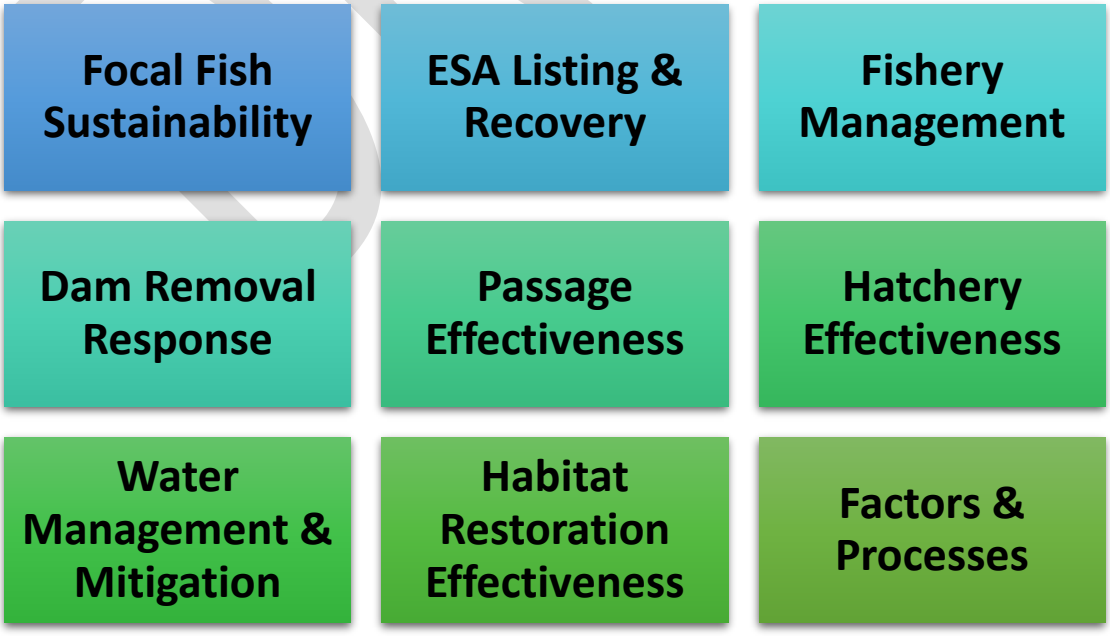

Figure 2. General applications of fish monitoring and research activities in the Klamath system.

1. ARE KLAMATH FOCAL FISH SPECIES SELF-SUSTAINING?

Status and trends of key fish species have long been monitored in the Klamath system relative to historical conditions and goals for long-term health and sustainability of these species. This monitoring serves the fundamental resource management interests, missions and responsibilities of tribal, state and federal agencies as reflected in a variety of legislative, regulatory and policy directives which govern these entities.

For instance, the California Fish and Game Code establish explicit policy direction in statute to the Department of Fish and Wildlife for conservation, maintenance and utilization of the aquatic resources of the state including a basis in adequate scientific information [Division 2 Chapter 7 § 1700]. Similarly, federal direction for conservation and management of fishery resources including essential fish habitat is codified in the Magnuson-Stevens Fishery Conservation and Management Act as well as a complex of other federal statutes (ESSA 2017). Tribal natural resource agencies are subject to their own similar authorities and requirements.

Naturally self-sustaining native fish populations were also identified as a primary goal of the IFRMP for ten focal fish species (Figure 3). These ten focal species are addressed herein.

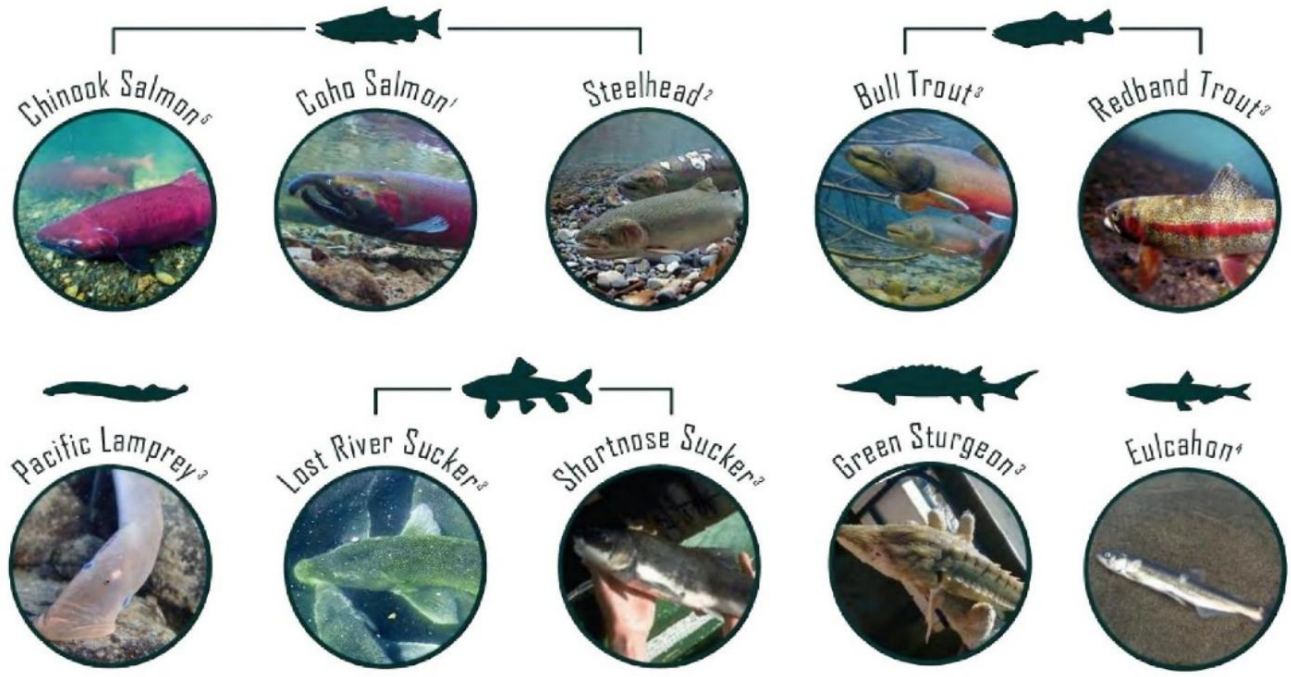

Figure 3. Focal fish species in the Klamath Basin identified by the IFRMP

Fall Chinook (*Oncorhynchus tshawytscha*) are the predominant salmon run type in Klamath Basin (ESSA 2017; PFMC 2019). Adults generally return to freshwater during August-September and spawn from October to December. Spawning occurs in the mainstem Klamath and Trinity Rivers and in large tributaries including the Salmon, Scott and Shasta rivers and Bogus, Indian, Elk and Blue creeks. Fall Chinook are also currently produced by Trinty River and Fall Creek Hatcheries (and previously by Iron Gate Hatchery). Wild juveniles generally emerge from the gravel in February-March and generally migrate seaward at age 0+ between February and August after a brief period of freshwater rearing (ocean type life history). In the ocean, Klamath Fall Chinook are generally distributed along the northern California and southern Oregon coast. Klamath Fall Chinook generally inhabit coastal waters of northern California and southern Oregon. Adults typically return to freshwater at 2-5 years of age (predominately at age 4). Klamath Fall Chinook support culturally and economically important commercial,

sport, and tribal fisheries in freshwater and the ocean. Stock-recruitment analyses indicate that maximum sustained yield is produced by natural spawning escapements of approximately 40,700. Natural escapement has averaged approximately 28,000 per year in 2015-2024 following a downturn in marine survival. Fall Chinook returning to Klamath hatcheries comprised about 30% of the total annual run during this period. Monitoring of Fall Chinook is extensive throughout the basin.

Spring Chinook (*Oncorhynchus tshawytscha*) historically returned to major tributaries throughout the lower Klamath Basin (Trinity, Scott, Shasta, and Salmon rivers) and above Upper Klamath Lake into the Sprague, Williamson and Wood rivers (ESSA 2017). Mainstem dams in the Klamath and Trinity rivers blocked access to much of the historical range of spring Chinook. A small population exists in the Salmon River and a larger hatchery-supplemented natural spawning population occurs in the Trinity River (ESSA 2017). Trinity River Hatchery produces spring Chinook as mitigation for the Trinity River Project. Natural escapement has averaged approximately 4,300 adults per year in 2013-2022 of which over 90% was in the Trinity River.

Adults typically return from the ocean primarily from early February to July, peaking from March to mid-June. Adults hold in deep pools throughout the summer before spawning from September through mid-October. Adults are typically 3-4 years of age. Juveniles generally emerge from the gravel beginning in February, rear in runs and pools for a year, then migrate to the ocean as smolts at age 1 between February and mid-June. In the ocean, Spring Chinook are generally distributed farther offshore than Fall Chinook. This stock is harvested in the lower Klamath and Trinity rivers by Yurok and Hoopa tribal fisheries. Monitoring efforts for Spring Chinook are centered in the Salmon and Trinity Rivers.

Coho Salmon (*Oncorhynchus kisutch*) return to rivers and streams throughout the accessible portions of the Klamath and Trinity basins. Coho were extirpated upstream from Iron Gate Dam. Klamath Coho are part of the Southern Oregon/Northern California Coastal Evolutionarily Significant Unit (ESU) listed as threatened under the Federal ESA in 1997 and by California in 2005. Nine Klamath populations include the Upper Klamath River, Shasta River, Scott River, Salmon River, Middle Klamath River, Lower Klamath River. Three Trinity populations include the Upper Trinity River, Lower Trinity River, and South Fork Trinity River. All of these Klamath coho populations are at a moderate or high risk of extinction because of their small population sizes. SONCC Coho are subject to a 2014 Recovery Plan (NMFS 2014) and periodic status reviews (NMFS 2022, 2024). Coho are also propagated at Fall Creek and Trinity River Hatcheries, and previously at Iron Gate Hatchery.

Adult coho typically return from mid-September through mid-January often associated with pulse flows due to fall rain events (ESSA 2017). Adults return to freshwater at three years of age with a small percentage returning as precocious jacks at age two. Spawning usually occurs during mid-September through mid-January in small, low gradient tributary streams, although they have been observed spawning in side channels, at tributary confluences, and suitable shoreline habitats in the river mainstem. Juveniles generally emerge from the gravel from March to July and rear in fresh water for up to 15 months before migrating to the ocean as smolts between March and July. Juveniles may also emigrate downstream areas shortly after emerging from spawning gravels. Juveniles may rear in the tributaries where spawned or redistribute into suitable habitat in other tributaries. Coho generally spend about another 15 months in the ocean before returning to their natal stream to spawn as 3-year-olds. Ocean distribution is primarily along the northern California and Oregon coasts.

Steelhead (*Oncorhynchus mykiss*) are widely distributed throughout the Lower Klamath River downstream of Iron Gate Dam, and in its tributaries (ESSA 2017). Historical distribution was upstream including headwater tributaries of Klamath Lake. Fall and Winter runs are present. Hodge et al. (2016) found a diverse life-history portfolio that the authors partitioned into 38 life-history types. Anadromous and resident life histories are represented in both anadromous and resident components of the *O. mykiss* population such that anadromous steelhead can be produced by resident adults and visa versa.

Winter run steelhead spawn in rivers and streams throughout the accessible area with significant populations in the Trinity, Scott, Shasta, and Salmon rivers. Most remaining summer steelhead are believed to spawn in tributaries between the Trinity River (RM 43.3) and Seiad Creek (RM 132.7). Juveniles typically rear in freshwater for one or two years before emigrating in spring as smolts. Adults generally spend one or two years in the ocean where they range widely offshore. Current monitoring efforts focused on adult fall and winter steelhead in the Klamath Basin are limited. Some information on adult returns and juvenile occurrence is collected in conjunction with Chinook and coho assessment efforts. Dedicated steelhead monitoring occurs in selected areas.

Lost River Sucker (*Deltistes luxatus*) and ***Shortnose Sucker*** (*Chasmistes brevirostris*) suckers are large, long-lived, lake-dwelling species endemic to the upper Klamath Basin (Burdick 2023; USFWS 2024). Both species are currently on the federal, Oregon, and California endangered species lists. The species are most abundant in Upper Klamath lakes with spawning populations extending upstream to tributaries such as the Williamson and Sprague rivers. Populations also exist elsewhere in the basin, including Clear Lake, with smaller numbers of individual observed in J.C. Boyle Reservoir, Tule Lake, and Copco Reservoir. The number of adult endangered Lost River and shortnose suckers in Upper Klamath Lake, the primary remaining habitat for these species, declined by 65 to 85 percent between 2001 and 2020 (Burdick 2023). Extinction is increasingly likely for these species unless their population trajectories can be changed.

Shortnose sucker adults average about 21 inches in length, mature at four to six years and have been aged to 33 years (ESSA 2017). Lost River Sucker adults average about two and a half feet long, mature at four to nine years and have been documented to live as long as 57 years. Both species generally migrate approximately 7 to 12 miles into a river or stream to spawn. Lost River suckers will also spawn at shoreline springs along lake margins in Upper Klamath Lake and similar water bodies within their range. Spawning occurs from March through May. Both species are limited by very high mortality within the first year or two of life. There are many hypothesized causes of high juvenile sucker mortality, including poor water quality, diseases aggravated by warming water temperatures, and the reduction in wetland habitat that provides food and cover.

Bull Trout (*Salvelinus confluentus*) are predatory char that are widely distributed in the northwestern US but are considered a relic species in the Klamath Basin (NRC 2004; ESSA 2017). The Klamath Basin is at the southern extent of the species range and the population is considered genetically distinct (ODFW 2016). Bull trout in the Klamath Basin is currently limited to a few isolated headwater streams in Oregon (ODFW 2016; USFWS 2015, 2026). Populations are small and largely unconnected. These areas are largely small, spring fed-streams with steep gradients. Bull trout require cold, clean water. Temperatures colder than 10°C are required for successful spawning and early rearing and temperatures more than about 15°C are thought to limit bull trout distribution (Rieman & McIntyre 1993; Buchanan & Gregory 1997; ODFW 1997).

As of 2017, bull trout were documented in seven areas, representing a total distribution of only21 miles of the upper Klamath Basin (ODFW 2010, 2016; ESSA 2017). However, significant populations remain only in Sun Creek, Threemile Creek and Long Creeks (Z. Tiemann, USFWS, pers. comm. 9/17/2025). The Sun Creek population is located mostly within the boundaries Crater Lake National Park and is the largest in the Klamath Basin, exceeding 2000 individuals. Most bull trout are (ODFW 2016). Four resident populations were extirpated in 2021 (Boulder, Dixon, Brownsworth, and Leonard) after the Bootleg Fire, either through acute lethal temperatures or through ash and sediment flows after heavy rainfalls shortly after the fire. Bull trout in the Klamath Basin are listed as Federal ESA Threatened (1998), and ODFW State Sensitive (ODFW 2016). Bull trout are considered extinct in California (ESSA 2017).

Redband Trout are resident *Oncorhynchus mykiss* populations occurring east of the Cascade Crest with distinct genetic differences from coastal populations (ESSA 2017). Klamath Redband Trout *(O mykiss newberrii*) are a unique subspecies indigenous to the river and its tributaries (ODFW 1997). Redband trout occur throughout

Klamath headwater systems. The Interior Redband Conservation Team (ICRT), comprised of representatives from federal, state, and tribal agencies as well as Trout Unlimited identified fourteen conservation populations of redband trout in the Klamath Basin (ICRT 2016). This subspecies has persisted in the upper Klamath over time because of their ability to thrive in lake and stream conditions that would be lethal to most salmonids (NRC 2004). Redband can rear in lakes and migrate to tributaries for spawning (adfluvial strategy), rear in relatively larger streams or rivers and migrate to tributaries for spawning (fluvial strategy) or display more restricted movements within natal stream networks (resident strategy) (IRCT 2016). Klamath redband trout are state listed as a sensitive species in Oregon (ODFW 2016). Federal agencies recognize Klamath redband trout as a Species of Concern (USFWS 2009).

Pacific Lamprey (*Lampetra tridentata*) are an ancient lineage of fish (having remained largely unaltered for 360 million years) that are eel-like in form but lack the jaws and paired fins of true fishes (ESSA 2017). They are the most common of eight lamprey species occurring in the Klamath Basin. Pacific Lamprey are a Tribal Trust species and a target of tribal fisheries in the Klamath for subsistence and cultural purposes. Like salmon, adult Pacific Lamprey return from the ocean to spawn. The species is found in rivers and streams throughout the portion of the basin accessible to anadromous fish and was extirpated above Iron Gate Dam in the Klamath River and above Lewiston Dam in the Trinity River, unable to overcome the passage barriers. Spawning habitat is generally characterized as gravel-bottomed substrate, at the upstream edges of riffles. Rearing habitat consists of fine sediments or sand deposits along the channel margins. After emergence from spawning gravels, ammocoetes drift downstream to nearby pockets of fine sediments (sand deposits). There they burrow and grow into juveniles. Ammocoetes spend up to seven years in the freshwater environment before migrating back out to the ocean. Pacific Lamprey remain in the ocean and live as predators for several years.

Green Sturgeon (*Acipenser medirostus*) is a large anadromous species with a long life (up to 70 years), that spends most of its life in marine environments, often migrating thousands of miles along the west coasts of Mexico, the United States and Canada (ESSA 2017). Spawning is only known to occur in the Rogue, Sacramento, and Klamath rivers. Green Sturgeon that spawn in the Klamath River belong to the Northern Distinct Population Segment (nDPS) and are listed by NOAA Fisheries as a Species of Concern, due to impacts from fisheries harvest, alterations to freshwater habitat, and the lack of population data. Green sturgeon is a Tribal Trust species and a tribal fishery exists for Green Sturgeon in the Lower Klamath Basin. The number of green sturgeon spawners returning to the Klamath River annually in recent times is largely unknown. The Klamath River is generally believed to support significant and relatively stable spawning population. Green Sturgeon enter freshwater to spawn in April-June and then return to the ocean where they spend most of their adult lives. Spawning occurs in the Klamath mainstem. Juveniles spend 1-4 years in freshwater before migrating seaward. Monitoring of Klamath Green Sturgeon is limited.

Eulachon *(Thaleichthys pacificus)* are an anadromous type of smelt that predominantly live in the ocean but briefly return to their natal streams to spawn (ESSA 2017). The southern Distinct Population Segment (DPS) for eulachon was listed as Threatened under the Endangered Species Act in 2010. The Klamath River is a sub-population of eulachon within the southern DPS (NMFS 2016a). Eulachon were of great cultural and subsistence importance to the Yurok Tribe on the lower Klamath River and are a Tribal Trust species. NMFS has developed a formal critical habitat designation for eulachon, which includes the tidally influenced waters of the Klamath River extending upstream 10.7 miles to just above the Omogar Creek confluence. Adults return to freshwater to spawn at ages 2 to 5 and most die after spawning. Spawning generally occurs from January through March in the Klamath River. Eggs are broadcast over substrate where they adhere before hatching within 20-40 days depending on water temperature. Shortly after hatching, the larvae are carried downstream and dispersed by estuarine, tidal, and ocean currents.

2. What is the Status & Trend of ESA Fish Species?

Status and trends monitoring is central to the administration of requirements for fish species listed under Federal and State Endangered Species Acts. Table 1 includes a complete list of fish species of special concern in the Klamath Basin.

Table 1. Federal, California and Oregon special status fishes of the Klamath River Basin.

Species		Status		
		U.S. [1]	CA[2]	OR[3]
Green Sturgeon – Northern DPS	*Acipenser medirostris*	SC	SSC	--
Green Sturgeon – Southern DPS	*Acipenser medirostris*	T	--	--
White Sturgeon	*Acipenser transmontanus*	--	SSC	--
Klamath Largescale Sucker	*Catostomus snyderi*	--	SSC	--
Klamath Marbled Sculpin	*Cottus klamathensis*	--	SSC	--
Lost River Sucker	*Deltistes luxatus*	E	E, FP	E
Shortnose Sucker	*Chasmistes brevirostris*	E	E, FP	E
Northern California Brook Lamprey	*Entosphenus folletti*	--	SSC	--
Pit-Klamath Brook Lamprey	*Entosphenus lethophagus*	--	SSC	--
Klamath River Lamprey	*Entosphenus similis*	--	SSC	--
Pacific Lamprey	*Entosphenus tridentatus*	--	SSC	--
Tidewater Goby	*Eucyclogobius newberryi*	E	--	--
Blue Chub	*Gila coerulea*	--	SSC	--
Chinook Salmon – Upper Klamath and Trinity Rivers ESU	*Oncorhynchus tshawytscha*	C	T, SSC	--
Chinook Salmon – S. Oregon/N. California Coastal ESU	*Oncorhynchus tshawytsch*	C	SSC	--
Coastal Cutthroat Trout	*Oncorhynchus clarkii clarkii*	--	SSC	--
Coho Salmon – Southern Oregon/Northern California ESU	*Oncorhynchus kisutc*	T	T	--
Steelhead – Klamath Mountains Province DPS	*Oncorhynchus mykiss*	--	SSC	--
Bull Trout	*Salvelinus confluentus*	T	E	--
Redband Trout	*Oncorhynchus mykiss newberrii*	--	--	S
Longfin Smelt	*Spirinchus thaleichthys*	C	T	--
Eulachon	*Thaleichthys pacificus*	T	--	--

[1] Federal Status: T = Threatened; E = Endangered; C = Candidate/Under Petition for Listing; SC = Species of Concern; FP = Fully Protected (California).

[2] California Status: T = Threatened; E = Endangered; FP = Fully Protected; and SSC = Species of Special Concern.

[3] Oregon Status: E = Endangered, S = Sensitive.

Status and trends information is used to make formal listing determinations on whether a species is threatened or endangered with extinction. Under the Federal ESA, this determination considers demographic status and trends which for salmon have generally been defined for salmonids based on a "Viable Salmonid Population" concept to include abundance, productivity, spatial structure and diversity parameters.[1] Federal ESA listing determinations also consider statutory listing factors, also sometimes called "threats," which include (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 manmade factors affecting its continued existence.

After a federal ESA listing, current information on status and trends is reviewed at five-year intervals to determine whether the listing determination is still appropriate. Status and trend information is also evaluated against recovery criteria and goals identified in species recovery plans completed for species following listing. In addition,

[1] Similar demographic population parameters are identified for other ESA-listed species.

status and trend information is essential in ESA consultations required for actions which might potentially take listed species or their essential habitats.[2] Federally-listed species In the Klamath system include:

Lost River Suckers and *Shortnose Suckers* are listed as endangered (53 FR 27130, 18 July 1988), are managed by USFWS and are subject to a revised recovery plan (USFWS 2012). Both species were listed as endangered by California in 1974 and the Oregon ESA.

Coho Salmon in the Klamath system are on the Southern Oregon/Northern California Coastal ESU listed as part of as a threatened species (62 FR 24588, 6 May 1997), are managed by the NMFS, and are subject to a 2014 Recovery Plan (NMFS 2014). SONCC coho salmon were listed by California as threatened in 2005.

Chinook Salmon: Upper Klamath and Trinity Rivers Evolutionarily Significant Unit (ESU) was petitioned for Endangered Species Act (ESA) listing on November 2, 2017. The petition requested that either the ESU be listed as threatened or endangered under the ESA or alternatively a new ESU is defined for the spring-run component of the Upper Klamath and Trinity Rivers ESU and that ESU be listed as threatened or endangered. In 2018, NMFS announced a 90-day finding indicating the petitioned actions may be warranted and initiated a status review.

Under a separate California Endangered Species Act (CESA) status review, the California Fish and Game Commission listed the spring-run Chinook Salmon component of the Upper Klamath and Trinity Rivers ESU as threatened under CESA on January 24, 2022.

Eulachon in the Klamath system are part of the Southern DPS population listed as threatened in 2010 (75 FR 13012 March 19, 2010) are managed by the NMFS. Critical habitat for this species includes the lowest 10.7 RM of the Klamath River (NMFS 2024).

Bull Trout in the Klamath Basin are listed as threatened (1998) and subject to USFWS management. Current distribution is limited to the upper basin above Klamath Lake.

Green Sturgeon: The Klamath population is not listed under the U.S. ESA although individuals from the listed southern DPS (71 FR 17757; April 7, 2006) may be present in the Klamath estuary (NMFS 2024).

[2] Examples of recent ESA consultations include Surrender and Decommissioning of the Lower Klamath Hydroelectric Project (NMFS 2021) and Klamath Project Operations from October 1, 2024 though September 30, 2029 (NMFS 2024).

3. How Many Salmon are Available for Harvest and Harvested?

Fisheries in the Klamath basin and ocean are monitored to support sustainable management of Klamath salmon and Steelhead. Sustainable fisheries optimize benefits of harvestable surpluses, ensure adequate natural spawning escapement of target stocks and protect weak stocks from fishery impacts which might affect long-term viability. Klamath Fall Chinook and Coho are subject to significant harvest in both freshwater and the ocean. Smaller fisheries occur for Spring Chinook in freshwater. A freshwater fishery for Steelhead is mostly catch and release.

Tribal and non-tribal fisheries in freshwater are managed by the respective authorities. Regulatory jurisdiction for ocean fisheries is the responsibility of the states within 3 miles of shore and by the federal Pacific Fishery Management Council (PFMC) from 3 to 200 miles off the coasts of California, Oregon and Washington. PFMC fisheries are managed according to Salmon Fishery Management Plans developed and implemented under the Magnuson Stevens Fishery Conservation and Management Act of 1976 as amended in 1996 and 2007.

3.1 Fall Chinook

Klamath Fall Chinook are a primary focus of fishery management efforts as they are subject to significant harvest in freshwater and the ocean. In-river fisheries are conducted by the Yurok Tribe within the lower 44 miles of the Klamath River. Inriver fisheries are conducted by the Hoopa Tribe in the Trinity River from one mile above the confluence with the Klamath River upstream approximately 12 miles to the boundary of the Hoopa Valley Reservation. In-river non-tribal recreational fisheries may occur in the Klamath and Trinity Rivers in some years depending on abundance. Klamath Fall Chinook are also harvested in ocean commercial and recreational fisheries in California and Oregon.

Harvest is regulated based on abundance of natural-origin spawners. Exploitation rates and allocation among fisheries is governed by a complex management plan developed by fishery co-managers and implemented through the annual Pacific Fishery Council process (PFMC 2007, 2019). Detailed reports are available on the fishery management process in a series annual PFMC reports (e.g., PFMC 2025a, b).

Extensive annual stock assessments of spawner abundance and fishery harvest are necessary for management of Fall Chinook fisheries. Numerous basin partners participate in annual escapement monitoring including the Hoopa Valley Tribe, Karuk Tribe, Mid-Klamath Watershed Council, Northern California Resource Center, Quartz Valley Indian Reservation, Siskiyou Resource Conservation District, Salmon River Restoration Council, U.S. Forest Service, USFWS, AmeriCorps Watershed Stewards Program, Yurok Tribe, and CDFW (CNRS & CDFW 2024, KRTT 2024). Annual harvest is estimated for each fishery by the respective management authorities.

Comprehensive annual run reconstructions based on monitoring, estimate escapement of hatchery and natural spawners by area, in-river harvest by fishery and total run size by age class to the river. This information is compiled each year and reported in the form of a “Megatable” published by the CDFW. Ocean harvest of Klamath Fall Chinook is estimated from ocean fishery monitoring and stock apportionment using recoveries of coded wire tags in Fall Chinook produced by Klamath and Trinity salmon hatcheries. Age composition breakdowns within the run are determined by Klamath River Technical Advisory Team of co-managers based on scale reading age determinations, length frequency distributions and Coded Wire Tag (CWT) data. These metrics are used in a Klamath Ocean Harvest Model to predict ocean abundance which is then used in annual management processes to identify appropriate harvest rates and allocate sustainable harvest levels for various user groups in the Klamath Fishery Management Zone for the following fishing season. Klamath Fall Chinook stock assessments from adult monitoring was used to establish risk-based harvest rules used to regulate ocean and freshwater fisheries (PFMC 2021). Additionally, Klamath River age-4 marine harvest rate is used as a surrogate to protect listed California Coastal Chinook (CCC) salmon stocks and under current NOAA Fisheries guidance.

3.2 Spring Chinook

Spring Chinook are harvested in the Klamath and Trinity Rivers from May to July primarily by tribal fisheries. In-river fisheries are conducted by the Yurok Tribe within the lower 44 miles of the Klamath River and the Hoopa Tribe in the Trinity River from one mile above the confluence with the Klamath River upstream approximately 12 miles to the boundary of the Hoopa Valley Reservation. Non-tribal recreational fisheries may occur in the Klamath and Trinity Rivers in many years depending on abundance. Harvest, hatchery escapement and natural escapement are monitored for tribal fishery management purposes. This information is compiled each year and reported in the form of a "Megatable" published by the CDFW. Klamath Spring Chinook harvest is not assessed in ocean fisheries due to their low numbers.

3.3 Coho

Due to their depressed status and ESA listing, Klamath coho are not subject significant harvest (ESSA 2017, PFMC 2021). Coho salmon-directed fisheries and coho salmon retention have been prohibited off the coast of California since 1996. Incidental mortality occurs from non-retention impacts in California and Oregon Chinook-directed fisheries and in Oregon's mark-selective coho fisheries. Klamath Basin Tribes (Yurok, Hoopa, and Karuk) harvest a relatively small number of coho salmon for subsistence and ceremonial purposes under federal reserved fishing rights in the Klamath River. Coho salmon are encountered occasionally during fisheries targeting fall Chinook and are targeted during their peak migration in October. Coho are caught in gillnets and by hook-and-line. The Hoopa Valley Tribe selectively harvests marked hatchery-origin Coho Salmon at a Trinity River weir.

Coho salmon-directed fisheries and Coho salmon retention have been prohibited off the coast of California since 1996. California's freshwater sport fishing regulations prohibit retention of Coho salmon. Incidental mortality occurs because of non-retention impacts in California and Oregon Chinook-directed fisheries and in Oregon's mark-selective Coho fisheries.

Klamath Coho fisheries are monitored and regulated to limit incidental impacts to low levels which are deemed not likely to jeopardize viability. Stock assessment information collected in adult monitoring was used to establish risk-based harvest rules used to regulate ocean and freshwater fisheries (PFMC 2021). Fisheries impacting SONCC Coho are regulated not to exceed a total fishery (marine and freshwater) exploitation rate (ER) limit specified in NMFS's ESA consultation of 15% for all populations within the SONCC Evolutionary Significant Unit, except the Trinity River coho population unit (Upper Trinity River, Lower Trinity River, SF Trinity River) which has a total fishery ER limit of 16%. Freshwater impacts are determined based on monitoring and harvest and returns provided by co-managing agencies and tribes (i.e., the Oregon Department of Fish and Wildlife, Yurok Tribe, Hoopa Valley Tribe, California Department of Fish and Wildlife).

3.4 Steelhead

Small recreational fisheries occur for steelhead in freshwater. Fishing is mostly catch and release. Small numbers of steelhead may also be caught incidental to harvest of target Chinook and Coho species in tribal fisheries during Fall.

3.5 Other Fish Species

Trout, lamprey, sturgeon and other fish endemic to the Klamath Basin are managed by CDFW and ODFW. Klamath Basin tribes oversee management and regulation of fish species that occur on their reservations. No harvest has occurred for Lost River Sucker or Shortnose Sucker since 1987 (USFWS 2024).

4. What is the Anadromous Fish Response to Dam Removal?

Extensive monitoring is being implemented or is planned to measure and track the reintroduction of anadromous fishes and progress toward viable self-sustaining populations of anadromous fishes in the upper Klamath River following removal of the four hydroelectric dams (ODFW and KT 2021, CNRS & CDFW 2024). This data will inform and guide future restoration efforts including the effectiveness of a volitional passage strategy and the staging/sequencing of future management decisions.

Monitoring required under the lower Klamath Project is summarized in California's Klamath River Anadromous Fishery Reintroduction and Restoration Monitoring Plan (CNRS & CDFW 2024). The KRRC's Definite Plan for the Lower Klamath Project (KRRC 2018) and Definite Decommissioning Plan (KRRC 2020) include monitoring of project effects on aquatic and terrestrial resources.[3] Detailed guidance is provided by 16 resource management plans including an Aquatic Resources Management Plan (ARMP) and Reservoir Area Management Plan (RAMP), both of which contain measures specific to anadromous fishes. Work involves an Aquatic Resources Group (ARG) of representatives from NOAA Fisheries, USFWS, CDFW, ODFW, Yurok Tribe, Hoopa Valley Tribe, Karuk Tribe, The Klamath Tribes, and KRRC.

Figure 4. Removal of Iron Gate Dam on the Klamath River (https://www.fisheries.noaa.gov/feature-story/teams-and-technology-trace-klamath-river-recovery-tracking-new-salmon-returns).

[3] The final FERC approved resource management plans are available on FERC's eLibrary at https://elibrary.ferc.gov/eLibrary/search under Docket Number P-14803-001

Examples of monitoring activities identified in a series of subplans include:

- Presence and distribution of adult Chinook Salmon, Coho Salmon, Steelhead, and Pacific Lamprey within the hydroelectric reach and the lower reaches of tributaries that are currently inundated by the reservoirs following dam removal (Fish Presence Plan).
- Identification of fish passage barriers within the 8-mile reach downstream of Iron Gate Dam, within the Copco 2 Bypass Reach, and at the confluences of Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Shovel Creek (Tributary-Mainstem Connectivity Plan).
- Mainstem Klamath River suspended sediment concentrations and tributary water temperatures high enough during the drawdown year to consider capturing juvenile fish from tributary confluences and relocating them to in-basin sites with suitable or unimpaired water quality (Juvenile Salmonid and Pacific Lamprey Rescue Plan).
- Post reservoir drawdown field surveys and remote sensing to determine the distribution and extent of spawning habitat available within the hydroelectric reach and several key tributaries including Jenny, Fall, and Shovel creeks in California, and Spencer Creek in Oregon (Spawning Habitat Availability Report and Plan).

In addition to the Tributary-Mainstem Connectivity Plan, the Reservoir Area Management Plan (RAMP) includes monitoring and remediation of fish passage barriers within the reservoir footprints and the associated tributaries and confluences within those footprints. It also provides habitat restoration activities designed to help restore fish habitat and reestablish upland and riparian habitats in the reservoir footprints.

Monitoring requirements for the effectiveness of anadromous fish reintroduction efforts in the upper Klamath Basin are detailed in an implementation plan by the Oregon Department of Fish and Wildlife and the Klamath Tribes (ODFW and KT 2021). This plan identifies an active strategy for reintroduction of Spring Chinook. This plan calls for a two-phased reintroduction strategy. Phase 1 includes investigations of survival, movement, passage, and release methods of tagged juveniles, while also improving supportive conservation hatchery methods. Phase 2 will increase fish releases (>100,000 smolt sized juveniles released per year) with the intent to produce a significant number of returning adults and make progress toward the objective of repopulating habitat in the upper basin to harvestable levels. Phase 1 was initiated in 2022 with the annual release of both PIT tagged and radio tagged juvenile spring-run Chinook salmon in tributaries of UKL, and at locations between Keno and Link dams (Hereford 2023; Tallman 2023; NMFS 2024).

5. Can Anadromous Fish Successfully Pass Keno & Link River Dams?

Fish passage restoration encompasses a broad suite of work types that involve removing barriers to fish passage or providing alternative passage over barriers in the form of fish chutes, pools, or ladders (ESSA 2017). In the Klamath Basin, fish passage improvement projects at barriers other than road crossings generally involve low-head seasonal flashboard dams or permanent dams that do not create impoundments, though the possible removal of larger dams is examined in the section discussing case studies of barrier removal projects (ESSA 2017).

Fish ladders are operated at both Keno Dam (RM 239.2) and Link River Dam (RM 260.5) on the upper Klamath River (Figure 5). Effectiveness for salmon passage is unknown and under evaluation. ODFW & KT (2021) recommend a facility at Keno Dam and/or Link River Dam to allow for the sampling of fishes passing upstream. Sampling adult fish and tagging them at Keno Dam and/or Link River Dam will be an integral component to a monitoring strategy at such time as migrating adults are determined to be returning to these areas ODFW & KT (2021).

Keno Dam: Ownership of this dam transferred from PacifiCorp to the Bureau of Reclamation in August of 2024. The fish ladder in Keno Dam does not currently meet state and federal fish passage criteria - In particular, the orifices that allow fish to pass from bay to bay and move up the ladder are too small for large-bodied fish.[4] Adult redband trout can pass through the fish ladder at Keno (Starcevich & Jacobs 2006, ODFW & KT 2021), but adult Chinook are considerably larger. Two Chinook were observed in the Keno dam fish ladder on Oct. 25, 2024 but no fish have been detected above the dam to date. Plans are underway to implement fish passage improvements with high priority improvements scheduled to begin in 2025 (NOAA 2024). A comprehensive planning process is identifying options and a 30% design (B. Ramirez, ODFW, pers. comm.). A video camera captured a Chinook salmon ascending the fish ladder at Keno Dam on the upper Klamath River on Sept. 24, the first picture of a salmon ascending the upper bays of the ladder since four hydroelectric dams were removed in 2024.[5]

Link River Dam: Link River Dam regulates the lake levels of Upper Klamath Lake. The dam is operated by PacifiCorp under contract to the USBR (the owners of the dam). The USBR replaced an inadequate fish ladder in 2005 to allow efficient passage of endangered suckers, Redband Trout, and lampreys migrating from Lake Ewauna to Upper Klamath Lake (ODFW & KT 2021). A few weeks after a Chinook salmon was spotted passing Keno Dam on Sept. 24, another was seen on camera at the Link River fish ladder (Oct. 6) (CBB 10/24/25).

Irrigation Diversions: Irrigation diversion structures beyond may prevent, entrain and or otherwise influence movement (immigration or emigration) of anadromous fishes of all life stages (CNRS & CDFW 2024). NOAA Fisheries, Pacific States Marine Fisheries Commission (PSMFC), and Trout Unlimited recently cataloged and assessed diversions from Link River Dam downstream to Iron Gate Dam. The identified diversion structures may need to be brought into compliance with landowners' support to meet federal and state fish screening and passage requirements. CNRS & CDFW (2024) recommended that a similar effort should be conducted on the tributaries.

[4] https://www.opb.org/article/2024/11/03/klamath-river-salmon-tracking/
[5] https://myodfw.com/news/first-image-chinook-salmon-passing-keno-dam-upper-klamath-river

Figure 5. Link River Dam (upper photo) and Keno Dam (lower photo).

6. Are Water Management Measures being Implemented Effectively?

Fish monitoring has long been an integral component in development and evaluation of water management and mitigation measures for the Klamath and Trinity River Projects. Water resources are also affected by extensive irrigation and other modifications and operations throughout the basin (ESSA 2017). The USBR stores, diverts, and conveys water to meet authorized project purposes and contractual obligations in compliance with state and federal laws and carries out the activities necessary to maintain the projects and ensure its proper long-term functioning and operation (NMFS 2024). Water management requirements have evolved over the years as specified in a series of regulatory agreements and biological opinions (ESSA 2017).

6.1 Klamath River

Klamath River water management has long been regulated by requirements of the USBR's Klamath Project and PacifiCorp's Klamath Hydroelectric Project. The Klamath Project operates three reservoirs (Upper Klamath Lake, Clear Lake Reservoir and Gerber) in the upper basin to store, divert and convey water for a service area that contains approximately 230,000 acres of irrigable land. The Klamath Hydroelectric Project operated four dams and reservoirs in the lower basin until their removal in 2024.[6]

- From 1962 to 2000, minimum seasonal flow requirements in the Klamath River downstream from Iron Gate Dam were stipulated by the Federal Energy Regulatory Commission as part of a long-term license agreement.
- A biological opinion published by the USFWS (2008) on ESA listed suckers established monthly minimum Upper Klamath Lake water elevations.
- In 2010, a NOAA Fisheries biological opinion on Reclamation's Klamath Project established new monthly minimum flow requirements below Iron Gate Dam to protect ESA threatened coho salmon (NMFS 2010).
- In 2013, NMFS and USFWS published a joint biological opinion that updated requirements for Upper Klamath Lake elevations and minimum flows downstream from Iron Gate Dam.
- In 2019, NMFS issued a biological opinion on Klamath Project operations from April 1, 2019 through March 31, 2024 (later extended to October 31, 2024) providing direction during the dame removal period.
- In 2024, a new biological opinion was issued by NMFS governing post-dam removal operations of the Klamath Project from 2024 to 2029.

The 2024 Klamath Project biological opinion affirms support by the USBR for research and monitoring projects that inform managers on the status of ESA-listed species populations and evaluation of project impacts as appropriated funds allow.

Term and conditions of the current Biop direct USBR funding for monitoring the abundance, prevalence of infection and predicted mortality of emigrating juvenile salmon in the Klamath River (NMFS 2024). The Arcata Fish and Wildlife Office of the USFWA and its Tribal partners operate rotary screw traps and frame nets each spring and summer during the juvenile Chinook and coho salmon emigration period to estimate the abundance of outmigrant juvenile salmon at three locations on the Klamath River. Mark-recapture information estimates characteristics and abundance of outmigrant populations on a weekly-stratified basis, which are used to calibrate and validate a Stream Salmonid Simulator Population Dynamics Model (S3 Model). These data also inform managers in real-time on population levels and effects of infectious diseases for both Chinook and coho salmon.

The 2024 Biop also identifies the Shasta River Rotary Screw Trap as an essential monitoring component for informing flow management and estimating incidental take of coho salmon. Operation by ODFW of a Rotary Screw

[6] The project also included Keno Dam.

Trap at Spencer Creek is also identified for weekly estimation of coho salmon leaving which can be used in the S3 model for impact estimation in the Keno Dam to Iron Gate reach.

The 2024 Biop calls for continued funding by the USBR for updates to the S3 Population Dynamics Model with contemporary data on hatchery production and *C. shasta* spore concentrations. The S3 Model was developed and implemented by the USGS as a decision-support tool to aid in water and basin management (Bartholow et al. 2002; Perry et al. 2018, 2019, 2023; Plumb et al. 2019). The tool consists of an integrated subset of models used to predict the effects of water management alternatives on movement, health, and production of juvenile Chinook salmon (ESSA 2017). The model tracks causes of mortality (i.e., red scour, habitat limitations, disease, water quality, etc.) over time throughout the sub-adult life history of Chinook salmon within the 223-mile section of the mainstem Klamath River spanning from Keno Dam in Oregon to its confluence with the Pacific Ocean in California.

Finally, the 2024 Biop calls for new fish monitoring to assess the fish response to dam removal:

- Spawner escapement estimates and distribution data collected at mainstem Klamath River locations below Keno Dam by USFWS.
- Spawner escapement estimates upstream of Link River Dam estimated through use of a counting facility (e.g., video or sonar).
- Prevalence of mortality estimates for juvenile coho and Chinook salmon collected and processing for *C. shasta* infection at juvenile monitoring sites completed by USFWS that are completed by Karuk and Yurok Tribes and Oregon State University.
- Juvenile productivity estimates by reach from data will be collected by USFWS using outmigrant traps at key locations such as Copco, Interstate 5, Kinsman, and Weitchpec.

6.2 Trinity River

The purpose of the Trinity River Restoration Program is to mitigate impacts of dam construction and related diversions of the Trinity River Division of the Central Valley Project on anadromous fish populations. The long-term goals of the Program are to: 1) restore the form and function of the Trinity River; 2) restore and sustain natural production of anadromous fish populations in the Trinity River to pre-dam levels; and 3) to facilitate full participation by dependent tribal, commercial, and sport fisheries through enhanced harvest opportunities.

Water management in the Trinity River mainstem is governed by a 2000 Fishery Record of Decision (ROD) by U. S. Department of the Interior. The ROD adopted recommendations to implement a set of actions determined to be necessary and appropriate to restore and maintain the anadromous fishery resources of the Trinity River and created the Trinity River Restoration Program (TRRP or Program). Most recently, a 2023 Program Document identified refinements to an Adaptive Environmental Assessment and Management program to guide implementation of the next phase of the Trinity River Restoration Program. A 2022 Science plan provides guidance for work to reduce critical management uncertainties and support the successful implementation of the strategies to achieve TRRP goals.

Flow schedules are managed to encourage outmigration of salmonids, maintain favorable water temperatures and reduce potential fish disease outbreaks. Primary fish monitoring activities include:

- Juvenile population monitoring at rotary screw traps near Willow Creek and North Fork to estimate abundance, timing and size;
- Adult population monitoring by fish trapping and tagging at weirs near Willow Creek and Junction City to estimate escapement, harvest and contributions of hatchery and natural-origin fish; and
- Carcass and redd surveys to provide information on timing and spatial distribution of spawning and pre-spawn mortality (Pickard et al. 2023).

7. Are Hatchery Programs Achieving Established Objectives?

Hatchery production and returns of salmon and steelhead are monitored to assess hatchery effectiveness, evaluate potential wild fish tradeoffs and adaptively manage programs for established objectives. Hatcheries were intended to mitigate for habitat lost due to dam construction by producing fish to support harvest. Objectives have evolved over time to include support of conservation and recovery of depleted stocks including ESA-listed Coho Salmon and reintroduction of Spring Chinook into Klamath headwaters rivers. Hatcheries also serve key functions in various monitoring and evaluation activities including coded wire tagging of Fall Chinook for fishery stock assessment and management purposes.

7.1 Iron Gate Hatchery

Iron Gate Hatchery is located on the mainstem Klamath River just downstream of Iron Gate Dam and is operated by CDFW. The hatchery program was initiated in 1966 to mitigate habitat blocked between Iron Gate Dam and the Copco dams. Annual production goals established in the 1960's included 900,000 yearling fall-run Chinook salmon, 5.1 million subyearling Fall Chinook, 75,000 yearling coho salmon, and 200,000 yearling steelhead (CDFG and Pacific Power and Light Company 1996). Steelhead production was discontinued in 2012 in part due to a lack of returning adults (CNRS & CDFW 2024).

The coho salmon program at Iron Gate Hatchery was redefined in 2014 to incorporate conservation principles to protect and conserve the genetic resources of the upper Klamath River population as specified in an ESA Section 10(a)(1)(A) Permit administered by NOAA Fisheries and a Hatchery and Genetic Management Plan for Iron Gate Hatchery Coho Salmon (CDFW & PacifiCorp 2014). Hatchery monitoring activities were expanded in 2016 to include hatchery influence on natural spawning coho with funding by PacifiCorp as per specifications in the Hatchery Genetic Management Plan (CNRS & CDFW 2024). The monitoring effort included spawning and carcass surveys in the mainstem Klamath River and tributaries.

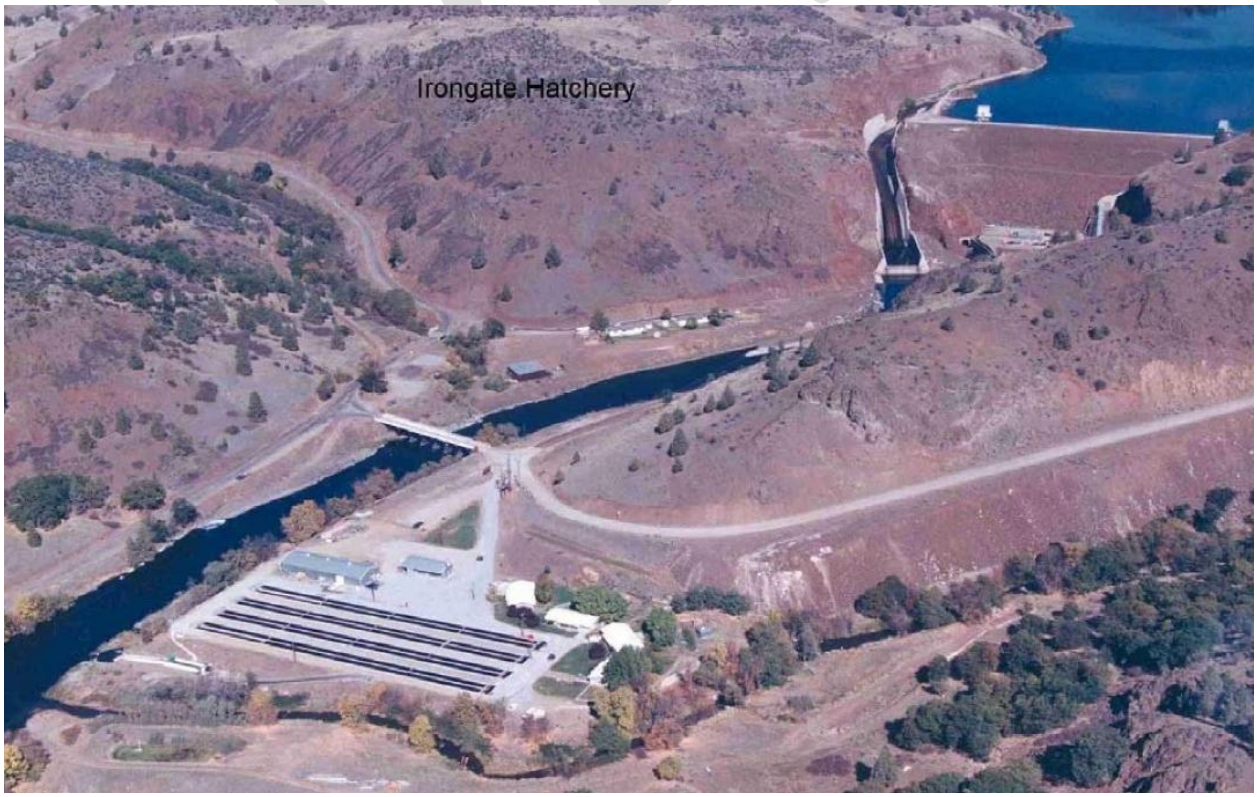

Figure 6. Iron Gate Hatchery and Dam (source: Chesney & Knechtle 2012).

Hatchery operations of Iron Gate Hatchery were moved to Fall Creek Hatchery upon dam removal under a Hatcheries Management and Operations Plan by the KRRC (2022). Removal of Iron Gate Dam eliminated the water supply of the Iron Gate Hatchery. CDFW retains Iron Gate Hatchery and may continue to use the facility as needed.

7.2 Fall Creek Hatchery

Iron Gate hatchery operations are being moved to an improved Fall Creek Hatchery upon dam removal (KRRC 2022, NMFS 2023). The hatchery is operated by CDFW with funding from Pacificorp. Fall Creek Hatchery was built in 1919 as compensation for the loss of spawning grounds that occurred with the construction of Copco 1 Dam. The hatchery was mainly operational before the construction of Iron Gate Dam in 1966 but was also used periodically from 1979 to 2003 and as recently as 2021 and 2022 when the existing raceways were repaired and used to rear juvenile Iron Gate Hatchery fall-run Chinook salmon. Fall Creek Hatchery has undergone extensive modification and construction of new facilities to support planned production. PacifiCorp is funding construction and hatchery operations for up to eight years following removal of Iron Gate Dam.

Hatchery production goals include 75,000 Coho yearlings; 250,000 Fall Chinook yearlings (25% marked); and 3 million fall-run Chinook salmon sub-yearlings (≥50% coded wire tagged). Fall Creek hatchery production of Fall Chinook is just over 50% of the historical Iron Gate production level and is expected to reduce total adult returns to the Klamath River, at least initially, until newly accessible reach full production capacity which is will likely take multiple generations (CNRS & CDFW 2024). The lower production goals for fall Chinook are based in part on the smaller facility and water supply, and wastewater discharge limitations at Fall Creek Hatchery compared to Iron Gate Hatchery.

The production goal for Coho Salmon is unchanged from Iron Gate Hatchery. Coho will be produced with the primary purpose of protecting the genetic resources of this population and reducing extinction risks (NMFS 2023). The program is integrating natural origin adults into broodstock and using a genetically based spawning matrix to prevent or otherwise reduce potential inbreeding. The secondary purpose of the program is to provide adult coho salmon that could disperse into newly available habitats following dam removal.

Currently there are no plans or funding to operate the hatchery beyond eight years. However, if there is a future need to operate, it will be decided in coordination with regulatory agencies, Tribes, and other basin partners; informed by Klamath Basin monitoring; and will need to adhere to federal and state regulatory permitting requirements. The HGMP for Fall Creek Hatchery does not require continuation of coho salmon mainstem and tributary surveys and once hatchery operations are moved to Fall Creek Hatchery.

7.3 Trinity River Hatchery

Trinity River Fish Hatchery began operations in 1963 at RM 111.7 immediately downstream from Lewiston Dam in order to help mitigate for lost production of habitats upstream from the Trinity River diversion. Operation and maintenance are funded by the Bureau of Reclamation. The facility is operated and managed by CDFW. The hatchery spawns, rears and releases Spring Chinook, Fall Chinook, Coho and Steelhead.

Hatchery effectiveness is assessed relative to salmonid escapement goals established by the Trinity River Restoration Program. Goals were based on estimates of lost adult production in blocked areas. Current Trinity River basin adult escapement goals for NOR adults are 6,000 Spring Chinook, 62,000 Fall Chinook, 1,400 Coho and 40,000 steelhead (Kier et al. 2023). Goals for hatchery adult escapement are 3,000 spring Chinook, 9,000 fall Chinook, 2,100 Coho and 10,000 steelhead. Corresponding hatchery release goals for Spring Chinook are 1 million fingerlings (June release) and 400,000 subyearlings (October release). The Fall Chinook goal is 2 million fingerlings in June and 900,000 subyearlings in October. Spring and Fall Chinook are marked at a rate of 25 percent with an adipose fin-clip and coded wire tag.

Figure 7. Trinity River Hatchery and Lewiston Dam (USBR photo).

The current Coho release goal is 300,000 juveniles produced from natural-origin broodstock collected for spawning from the hatchery ladder or the upper Trinity fish weir. Hatchery-produced Coho are released on-station, from remote streamside incubators and as unfed fry in various Trinity River tributaries. Production of Coho Salmon was reduced from 500,000 in response to a 2014 lawsuit under EPIC v. Lehr et al 2014 (Kier et al. 2023). The current program is managed according to an HGMP (USBR & CDFW 2017) which has been approved by NMFS (2020). The HGMP details associated monitoring and evaluation actions consistent with requirements specified under the ESA. For monitoring purposes, all Coho through brood year (BY) 2020 had their right maxillary bone (RM) clipped as a hatchery identifier and all Coho since BY 2021 received 100% ad-clips + CWT and no RM clips (Kier et al. 2023).

The lawsuit, consent decree, and subsequent HGMP that curtailed production of Coho Salmon at TRH also mandated production of steelhead be reduced from 800,000 to no more than 448,000 and imposed limitations on the timing of smolt releases (Kier et al. 2023). Standard operating procedure is for all steelhead to be adipose fin-clipped (ad- clipped) prior to release for monitoring purposes.

7.4 Sucker Assisted Rearing Program

The USFWS started a Sucker Assisted Rearing Program (SARP) for Lost River Suckers and Shortnose Suckers in 2015 to augment populations in Upper Klamath Lake (USWFS 2023). A rearing program was identified in the Recovery Plan (USFWS 2012) and is expected to provide the best short-term avenue to increase the number of endangered suckers in Upper Klamath Lake (USFWS 2023).

Wild-origin age-0 fish are captured and brought into a hatchery for rearing. The program expanded based on initial success, and in 2021, the rearing facility received designation as the Klamath Falls National Fish Hatchery. Approximately 74,018 production size (age 2 + suckers that are approximately 200 mm) suckers have been released from 2018 to 2024 (USFWS 2024). Less than 5,000 juvenile suckers were released each year, during the first few

years (2016 to 2018) of the rearing program but production numbers have grown to over 15,000 juveniles released in 2020. USFWS (2024) expects to reach an annual goal of rearing and repatriating up to 60,000 suckers (of all species) to Upper Klamath Lake with the new hatchery construction and successful development of captive broodstock. Construction on the expansion of the Klamath Falls National Fish Hatchery began in 2022 and is scheduled to be completed in 2026.[7]

Monitoring efforts are focused on improving the survival and growth of individuals while in captivity, maximizing survival and recruitment once reintroduced into Upper Klamath Lake, and increasing the overall numbers of individuals stocked (CNRS & CDFW 2024). Development and maintenance of captive brood stock and the refinement of husbandry practices to ensure production of viable larvae is a top priority in planning for potential catastrophic events.

7.5 Klamath Headwaters Spring Chinook Reintroduction

An implementation plan for the reintroduction of anadromous fishes in tributaries of Upper Klamath Lake identifies an active reintroduction effort for spring-run Chinook Salmon in two phases (ODFW & KT 2021). Phase 1 would involve reintroduction studies which include release of tagged juveniles to monitor their migration behavior and survival post release. An in-basin stock (Salmon or Trinity River) will be used for this effort. Phase 2 (Repopulation Phase) would build on the results of Phase 1 to use the most effective methods, extent, and intensity of transplantation required to repopulate habitat above Upper Klamath Lake. Reintroduction studies may begin prior to the availability of fish passage through the KHP.

[7] https://www.klamathtribesnews.org/2024/04/01/the-u-s-fish-and-wildlife-service-is-constructing-a-multi-million-dollar-sucker-hatchery/

8. Is Fish Habitat Restoration Effective?

Habitat effectiveness monitoring determines whether restoration activities have achieved desired results. Related assessments help identify how fish are using the habitat, what factors are limiting and which habitat restoration actions are most effective. The IFRMP identifies nine general categories of restoration actions which can benefit fish habitat (Table 2).

ESSA (2017) distinguishes three types of project effectiveness monitoring. *Implementation monitoring* evaluates whether project objectives are carried out as planned. *Physical effectiveness monitoring* evaluates whether restoration actions are resulting in the expected physical effects. *Biological effectiveness monitoring* evaluates whether an expected biological response occurred.

This document focuses on fish biological monitoring which is typically based on fish habitat use, distribution, abundance, density, and parameters such as growth and survival. This fish monitoring is generally conducted in conjunction with extensive habitat assessment and monitoring. Additional information on physical habitat monitoring activities and priorities throughout the Klamath Basin may be found in the IFRMP (2023).

ESSA (2017) notes that biological effectiveness monitoring can be a complex and technically challenging endeavor. Monitoring long-term responses is easily confounded by other limiting factors or variables that are not related to the restoration action. Responses to restoration actions may also be difficult to detect or interpret at some spatial scales, requiring assumptions that are easily violated. As a result, biological effectiveness monitoring is rarely conducted at a population scale (ESSA 2017). Therefore, habitat restoration-related fish monitoring is often focused on short-term monitoring of actions with fast response times and localized to the vicinity of the restoration action. Evaluations may be structured in a rigorous before and after, and/or treatment and control design, or may be based on inferences from more limited assessments (e.g., fish utilization of habitat improvements).

Examples of fish monitoring programs for habitat restoration effectiveness are summarized below.

Lower Klamath Tributaries: Fish production effects of constructed off-channel habitats, wood jams and riparian replanting in several streams are being monitored by Yurok Tribe Fisheries Program (Antonelli 2012; Beesley 2017; ESSA 2017; Faulkner et al. 2019). Sites included Hunter, McGarvey, Hoopaw and Terwer Creeks. Fish monitoring includes snorkel surveys, juvenile migrant trapping, juvenile PIT tagging and PIT tag detection arrays. Physical habitat and water quality assessments are a significant component of this program.

Middle Klamath Tributaries: Fish benefits of a series of off-channel ponds constructed in tributary streams are being monitored by the Mid Klamath Watershed Council in conjunction with the Karuk Tribe and Humboldt State University (MKWC 2015, 2019, 2022). Juvenile coho salmon are the focus of this work which includes snorkel surveys, beach seining, PIT tagging and operation of PIT arrays to estimate abundance, growth and movements.

Scott River: The Scott River Watershed Council is monitoring juvenile coho salmon monitoring program to assess effects of habitat restoration in the Scott River and its tributaries (SRWC 2023, 2024). Seines and minnow traps to capture and collect data from fish inhabiting both restored and untreated habitat units in these streams. Juveniles are PIT tagged. A network of PIT arrays is operated in these streams allowing tagged fish to be detected as they move throughout the watershed. Recaptures of tagged fish also provide information on fish growth rates.

Trinity River Tributaries: Juvenile salmonids are monitored by the Hoopa Valley Tribal Fisheries Program to assess habitat restoration success in a seven reservation streams (NOAA 2025). Fyke nets have been deployed in Campbell, Hostler, Mill, Pine, Soctish, Supply, and Tish Tang Creeks since 1997 to quantify the abundance of out-migrating juvenile Chinook salmon, Coho salmon and steelhead.

Table 2. Restoration action type categories and definitions (IFRMP 2023).

Action Type Category	Definition and Example Action Types
	This category includes actions that result in the installation, improvement or maintenance of screening systems that prevent fish (especially juveniles) from entrainment into areas that do not support fish survival; for example, into irrigation diversion channels.
	These actions improve or provide for fish migration up and down stream, including fish passage at road crossings (bridges or culverts), barriers (dams or log jams), fishways (ladders, chutes or pools), weirs (log, rock). Restoring fish passage in the Klamath Basin is particularly relevant to anadromous fishes given historical restriction of access to hundreds of miles historical habitat due to both mainstem dams and smaller diversion dams.
	These actions maintain and/or increase the flow of water to provide needed fish habitat conditions. Action Types used can include temporary water rights purchases/leases, permanent dedication of instream flows, or irrigation practice improvements including water conservation projects to reduce stream diversions or extractions.
	These actions increase or improve physical conditions and/or connectivity within the stream environment (below the high water mark) to increase fish abundance. Historical approaches focused on placement of instream structures, while recent approaches are more complex and include channel reconfiguration, streambank stabilization, and use of low-tech process-based restoration techniques like beavers or beaver dam analogues to increase stream complexity.
	These actions focus on restoring riparian vegetation to improve fish habitat, food production, stream temperature regulation, and runoff capture and deposition. The most frequently used Action Types or techniques in this category include grazing management, the installation of riparian exclusion fencing, and riparian planting to accelerate the recovery of native species on previously grazed streambanks.
	These are landscape-level actions implemented above the floodplain and intended to benefit fish habitat, for example, by reducing or eliminating fine sediment or nutrient inputs from upland areas into streams. In the Klamath Basin, Action Types in this category may include: (1) rehabilitating or decommissioning logging roads, and (2) upland grazing management, and (3) managing upland vegetation to reduce the risk of severe wildfires.
	This category includes actions that aim to directly improve instream water quality by reducing the impacts of instream point or non-point pollution, such as manure storage practices, improvements to irrigation systems to reduce runoff, and water treatment or recycling systems. Note this category is defined by the activity, rather than the stressor addressed, and many other types of restoration can also indirectly improve water quality.
	This category includes actions designed to improve, restore, or create wetland, meadow, or floodplain areas connected streams that are known to support fish production through their role in providing spawning, nursery, or feeding habitat. Action types used may include breaching dikes, re-flooding, and re-planting historical wetlands as well as creation of artificial wetlands.
	This category includes actions that result in improvement of or increase in the availability of estuarine or nearshore marine habitat (tidally influenced areas) such as tidal channel restoration, tidal floodplain connectivity, tidegate fish passage or diked land conversion.

9. What Factors and Processes Fish Status, Effects and Management?

Evaluations of factors and processes related to fish status, impacts and management might generally be described under the category of research. Research may be conducted to reduce critical uncertainties, identify effectiveness, or validate key hypotheses or assumptions. Research characterizes unknown ecological relationships and evaluates whether the hypothesized cause and effect relationships between restoration action and response (physical or biological) were correct. Research on the Klamath basis addresses cause and effect relationships between fish, limiting factors, and actions that address specific threats related to limiting factors.

PART 2 - INVENTORY OF CURRENT MONITORING ACTIVITIES

Current monitoring activities for salmon, steelhead and trout are summarized in Table 4. Stock specific details of monitoring may be found in subsequent sections organized by monitoring type.

Current monitoring activities for Lost River Suckers and Shortnose Suckers in the upper Klamath Basin are summarized in Table 3. The US Bureau of Reclamation (USBR) funds a significant amount of fish research and monitoring in the Klamath Basin. The agency provides funding to tribal natural resource departments, other federal agencies (i.e., FWS and USGS) and to universities.

Table 3. Summary of current monitoring activities for Lost River Suckers and Shortnose Suckers in the Klamath River basin.

	Adults					Juveniles		Water bird predation
	Tramel nets	Weir	PIT Tagging	PIT Tag Detection Systems	Telemetry	Trap Nets	Entrain-ment	
Keno Dam				ODFW/BOR				
Lake Ewauna						USGS		
Link River Dam								
Upper Klamath Lake								USGS
Williamson R.								
Sprague R.								
Wood R.								
Other tributaries				USGS				
Clear Lake				USGS				

Ongoing		Planned		Proposed	

Table 4. Summary of current Klamath Basin fish salmon, steelhead and trout monitoring activities by area.

Area	Location	Spawner/Redd/ Carcass Survey	Adult Weir Video/Trap	Adult Snorkel/Dive Survey	Adult Sonar	Adult Dam Counts	Adult Hatchery Trap	Telemetry	Juvenile Migrant Trap	Juvenile Collection misc.	Juvenile Snorkel Survey	PIT Tag Array	Juvenile Hatchery Releases	Fishery Harvest	Fish Disease
Lower-Mid Klamath	Mainstem	USFWS						USGS/ KT/YT	USFWS (2)	KT/YT		KT		YT/ CDFW	OSU
									KT (2)						OSU
									YT						OSU
	L. Klamath tributaries	YT		YT					YT		YT	YT			
	Salmon R.	CDFW		SRRC/KT				KT	KT (3)	KT	SRRC				
	Scott R.	CDFW/KT	CDFW	CDFW/KT				KT	CDFW	SRWC	SRWC	SRWC			
	Shasta R.	CDFW	CDFW					KT	CDFW		CDFW	SRWC			
	Mid. Klamath tributaries	CDFW/KT		USFS/KT							KT	KT			
	Bogus Cr.	CDFW	CDFW						CDFW			SRWC			
	Iron Gate Hatchery						CDFW						CDFW		
Trinity	Mainstem Lower	USFWS/HVT	CDFW						USFWS					HVT	HVT
	Mainstem Upper		CDFW						HVT						
	Lower Tributaries	HVT						YT/HVT	HVT	HVT					
	Upper Tributaries	YT		USFWS											
	Trinity Hatchery						CDFW						CDFW		
Upper Klamath	Mainstem CA	USFWS/KT			Cal Trt			Cal Trt/KT	CDFW		CDFW				
	Mainstem OR	ODFW	ODFW					ODFW	ODFW						
	Scotch/Camp Cr.	CDFW	CDFW						CDFW		CDFW				
	Jenny Cr.	CDFW	CDFW						CDFW		CDFW	CDFW			
	Fall Cr.	CDFW					CDFW		CDFW		CDFW		CDFW		
	Shovel Cr.	CDFW	CDFW						CDFW		CDFW	CDFW			
	Spencer Cr.	ODFW/KT	ODFW						ODFW		ODFW	ODFW			
	Other tributaries	CDFW									CDFW				
Klamath Headwaters	Keno Dam					ODFW						ODFW			
	Lake Ewauna											USGS			
	Mainstem Keno-Link R.							USGS							
	Link River Dam					BOR/ODFW						USGS			
	Upper Klamath Lake							USGS				USGS	USFWS		
	Williamson R.	TKT						TKT	TKT			USGS	ODFW		
	Sprague R.	TKT						TKT	TKT			USGS	ODFW		
	Wood R.	TKT						TKT	TKT			USGS	ODFW		
	Other tributaries														

Ongoing | Planned | Proposed

Key: CalTRT = California Trout, CDFW = California Department of Fish and Wildlife, HVT = Hoopa Valley Tribe, KT = Karuk Tribe, ODFW = Oregon Department of Fish and Wildlife, TKT = The Klamath Tribes, USFS = U. S. Forest Service, USFWS = U.S. Fish and Wildlife Service, USGS = U. S. Geological Survey, YT = Yurok Tribe.

1. SALMON & STEELHEAD

1.1 Spawner, Redd & Carcass Surveys

Spawning ground surveys for anadromous fish are conducted throughout the Klamath Basin to estimate abundance and distribution of returning adults (Figure 8). Surveys are conducted in the mainstem Klamath and Trinity Rivers, major tributaries Salmon, Scott, and Shasta rivers, and numerous other smaller tributaries (Table 5). Surveys are also planned and implemented in the mainstem Klamath and tributaries upstream from the Iron Gate dam site following dam removal. Fall Chinook are a prime focus of surveys but Spring Chinook, Coho and Steelhead may also be surveyed depending on the area. Surveys are a cooperative effort by federal, state, tribal and other partners led generally by the USFWS (Klamath and Trinity mainstems) and CDFW (tributaries).

Foot and boat-based surveys may count live adult fish, carcasses, and/or redds depending on species. Surveys for redds and spawning fish are conducted concurrently with carcass surveys or other survey methods. Surveys are repeated at intervals throughout the salmon spawning season and counts then extrapolated to provide estimates of total escapement. Carcass surveys also allow for the collection of biological data on length, sex, origin (natural- or hatchery-origin), and spawning success; scales or otoliths for age analysis; and tissues for genetic analysis and prevalence of certain pathogens. Carcasses are also examined for marks or tags which may be used in mark-recapture analysis to generate estimates of abundance.

Mainstem Klamath Fall Chinook Survey: Adult fall-run Chinook Salmon carcasses and redds have been surveyed annually since 1978 from October through November between the Iron Gate Dam site (RM 192.6) and Wingate Bar (RM 101.0) to estimate annual escapement, age and sex composition, hatchery-wild proportions and spawning success (Gough et al. 2020, USFWS 2024). The survey between Iron Gate damsite and the Shasta River confluence is conducted by the USFWS AFWO and the YTFP. The survey between the Shasta River confluence and Wingate Bar is conducted by the USFWS AFWO and the Karuk Tribe of California. This work is funded by USFWS.

Figure 8. Mainstem Klamath River salmon spawning ground surveys (Photos provided by Toz Soto).

Table 5. Spawner, redd and/or carcass survey locations for monitoring of anadromous salmonids in the Klamath Basin.

	Location	Species	Years		Months	Lead
Lower-Mid Klamath	Mainstem Wingate Bar - Shasta R	CF	1993	Pres.	Oct-Nov	USFWS
	Mainstem Shasta R - Iron Gate	CF	1993	Pres.	Oct-Nov	USFWS
	Mainstem	CO		Pres		KT
	Blue Creek	CF				YTFP
	Salmon River	CF, CO	1978	Pres.	Oct-Dec	CDFW
	Salmon River	CS, ST	2000	Pres.	?	?
	Scott River	CF, CO	1978	Pres.	Oct-Dec	CDFW
	Shasta River	CF, CO	1978	Pres.	Oct-Dec	CDFW
	Tributaries other	CF, CO	1978	Pres.	Oct-Nov	CDFW/KT
	Bogus Creek	CF, CO	1978	Pres.	Oct-Jan	CDFW
Upper Klamath[1]	Mainstem Iron Gate to OR border	CF, CO	2024	Pres.	Oct-Dec	USFWS/KT
	Scotch/Camp Creeks	CF, CO, ST	2024	Pres.	Oct-Apr	CDFW
	Jenny Creek	CF, CO, ST	2024	Pres.	Oct-Apr	CDFW
	Fall Creek	CF, CO, ST	2024	Pres.	Oct-Apr	CDFW
	Shovel Creek	CF, CO, ST	2024	Pres.	Oct-Apr	CDFW
	Other tributaries	CF, CO, ST	2024	Pres.	Oct-Apr	CDFW
	Mainstem OR border - Keno Dam	CF, CO, ST, LM	2024	Pres.		ODFW
	Spencer Creek	CF, CO, ST, LM	2024	Pres.	Oct-?	ODFW
Trinity	Mainstem Mouth - Lewiston Dam	CF	1978	Pres.	Aug-Dec	USFWS
	Tributaries	CO	2014	Pres.		YTFP?
	Tributaries	ST	2000	Pres.	Mar-May	YTFP?
	South Fork Hyampton Reach	CF	?	Pres.		
	Hayfork Creek (South Fork)	ST	?	Pres.		

[1] Dam removal reach between Iron Gate Dam site and Keno Dam.

[2] CF = Fall Chinook, CS = Spring Chinook, CO = Coho, ST = Steelhead, LM – Lamprey.

Klamath Mainstem Coho Surveys: There are dedicated coho surveys in the mainstem Klamath by the Karuk Tribe tied to management and court proceedings related to dewatering and flow management.

Klamath Tributary Fall Chinook & Coho Surveys: Spawning surveys for Fall Chinook and Coho are conducted annually from October to December since 1978 in the Salmon, Scott, and Shasta rivers, as well as Bogus Creek and 22 other smaller tributaries (Antonetti & Partee 2013; Guidice & Knechtle 2022; Knechtle & Guidice 2018, 2023). Work occurs in conjunction with operation of an adult counting facilities in large tributaries. These assessments estimate species composition, abundance, hatchery composition, run timing, age structure, spawning distribution, fork length frequency and sex ratios. This work is funded by CDFW's Klamath River Project and the survey is currently a cooperative effort between the CDFW, USFS, Quartz Valley Tribe, Karuk Tribe, Northern California Resource Center, Siskiyou Resource Conservation District, and Siskiyou County Schools. Surveys in Blue Creek on the lower Klamath are conducted by the Yurok Tribe.

Salmon River Spring Chinook Survey: Since 2000, annual redd and carcass surveys for spring Chinook have been conducted collaboratively by the USFS, SRRC, CDFW, YT, KT and volunteers (SRRC 2011, ESSA 2017). Surveys include the Nork Fork, South Fork, Wooley Creek, other large tributaries, and occasionally the upper mainstem Salmon River (Cressey workshop presentation 2025). Information is used in conjunction with annual dive surveys to assess long-term trends for Spring Chinook.

Mainstem Trinity Fall Chinook & Coho Survey: Salmon redds and carcasses have been surveyed annually since 1978 from August until December on the mainstem Trinity River from Lewiston Dam (RM 113.1) to the confluence with the Klamath River (RM 0) to estimate spawning abundance, distribution, pre-spawn mortality, and hatchery-wild proportions (Gough et al. 2021, 2024). This work is funded primarily by the USBR through the Trinity River Restoration Program. Surveys are organized by the USFWS in partnership with CDFW, HVT, YTFP, and USFS' Shasta–Trinity National Forest.

Trinity Tributary Salmon Surveys: Redd and carcass surveys for Coho are periodically conducted by the YTFP and CDFW in upper Trinity River tributaries (Quinn et al. 2017). These activities are not funded every year (Sykes workshop presentation 2025). Comprehensive Fall Chinook surveys are not conducted because escapement is estimated from weir mark-recapture assessments (KRTT 2024). The Watershed Research and Training Center in Hayfork California Winter makes redd counts of Fall Chinook in Hyampton Reach (Sykes workshop presentation 2025).

Trinity Tributary Steelhead Surveys: Redd and carcass surveys for Winter Steelhead are periodically conducted by the YTFP and CDFW in upper Trinity River tributaries (Sykes workshop presentation 2025). These activities are not funded every year (Sykes workshop presentation 2025). Winter Steelhead redd surveys were historically conducted by CDFW in several tributaries in March and April (Hill 2010). The Watershed Research and Training Center in Hayfork California assists with redd counts in the South Fork Trinity and upper Hayfork Creek (Sykes workshop presentation 2025).

Upper Klamath mainstem Survey: A carcass and redd survey was initiated for fall Chinook in 2024 from October to December between the Iron Gate dam site (RM 192.6) and the Oregon state line (RM 212.2) (USFWS 2024). This survey was conducted by the Karuk Tribe and USFWS AFWO. ODFW began spawning surveys for fall Chinook and coho in 2024 in the mainstem between the state line and Keno Dam.

Upper Klamath Tributary Surveys: Post dam removal spawning surveys were identified in hydro reach tributaries including Jenny, Fall, Shovel, Scotch and Camp Creeks by California's reintroduction and restoration monitoring plan (CNRS & CDFW 2024). Spawning surveys were initiated by CDFW conducted in Shovel and Jenny Creeks in 2024 during fall (Romero 2024). Spawning surveys for fall Chinook and coho were initiated by ODFW and the Klamath Tribes in Spencer Creek in 2024 during fall. Observations by ODFW also include steelhead and Pacific Lamprey.

Upper Klamath Oregon Surveys (proposed): Weirs are identified in the Oregon portion of the mainstem Klamath River downstream from Keno Dam and in Spencer Creek by the ODFW and The Klamath Tribes reintroduction implementation plan (ODFW and KT 2021). A weir was operated for the first time in Spencer Creek in 2025 (B. Ramirez, ODFW, pers. comm.).

1.2 Adult Snorkel/Dive Surveys

Snorkel/Dive surveys count adult salmon and steelhead in several Klamath and Trinty tributaries. Effective visual counts are limited to areas with high water clarity. Steelhead are a particular focus of these surveys.

Table 6. Snorkel/dive surveys for monitoring of anadromous salmonid adults in the Klamath Basin.

	Location	Species[1]	Years		Lead
Lower-Mid Klamath	Blue Creek	CF	1994	Pres.	YTFP
	Salmon River	CS, ST	1995	Pres.	SRRC/KT
	Scott River	CS, ST, LM			CDFW/KT
	Misc. Tributaries	ST	1985	Pres.	USFS/KT
Trinity	Tributaries	CS, ST	1990	Pres.	USFS

[1] CF = Fall Chinook, CS = Spring Chinook, CO = Coho, ST = Steelhead, LM = Lamprey.

Blue Creek: Snorkel surveys are conducted for Fall Chinook (Faukner, YTFP, Pers. comm.).

Salmon River: Annual snorkel surveys are conducted in the Salmon River in late July to count spawning Spring Chinook and Steelhead (Hotaling & Brucker 2010, CNRS & CDFW 2024, SRRC 2024). Work has been conducted since 1995 by the Salmon River Restoration Council and other partners. Spring Chinook surveys complement annual redd and carcass surveys conducted from September through November (SRRC 2010). Work is currently funded by NOAA's Pacific Coastal Salmon Recovery Fund.

Scott River: Snorkel surveys are made by the USFS to count spring Chinook, steelhead and adult lamprey in the Scott River (Mauer 2002, Stapleton 5/14/25 presentation).

Lower-Mid Klamath Tributaries: Since 1985, snorkel surveys to count summer steelhead holding in tributaries located on or adjacent to lands administered by the USFS Orleans and Happy Camp Ranger districts in the lower Klamath River (CNRS & CDFW 2024). Counts include adults and half pounders and are conducted on Bluff Creek, Red Cap Creek, Camp Creek, Wooley Creek, Dillon Creek, Clear Creek, Elk Creek, Indian Creek, Thompson Creek, Grider Creek, and other tributaries to the Klamath River between Aikens Creek and Beaver Creek. Work is conducted by the USFS and KTDNA with funding provided by NOAA's Pacific Coastal Salmon Recovery Fund.

Trinity tributaries: Snorkel surveys for spring Chinook and summer steelhead have been conducted between since 1990 in the four major tributaries to the Trinity River: Canyon Creek, North Fork Trinity River, South Fork Trinity River, and New River (Cyr 2013, Hill et al. 2015). This work historically involved CDFW, USFS and YTFP. The Watershed Center of Hayfork California conducts snorkel surveys in the upper South Fork Trinity River and Hayfork Creek (Sykes 5/14/25 presentation). With staffing reductions in the USFS, the Watershed Center has assumed more of this work.

1.3 Adult Weir Video/Trap

Temporary weirs are employed at various locations throughout the basin to count returning adult salmon and steelhead and to conduct biological sampling (Table 5, Figure 10). Well-designed weirs have the capability of providing complete census data on fish moving upstream. Weirs direct fish either into traps or through openings where they may be identified and counted. Weirs with traps provide the opportunity to collect biological data (e.g., fish health, pathogens, tissue samples) and to tag or recapture individual fish. Carcass sampling may also be conducted at weirs as salmon wash back downstream following post-spawn mortality. Video facilities generally consist of a video camera, counting flume and an Alaska style weir strategically placed in a diagonal direction across the river channel. Fish immigrating upstream are directed through a narrow flume, which passes in front of an underwater video camera. The camera is connected to a time-lapse video recorder and monitor.

Figure 9. Willow Creek weir operated on the Trinity River (Kier et al. 2023).

Table 7. Weirs for monitoring of anadromous salmonid adults in the Klamath Basin (current and proposed).

	Location	Species	Years		Lead
Lower Mid Klamath	Scott River	CF, CO, ST	2007	Pres.	CDFW
	Shasta River	CF, CO, ST	1998	Pres.	CDFW
	Bogus Creek	CF, CO, ST	2003	Pres.	CDFW
Upper Klamath[1]	Jenny Creek	CF, CO, ST	2024	Pres.	CDFW
	Shovel Creek	CF, CO, ST	2024	Pres.	CDFW
	Camp Creek	CF, CO, ST	Proposed		--
	Mainstem below Shovel Creek	CS, CF, CO, ST	Proposed		--
	Spencer Creek	CF, CO, ST	2025	Pres.	ODFW
Trinity	Mainstem Willow Creek Weir	CS, CF, CO, ST	1978	Pres.	CDFW
	Mainstem Junction City Weir	CS, CF, CO, ST	1978	Pres.	CDFW

[1] *Dam removal reach between Iron Gate Dam site and Keno Dam.*

[2] *CF = Fall Chinook, CS = Spring Chinook, CO = Coho, ST = Steelhead.*

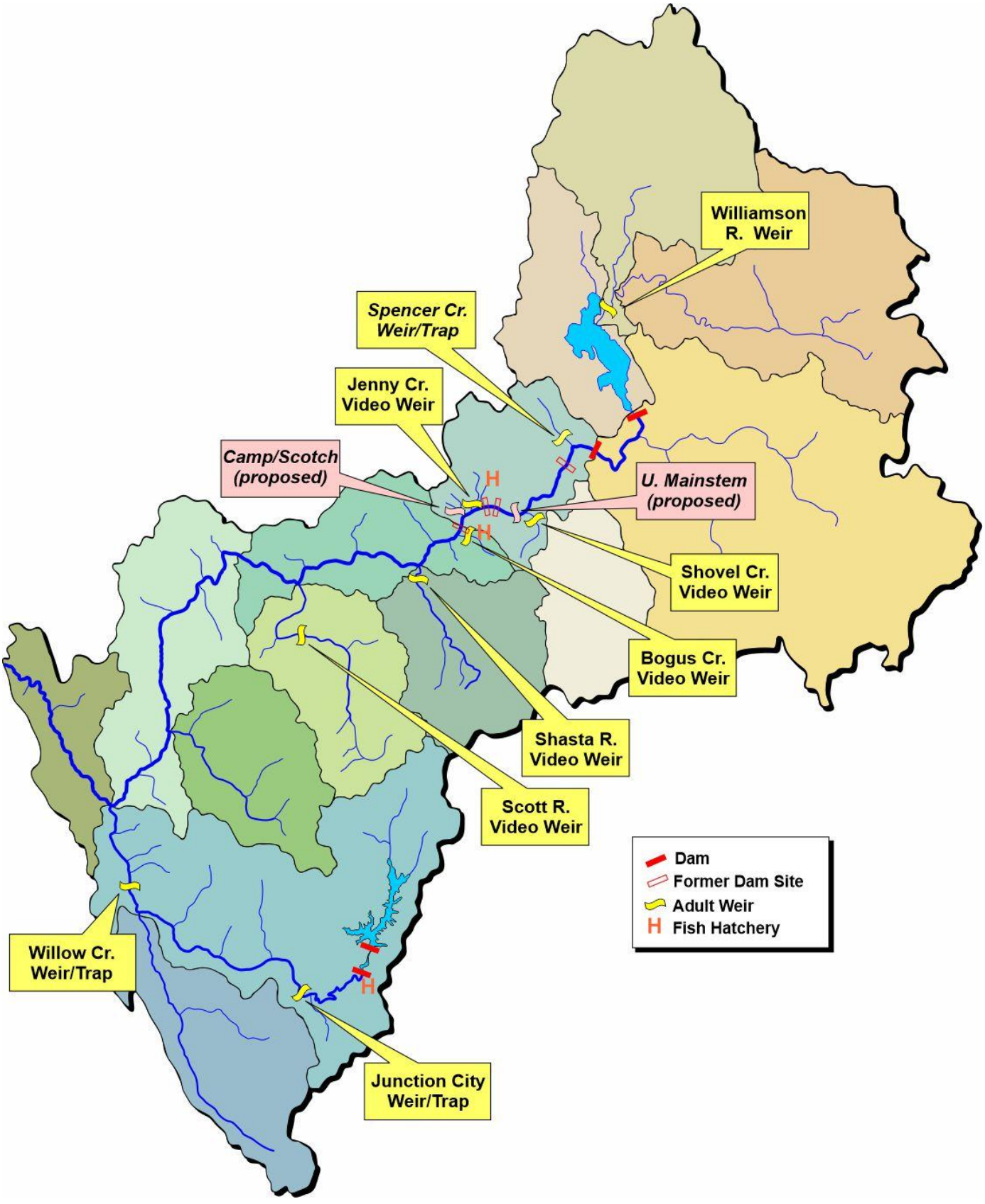

Figure 10. Current weir locations for monitoring of anadromous salmonid adults in the Klamath Basin.

Scott, Shasta and Bogus Video Weirs: CDFW currently operates video weirs on the Scott River, Shasta River, and Bogus Creek as part of the escapement data collection effort for adult fall-run Chinook salmon, coho salmon, and steelhead (Guidice & Knechtle 2022; Knechtle & Guidice 2023, CDFW 2024). Run-size estimates are acquired via an adult fish video counting facility and, downstream of that facility, during spawning ground surveys. Video monitoring counts s adult fall and winter steelhead but, in most years, video monitoring was terminated in December or January due to high flow events or other limitations and did not capture the full migration period (CNRS & CDFW 2024). The Scott River facility began operating in 2007 to allowed for accurate salmon estimation due to access limitations for spawning ground surveys on some private lands. Video equipment was first installed at the Shasta and Bogus weirs in 1998 and 2003, respectively. These weirs previously operated with traps.

Shasta, Scott and Bogus facilities are located roughly 600 feet, 18 miles and 0.25 miles upstream of the respective confluences with the Klamath River. Weirs have a long history of operation and methodology has evolved over time. Videos also provide information on any adipose fin-clipped or maxillary-clipped fish observed and the presence of lamprey. Weirs are operated in conjunction with spawning ground surveys. The video facility consists of a video camera, counting flume and an Alaska style weir strategically placed in a diagonal direction across the river channel. Fish immigrating upstream are directed through a narrow flume, which passes in front of an underwater video camera. The camera is connected to a time-lapse video recorder and monitor. The video recorder is set to include both a date and time stamp on every recording to accurately document run timing. The video counting facility typically operates 24 hours a day seven days a week during the adult salmon migration from early September through late December.

Upper Klamath Tributary Video Weirs: Adult Video weirs were installed and operated for the first time in 2024 on upper Klamath tributaries following removal of four upper Klamath dams (CDFW 2024). Jenny Creek weir began operating on September 25, 2024. Shovel Creek weir began operating on October 16, 2024. These weirs are expected to primarily count Fall Chinook but will also count any Coho or Steelhead which might be present. Weirs are planned to be operated annually from September to January (CNRS & CDFW 2024). California's reintroduction and restoration monitoring plan identified a potential weir location in Camp Creek below the confluence of Scotch Creek (CNRS & CDFW 2024).

Upper Klamath Oregon Surveys: Weirs were identified in the Oregon portion of the mainstem Klamath River downstream from Keno Dam and in Spencer Creek by the ODFW and Klamath Tribes reintroduction implementation plan (ODFW and KT 2021). A weir is planned to operate in Spencer Creek beginning in 2025 (B. Ramirez, ODFW, pers. comm.).

Trinity River Weirs/Traps: Since 1978, CDFW has led operations of two weirs in the mainstem Trinity River, one near the town of Willow Creek (RM 26.0) and one near the town of Junction City (RM 84.4) (Kier et al 2023; Gough et al. 2024). Chinook, Coho and steelhead are trapped and tagged at weirs with individually numbered Floy 'spaghetti' tags and released upstream to resume their spawning migration. Tagged and untagged fish are subsequently recaptured at TRH to produce mark-recapture estimates of abundance. Natural- and hatchery-origin components of the run are separated based on species-specific marks (i.e., fin or maxillary clip) applied to juveniles prior to release from the hatchery. In addition, coded-wire tags (CWT) are used to separate spring and fall runs of Chinook Salmon. CDFW has partnered with the HVT since 1995 to conduct weir operations. The YTF assists with Coho Salmon broodstock collection at the Junction Coty Weir and transportation to the Trinity River Hatchery. This work is funded by the USBR through the Trinity River Restoration Program.

1.4 Sonar

Over the last decade, active hydro-acoustic techniques have proven to be an effective method of unobtrusively evaluating anadromous fish populations in freshwater and marine environments (CDFW 2020). Sonar systems can be particularly effective in obtaining salmon and steelhead census counts in large, turbid river systems where weirs or visual counts are not practical. Bank mounted sonars are widely used to count salmon in other rivers including California's Eel River, Washington's Elwha River and numerous rivers in Alaska. Sonars may also be used in boat-mounted or hand-held systems to locate and count fish including sturgeon in the Sacramento River.

ARIS (Adaptive Resolution Imaging Sonar) is the latest generation of DIDSON technology imaging sonar which records movie-like imagery of a cone shaped cross section of the river and thereby any fish migrating up or downstream. It is a multi-beam system which provides a high-level resolution.

Sonars can operate continuously. Software is in various stages of development for the devices to process characteristic acoustic signals. However, current practice largely depends on but monitoring and interpretation by a person. For this reason, recordings may be subsampled and expanded for census counts. Images are not identifiable to species although some inferences can be made from size and time of movement. For this reason, sonar systems are often accompanied with additional fish sampling for species identification and apportionment.

Table 8. Sonar for monitoring of anadromous salmonid adults in the Klamath Basin (current and proposed).

Location	Species[1]	Years		Months	Lead
Mainstem < Iron Gate	CS, CF, CO, ST	2024	Pres.	?	CalTrout
Mainstem < Frain Ranch Reach	CS, CF, CO, ST	Proposed		TBD	TBD

[1] *CF = Fall Chinook, CS = Spring Chinook, CO = Coho, ST = Steelhead.*

<u>*Klamath Mainstem at Iron Gate*</u>: A fixed ARIS 1800 multi-beam SONAR began operation in fall of 2024 to monitor count migrating fish in the mainstem Klamath following removal of the four Klamath dams. The sonar is located at RM 193 approximately 200 meters below the former Iron Gate dam site. The entire width of the river is ensonified. The system was in operation from October 17-29 during the Fall Chinook migration and is planned to allow continuous monitoring of passing fish. This effort is led by CalTrout and is a cooperative effort with CDFW, YTFP, KTDNR and others. This project is operating in conjunction with netting, radio telemetry and PIT tagging. This site was identified in California's reintroduction and restoration monitoring plan as a preferred sonar location to document volitional dispersal into upstream historical habitats (CNRS & CDFW 2024).

<u>*Upper Klamath Oregon Surveys (proposed)*</u>: A sonar was proposed in the Oregon portion of the mainstem Klamath River above Iron Gate Dam and below the Frain Ranch Reach on Oregon by the ODFW and Klamath Tribes reintroduction implementation plan (ODFW and KT 2021).

1.5 Downstream Migrant Traps

Downstream migrant traps have been widely deployed in river mainstems and tributaries throughout the Klamath basin to sample juvenile salmonids during outmigration (Table 9, Figure 12). Traps are generally operated during spring when juvenile outmigration most typically occurs. Traps collect all age classes of outmigrating Chinook, Coho and Steelhead, as well as a variety of native and non-native fish species including lamprey.

A variety of trap types are utilized (Wallin et al. 2023). Rotary screw traps (Figure 11) are used in larger rivers, including the mainstem Klamath and Trinity Rivers. Rotary screw traps generally fish in faster, deeper water to capture older and larger age-0 and age-1 salmonids (Gough et al. 2015). Frame nets are placed closer to the bank in shallower, slower moving water close to the bank, and are in general more efficient at capturing younger and smaller age-0 salmonids migrating along river margins. Trap sites in larger river sites may employ a combination of rotary screw traps and frame nets. Fyke nets are generally deployed in smaller streams and may be used in conjunction with weirs which guide fish into the nets.

Trapping information is used to estimate the number, timing, size, and age of downstream migrating fish as well as provide opportunities to collect biological information (e.g., size, weight, tissue samples, scale samples). Data generated by juvenile trapping is used to assess abundance, productivity, distribution and diversity of salmonid populations. Trapping efforts often include mark-recapture efficiency tests where a sample of marked fish are released upstream and capture efficiency is estimated based on the proportion of those marked fish subsequently collected in the trap.

Traps also provide fish for PIT tagging and recapture PIT tagged fish (Beeman et al. 2012). PIT tagging is used in mark-recapture models to assess juvenile movements and survival. Tissue samples from trapped fish are used to assess the prevalence of infection with the parasite *Ceratonova shasta* (Nichols & True 2007; Nichols et al. 2009; True et al. 2010, 2011, 2013, 2016; Bolick et al. 2012, 2013). This data is also used to calibrate salmonid population and production models used as decision-support tools to aid in water and basin management (Bartholow et al. 2002, (Perry et al. 2018, 2019, 2023; Plumb et al. 2019).

Figure 11. Juvenile outmigrant rotary screw trap (photo provided by Mike Belchik).

Klamath Mainstem: Juvenile salmonid trapping is currently conducted at five sites on the mainstem Klamath River. Two sites between the Iron Gate Dam site and the Shasta River (I5 site and Bogus) are operated by the USFWS AFWO (USFWS 1989; Gough et al. 2015; David et al. 2016, 2017, 2018; Scheiff et al. 2001; Wallin et al. 2021, 2023). Two sites between the Shasta and Trinity Rivers (Kinsman and Big Bar) are operated by the KTDNR in conjunction with the USFWS AFWO. The YTFP operates a trap just above the confluence with the Trinity River (Weitchpec site). These traps have generally been operating annually since 2000. Funding for these efforts is primarily provided but the USBR's Klamath Area Office, with additional support provided by the U. S. Fish and Wildlife Service's Klamath River Fish Habitat Assessment Study administered by the Arcata Fish and Wildlife Office (Wallin et al. 2023).

Lower Klamath Tributaries: Juvenile salmonid trapping has been conducted in lower Klamath tributaries including Blue and McGarvey Creeks beginning in 1995 (Gale et al. 1998; YTFP 2009; Antonelli 2012, Antonelli & Partee 2012; Antonelli et al. 2012). Migrant trapping is also conducted in Waukell, Panther and Salt Creeks since 2006 (Faukner et al. 2019). Trapping in Blue Creek is conducted with a rotary screw trap. Trapping in the smaller tributaries is conducted with fyke or pipe traps. Work is conducted by the YTFP and KDNR. Long-term assessments were used to monitor trends. This work is currently accompanied by extensive PIT tagging and PIT tag detection systems for assessment of juvenile coho life history patterns and habitat use prior to smolt migration (Faukner et al. 2019).

Table 9. Juvenile outmigration trap locations for monitoring of anadromous salmonids in the Klamath Basin (current, planned and proposed).

	Location	Species[2]	Years		Months	Lead
Lower-Mid Klamath	Mainstem: Weitchpec site	CS, CF, CO, ST, LM	2000	Pres.	Mar-Jun	YTFP
	Mainstem: Big Bar site	CS, CF, CO, ST, LM	1988	Pres.	Mar-Jun	KTDNR
	Mainstem: Kinsman site	CS, CF, CO, ST, LM	2000	Pres.	Mar-Jun	KTDNR
	Mainstem: I5 site	CS, CF, CO, ST, LM	2000	Pres.	Mar-Jun	USFWS
	Mainstem: Bogus site	CS, CF, CO, ST, LM	2000	Pres.	Mar-Jun	USFWS
	McGarvey & lower tribs.	CF, CO, ST	1995	Pres.	Apr-Oct	YTFP
	Blue Creek	CF, CO, ST	1995	Pres.	Apr-Oct	YTFP
	Salmon River	CS, CF, CO, ST, LM	2001	Pres.		KTDNR
	Scott River	CS, CF, CO, ST, LM	2001	Pres.	Jan-Jun	CDFW
	Shasta River	CS, CF, CO, ST, LM	2001	Pres.	Jan-Jun	CDFW
	Bogus Creek	CF, CO, ST, LM	2015	Pres	Jan-Jun	CDFW
Upper Klamath[1]	Mainstem > Shovel Cr.	CS, CF, CO, ST, LM	Planned		Jan-Jul	CDFW
	Scotch/Camp Creek	CF, CO, ST, LM	Planned		Jan-Jul	CDFW
	Fall Creek	CF, CO, ST, LM	2024	Pres.	Jan-Jul	CDFW
	Jenny Creek	CF, CO, ST, LM	Planned		Jan-Jul	CDFW
	Shovel Creek	CF, CO, ST, LM	2025	--	Jan-Jul	CDFW
	Mainstem <Spencer Cr.	CS, CF, CO, ST, LM	Proposed			ODFW/KT
	Spencer Creek	CF, CO, ST, LM	2025	Pres.		ODFW/KT
Head waters	Sprague River	CS, CO, ST	Proposed			ODFW/KT
	Williamson River	CS, CO, ST	Proposed			ODFW/KT
	Wood River	CS, CO, ST	Proposed			ODFW/KT
Trinity	Mainstem Willow Creek site	CS, CF, CO, ST, LM	1989	Pres.		USFWS
	Mainstem Pear Tree site	CS, CF, CO, ST, LM	2003	Pres.		HVTF
	Lower Trinity tributaries	CF, CO, ST	1997	Pres.		HVTF

[1] *Dam removal reach between Iron Gate Dam site and Keno Dam.*

[2] *CF = Fall Chinook, CS = Spring Chinook, CO = Coho, ST = Steelhead, LM = Lamprey*

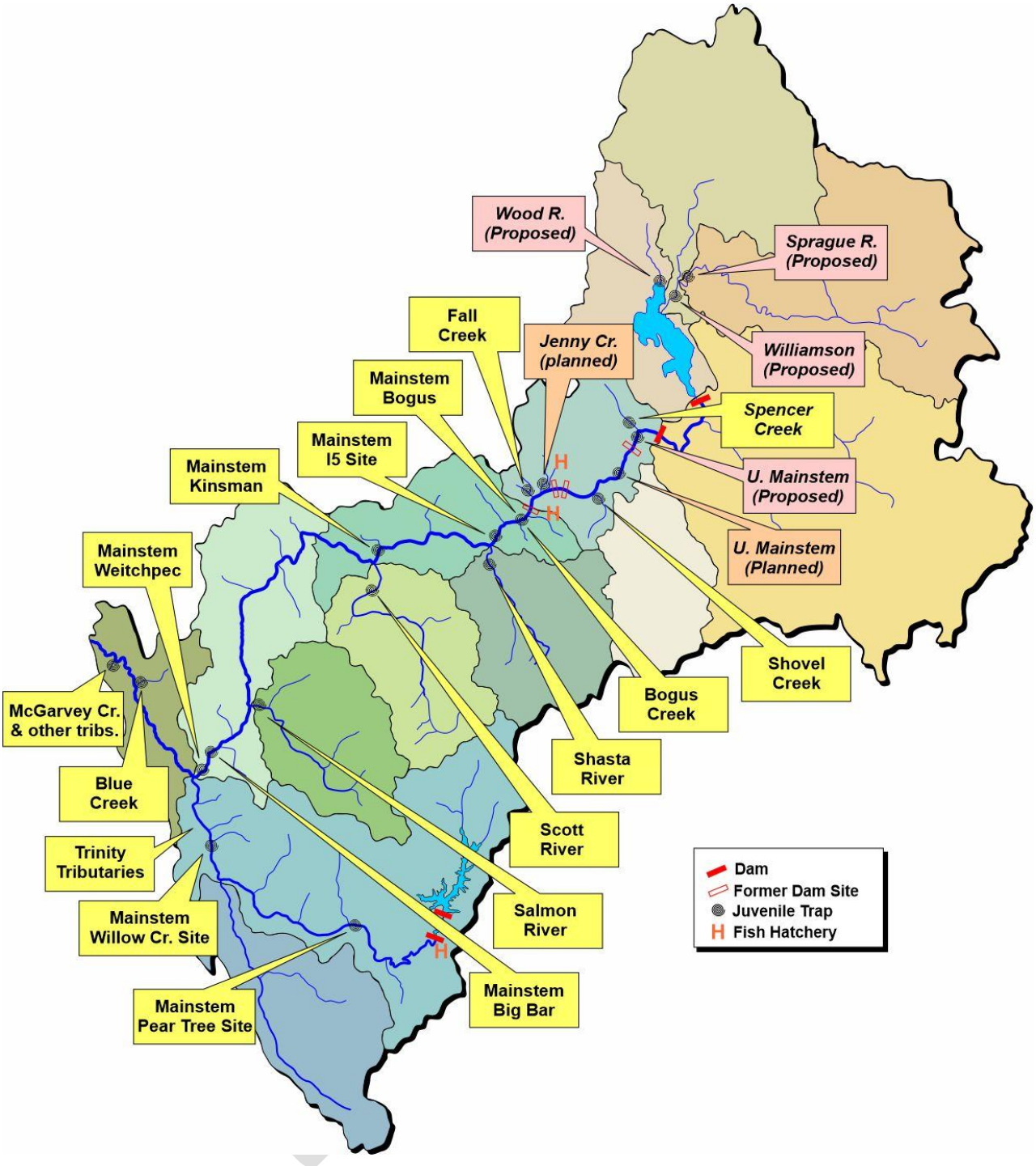

Figure 12. Juvenile trap locations for monitoring anadromous salmonids in the Klamath Basin (current, planned and proposed).

Shasta, Scott & Salmon Rivers: CDFW's Yreka Fisheries Program has operated rotary screw traps since 2001 in the Scott and Shasta rivers (Chesney et al. 2009, Stenhouse et al. 2016, Massie & Morrow 2021, Morrow & Bachteler 2023). Traps are located approximately 4.3 RM and 0.1 RM upstream from the river mouths, respectively. A rotary screw trap is operated on the Salmon River by the YTFP. Traps are typically operated from January to June, depending on conditions.

Bogus Creek: A fyke net has operated on Bogus Creek by CDFW since 2015 (CDFW 2025). This trap collects data on juvenile run-timing, weekly abundance estimates, size, and future smolt-to adult survival rates for juvenile Coho

Salmon to determine if hatchery practices are producing high quality Coho Salmon smolts which mimic the life histories of naturally produced Coho Salmon. Information is also collected on Chinook and steelhead. This trap is typically operated from January to June, but trapping may be suspended during periods of high flow.

Upper Klamath Tributaries: Post dam-removal juvenile fyke traps were identified in hydro reach tributaries including Camp Creek below the confluence of Scotch Creek, Fall Creek, Jenny Creek, and Shovel Creek by California's reintroduction and restoration monitoring plan (CNRS & CDFW 2024). Placement and operation are planned to occur in coordination with monitoring partners. Juvenile traps were placed in Fall and Shovel Creeks in 2025 (C. Robinson, personal communication, 6/10/25) and are planned to operated annually from January to July. A trap is planned for Jenny Creek tentatively for installation in December 2025. CNRS & CDFW (2024) indicates that funding is in place for this work.

Upper Klamath Mainstem (planned): The need for a post dam-removal juvenile trap in the hydro reach of the Klamath mainstem was identified by California's reintroduction and restoration monitoring plan (CNRS & CDFW 2024). This plan reported that potential locations for a rotary screw trap would be prioritized based on information gained through implementation of initial monitoring. On the mainstem Klamath River, a location may be selected in the vicinity of Iron Gate Dam to track outmigration past the former dam location. Alternatively, the USFWS's current rotary screw trap location just upstream of the Interstate 5 Bridge over the Klamath River could continue to be used to collect outmigration data. Another possible location could be upstream of Shovel Creek to collect outmigration data on fish moving down river from Oregon. Placement and operation of a mainstem rotary screw traps would only occur through careful planning and coordination with monitoring partners.

Upper Klamath Oregon: A juvenile trap is proposed in the Oregon portion of the mainstem Klamath River downstream of the Spencer Creek confluence and/or lower end of the Frain Ranch reach by the ODFW and Klamath Tribes reintroduction implementation plan (ODFW & KT 2021). A juvenile fyke trap was operated by ODFW in Spencer Creek to count downstream migrants beginning in 2025.

Klamath Headwaters (Proposed): Juvenile traps are proposed in the Williamson, Sprague and Wood Rivers by the ODFW and Klamath Tribes reintroduction implementation plan (ODFW & KT 2021).

Trinity Mainstem: Rotary screw traps have been operated on the mainstem Trinity River annually at a Willow Creek site (RM 21.1) since 1989 and a Pear Tree site (RM 73.3) since 2003 (Craig 1989; Craig 1992; Goldsmith 1993; Lang et al. 1998; McCleod et al. 1999; Scheiff et al. 2001; Pinnix et al. 2007; Pinnix & Quinn 2009; Pinnix et al. 2011; Petros 2011; Harris et al. 2012; Petros et al. 2013; Pinnix et al. 2013; Davids et al. 2013; Petros et al. 2014; Petros et al. 2015; Harris et al. 2016; Petros et al. 2017; Green et al. 2004; TGA 2021; Pinnix et al. 2022; Martel 2021, 2023, 2024).

Trapping occurs from January to August. Operations are a cooperative effort by the USFWS, HVTF and YTFP. Thise monitoring program tracks abundance and trends in abundance of naturally-produced Chinook, Coho and Steelhead. Monitoring of juvenile migrants is particularly focused on effects of water management including the response to implementation of the 2000 ROD (e.g., Pinnix et al 2022). Work is funded by the USFWS AFWO and USBR under the Trinity River Restoration Program.

Lower Trinity Tributaries: Fyke nets are deployed on six Trinity River tributaries, all located on the Hoopa Valley Indian Reservation: Campbell Creek, Hostler Creek, Mill Creek, Pine Creek, Soctish Creek, Supply Creek, and Tish Tang Creek (NOAA 2025). Fyke net trapping has been used to quantify the abundance of out-migrating juvenile salmonids (Chinook, Coho and steelhead) in Reservation tributaries in most years since 1997. This work is used to assess restoration success and to prioritize future restoration actions. Work is conducted by the HVTF and current funding is provided by NOAA's Pacific Coastal Salmon Recovery Fund.

1.6 Juvenile Snorkel Surveys

Juvenile snorkel surveys are being used in some streams to assess habitat usage and inform flow targets, in-river water management and habitat restoration activities (Robinson 5/14/25 presentation). Snorkel surveys are well suited for collecting information on distribution, habitat use and relative abundance of juvenile salmonids, particularly over-summering coho salmon (CNRS & CDFW 2024). Snorkel surveys typically occur during summer low water conditions between July and September. Unlike methods that capture or handle fish, direct observation can be conducted in warmer water without harming fish. Snorkel surveys can be cost effective, quickly done with small teams, and also effective where it is difficult to access streams such as in steep canyon reaches.

CDFW in-river snorkel surveys, CDFW Photo.

Figure 13. Stream snorkel survey (CNRS & CDFW 2024).

Table 10. Juvenile snorkel survey locations for monitoring of anadromous salmonids in the Klamath Basin.

	Location	Species	Years		Months	Lead
Lower-Mid Klamath	L. Klamath Tribs.	CO				YTFP
	Mid. Klamath Tribs.	CO	2011	Pres.	Mar-Dec	YTFP
	Salmon River	CS, CF, CO, ST				SRRC
	Scott River	CF, CO, ST	2024		Jun-Sep	SRWC
	Shasta River	CF, CO, ST			May-Aug	CDFW
Upper Klamath[1]	Mainstem	CF, CO, ST	Planned		Jul-Sep	CDFW
	Scotch/Camp Creeks	CF, CO, ST	Planned		Jul-Sep	CDFW
	Fall Creek	CF, CO, ST	2024	Pres.	Jul-Sep	CDFW
	Jenny Creek	CF, CO, ST	2024	Pres.	Jul-Sep	CDFW
	Shovel Creek	CF, CO, ST	2024	Pres.	Jul-Sep	CDFW
	Other tributaries	CF, CO, ST	Planned		Jul-Sep	CDFW
Trinity	Upper tributaries	CO				YTFP
	South Fork tributaries	CO				WCHC

Lower Klamath Tributaries: Snorkel surveys are conducted in selected streams by the YTFP. This work is monitoring coho habitat utilization and use of thermal refugia. Since 1985, the USFS has conducted summer Steelhead holding counts on tributaries located on or adjacent to lands administered by the USFS Orleans and Happy Camp Ranger districts in the lower Klamath River (CNRA & CDFW 2024). Counts are performed through snorkel surveys and include adults and half pounders and are a sum of the surveys conducted on Bluff Creek, Red Cap Creek, Camp Creek, Wooley Creek, Dillon Creek, Clear Creek, Elk Creek, Indian Creek, Thompson Creek, Grider Creek, and other tributaries to the Klamath River between Aikens Creek and Beaver Creek.

Middle Klamath Tributaries: Snorkel surveys are conducted in streams including Beaver Creek, Horse Creek, Seiad Creek, Stanshaw Creek and others for assessment of habitat restoration effectiveness (Whitmore 2014, MKWC 2015, 2019, 2022).

Salmon River: Cressey (5/14/2025 presentation) reported that juvenile snorkel surveys are conducted by throughout the watershed in association with tributary fish passage and habitat restoration projects to assess habitat conditions and fish usage. The SRRC conducts annual snorkel surveys for spring-run Chinook salmon and summer Steelhead (adults and half pounders) on the Salmon River (CNRA & CDFW 2024).

Scott River: Snorkel surveys were conducted within the Scott River and tributaries in summer 2024 to document distribution, relative abundance and habitat use of juvenile Chinook, Coho and Steelhead (SRWC 2024). This work is part of a Scott River Fisheries Monitoring Project conducted by the SRWC and QVIR with funding by CDFW's Climate Change Impacts on Wildlife fund. This project includes both juvenile and adult surveys to help inform fisheries, water management and future restoration activities.

Shasta River: Chesney et al. (2009) documented results of summer snorkel surveys in 2008 used to assess juvenile Coho distribution, habit use and habitat requirements. Robinson (5/14/2025 presentation) reported that snorkel surveys in Canyon and Big Springs areas of the Shasta River are conducted by CDFW and the KTDNR to assess juvenile habitat usage.

Upper Klamath Tributaries: Snorkel surveys for juveniles were identified in the hydro reach mainstem and tributaries including Scotch/Camp, Fall, Jenny, Shovel, Deer, and Beaver Creeks and Copco Springs by California's reintroduction and restoration monitoring plan (CNRS & CDFW 2024). CNRS & CDFW (2024) indicates that funding is on place for this work. Summer snorkel surveys in conjunction with habitat typing were completed in Shovel, Fall and Jenny Creeks in 2024 to collect information on *O. mykiss* prior to dam removal (Romero 2024).

Trinity River Tributaries: Juvenile snorkel surveys are conducted, primarily by the YTFP in the upper Trinity River tributaries for pre- and post-restoration site monitoring and post supplementation monitoring at remote stream incubator (RSI) and fry release sites (Sykes 5/14/25 presentation). RSI sites include Little Browns Creek, Browns Creek and West Weaver Creek (USBLM 2025). HVTF releases coho fry in lower Pine, Supply and Soctish creeks in the Hoopa Valley Reservation. A joint Yurok Tribe-Hoopa Valley Tribe Fisheries effort is releasing coho fry in Indian Creek, Browns Creek, Weaver Creek, Grass Valley Creek and Rush Creek.

Snorkel surveys in the South Fork Trinity are used by the YTFP in conjunction with the Watershed Center of Hayfork California to monitor East Tule and Hayfork Creek passage projects and to assess use of large woody debris restoration and remote stream incubator sites (Sykes 5/14/25 presentation).

1.7 Juvenile Collection

Extensive monitoring efforts for juvenile salmonids based on migrant trapping (discussed separately in this report) are supplemented in some areas of the basin with juvenile collections by a variety of methods including seines, minnow traps, fyke nets, and hand-held nets. These efforts primarily occur in tributary streams to inform assessments of distribution and habitat use often in relation to site-specific habitat restoration activities. Fish may be PIT tagged to assessment movements, growth and survival in relation to networks of PIT tag detection arrays. Juvenile may also be collected for fish health and genetic analyses.

Electrofishing is one of the most widely used methods for sampling salmonid fish and is particularly useful in situations where other techniques are not effective in capturing fish or when handling fish is necessary (e.g., tissue samples, tagging/marking) (CNRS & CDFW 2024). Electrofishing is best suited for monitoring juvenile fish in tributaries, although it can also be effective for sampling the margins of the mainstem or off channel habitats.

Table 11. Juvenile collection locations for monitoring of anadromous salmonids in the Klamath Basin.

	Location	Species	Years		Months	Lead
Lower-Mid Klamath	Mainstem	CF	2009	Pres.	Mar-Aug	KT, YT
	Lower Klamath Tributaries	CO				YT
	Salmon River	CS, CF		Pres.		KTDNR?
	Scott River	CO, ST		Pres.		SRWC
	Shasta River	CO	2008	Pres.		
	Mid. Klamath Tributaries	CO	2011	Pres.		YTFP
Trinity	Tributaries	CO, ST				HT?

Lower Klamath Tributaries: Fish production effects of constructed off-channel habitats, wood jams and riparian replanting in several streams are being monitored by Yurok Tribe Fisheries Program. Sites included Hunter, McGarvey, Hoopaw and Terwer Creeks. Physical habitat and water quality assessments are a significant component of this program.

Klamath Mainstem: Juvenile Chinook Salmon are collected by seine in the Klamath River mainstem from for fish health assessment (Voss et al. 2024). Work is conducted by the Karuk and Yurok tribes.

Salmon River: Juvenile "grab" sampling of Chinook is being conducted throughout the watershed to assess genetics, allele distribution and abundance of spring & fall Chinook, and juvenile habitat usage by age (Cressey 5/14/25 presentation). Work is being conducted by the Karuk Tribe, SRRC, and Amy Fingerle of UC Berkeley.

Scott River: The SRWC is using seines and minnow traps in the Scott River and tributaries during summer to capture and collect data from juvenile Coho and Steelhead to assess use of restored and untreated habitat units in these streams. Juveniles are PIT tagged to assess growth and movements based on recaptures and detections at networks of PIT tag detection arrays in the Scott River and other areas of the Klamath Basin (SRWC 2023, 2024).

Shasta River: Juvenile Coho have been captured and PIT tagged from summer rearing locations in the upper Shasta River and tributaries with fyke nets, minnow traps, seine nets and hand-held nets beginning in 2008 (Chesney et al. 2009, Adams 2013). Since 2008, CDFW's Yreka Program has used PIT tags to monitor juvenile Coho movements and survival in the Shasta and Scott Rivers (Chesney et al. 2009; CDFW 2016; SRWC 2024). A detector in the weir also provides information on returning adults.

Middle Klamath Tributaries: Juvenile coho are collected by various methods in streams including Beaver Creek, Horse Creek, Seiad Creek, Stanshaw Creek and others for assessment of habitat restoration effectiveness

(Whitmore 2014, MKWC 2015, 2019, 2022). Fish benefits of a series of off-channel ponds constructed in tributary streams are being monitored by the Mid Klamath Watershed Council in conjunction with the Karuk Tribe and Humboldt State University (MKWC 2015, 2019, 2022). Juvenile Coho salmon are the focus of this work.

Trinity Tributaries: Juvenile salmonid production has been monitored in seven reservation streams since 1997 by the Hoopa Valley Tribal Fisheries Program to assess habitat restoration success (NOAA 2025). Electrofishing has also been conducted for steelhead (Garrison 2002).

1.8 PIT Tagging & Detection

Passive integrated transponder (PIT) tags and their receiver arrays are a powerful tool for estimating movement, survival, and abundance, particularly for juvenile salmonids.

PIT tags do not have batteries and allow for the tagging of smaller fish, although they require relatively close distance for detection (ESSA 2017). Additionally, with no battery life issues, fish that are PIT tagged may be detected for the remainder of their lifetime.

A Klamath PIT tag database was initially developed by the USGS Klamath Falls Field Station and is now being maintained by PSMFC in cooperations with Klamath Basin monitoring partners. The basin-wide fish-tagging database allows researchers and managers to share and cross-examine fish tagging data between agencies. For example, CDFW may PIT tag a coho salmon in the Shasta River that is subsequently captured in a USFWS screw trap downriver. The importance of this data-sharing platform will increase should the upper and lower basins be reconnected via dam removal (ESSA 2017).

Table 12. PIT tag detection locations for monitoring of anadromous salmonids in the Klamath Basin (current, pending and proposed).

	Location	Species[2]	Years		Months	Lead
Lower-Mid Klamath	Mainstem					KT
	L. Klamath tributaries	CO	1995	Pres.		YTFP
	Middle Klamath tributaries	CO		Pres.		KTFP
	Scott River	CO	2016	Pres.		SRWC
	Shasta River	CO	2008	Pres.		CDFW
	Bogus Creek	CO		Pres.		
Upper Klamath[1]	Jenny Creek	CF,CO,ST	Pending			
	Spencer Creek	CF,CO,ST	Planned			
	Shovel Creek	CF,CO,ST		Pres.		
	Keno Dam	CF,CO,ST	Planned			
Head waters	Link R. Dam	CHS		Pres.		USGS
	Klamath Lake	CHS		Pres.		USGS
	Sprague River	CHS		Pres.		USGS
	Williamson River	CHS		Pres.		USGS
	Wood River	CHS		Pres.		USGS

[1] Dam removal reach between Iron Gate Dam site and Keno Dam.

[2] CF = Fall Chinook, CS = Spring Chinook, CO = Coho, ST = Steelhead, LM = Lamprey

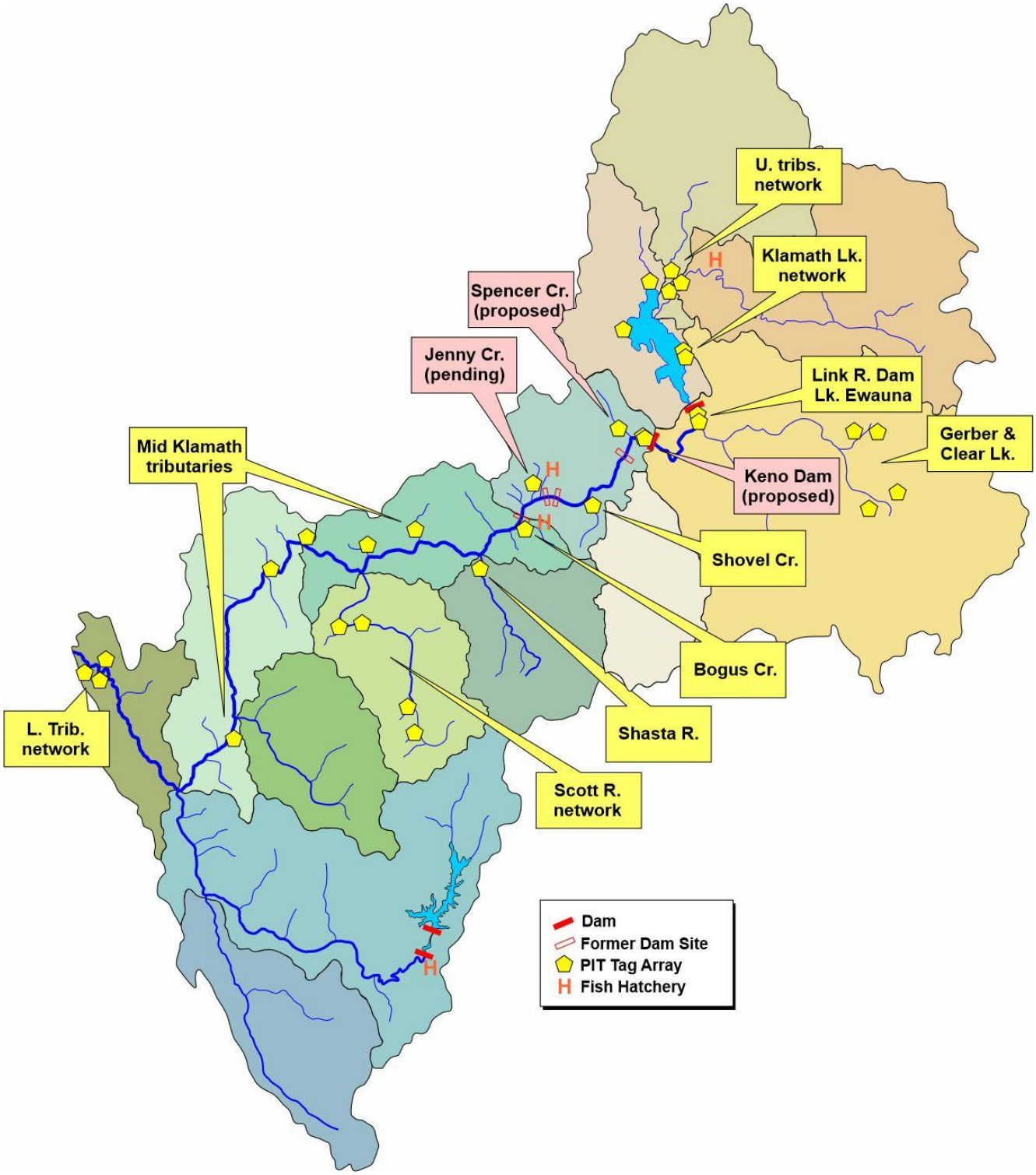

Figure 14. PIT tag detection locations for monitoring of anadromous salmonids in the Klamath Basin (current, pending and proposed).

Mainstem: PIT tag array is operated by the Karuk Tribe.

L. Klamath tributaries: Extensive PIT tagging and PIT tag detection systems occur in lower Klamath Tributaries for assessment of juvenile coho life history patterns and habitat use prior to smolt migration (Faukner et al. 2019). Fish are trapped for PIT tagging in Blue and McGarvey Creeks since 1995 (Gale et al. 1998; YTFP 2009; Antonelli 2012, Antonelli & Partee 2012; Antonelli et al. 2012) and in Waukell, Panther and Salt Creeks since 2006 (Faukner et al. 2019). Long term assessments are used to monitor trends.

Middle Klamath tributaries: Juvenile coho are PIT tagged and sampled by the KTFP in streams including Beaver Creek, Horse Creek, Seiad Creek, Stanshaw Creek and others for assessment of habitat restoration effectiveness (Whitmore 2014, MKWC 2015, 2019, 2022).

Scott River: Since 2016, SRWC has continually operated a passive integrated transponder (PIT) array network in the Scott River watershed that allows for tagged fish to be detected as they move throughout the streams in question. Detection data collected at the array stations provides insight into how habitat use varies seasonally, when smolts are outmigrating from their natal streams, etc. (CDFW 2016; SRWC 2023, 2024). A detector in the weir also provides information on returning adults.

Shasta River: Since 2008, CDFW's Yreka Program has used PIT tags to monitor juvenile coho movements and survival in the Shasta and Scott Rivers (Chesney et al. 2009; CDFW 2016; SRWC 2024). A detector in the weir also provides information on returning adults.

Bogus Creek: A PIT tag array is operated in Bogus Creek (SRWC 2024).

Jenny Creek: Installation of a PIT tag array near the mouth of Jenny Creek is pending.

Shovel Creek: A PIT tag array has been installed in Shovel Creek.

Spencer Creek: A PIT tag array near the mouth of Spencer Creek (tributary to Klamath River below Keno Dam) would allow for detections of tagged fish moving in and out of this tributary (ODFW & KT 2021).

Keno Dam: A proposed PIT tag array at the outlet of Keno Dam would increase detection probability of emigrating Juveniles out of the tributaries above Upper Klamath Lake as well as allow for survival and migration investigations of juveniles migrating From Link River Dam, through Lake Ewauna/Keno Impoundment to Keno Dam (ODFW & KT 2021).

Link River Dam: The Link River Dam fish ladder has four PIT tag detection arrays (maintained and operated by USGS) constructed within them to determine usage by tagged fish (ODFW & KT 2021).

Klamath Headwaters – U.S. Geological Survey (USGS) currently maintains and operates seven stationary PIT tag antenna (Biomark, full duplex) arrays strategically located in tributaries of Upper Klamath Lake (Wood River, Crooked River, Williamson River, and Sprague River), Link River Dam fish ladder, and the Link River 1.5 rkm (~1 mile) below the fish ladder. These PIT tag arrays are intended to monitor tagged endangered suckers, but also provide detection of PIT tagged Redband Trout. An additional PIT tag array located on the Williamson River above the confluence of the Sprague River would allow for detections of individuals migrating in the Williamson River and its tributaries (Spring Creek, ~300 cfs) above the Sprague River confluence. PIT tag arrays located on Fourmile Canal and Sevenmile Creek would allow for detection of fishes in these tributaries located on the northwest side of Upper Klamath Lake. Additional PIT tag arrays on the Upper Sprague River would allow for detections above the current arrays in the lower river.

1.9 Telemetry

Telemetry tags include acoustic and radio tags (transmitters) that serve a wide range of purposes and can be detected from relatively long distances, although can be limited by battery lifetime (ESSA 2017).

Table 13. Telemetry detection locations for monitoring of anadromous salmonids in the Klamath Basin (current, pending and proposed). To be completed –references needed

	Location	Species[2]	Years		Months	Lead
Lower-Mid Klamath	Mainstem					KT/YT
	Salmon River					KT
	Scott River					KT
Upper Klamath[1]	Mainstem CA					CalTRT/KT
	Mainstem OR					ODFW
Head waters	Mainstem Keno-Link R.					USGS
	Klamath Lake					USGS

[1] Dam removal reach between Iron Gate Dam site and Keno Dam.

[2] CF = Fall Chinook, CS = Spring Chinook, CO = Coho, ST = Steelhead, LM = Lamprey

Klamath mainstem (juveniles): A mark-recapture study was initiated using radio tags in 2006 by the USGS in a cooperative study to estimate the effects of Iron Gate Dam discharge on survival on juvenile coho salmon in the lower Klamath River, northern California. The purpose of the study was to provide information about the relation between survival of juvenile coho salmon and river discharge in the Klamath River downstream from Iron Gate Dam (Beeman et al. 2009).

Klamath mainstem (juveniles): The USGS is conducting a long-term research project evaluating outmigration survival and timing of juvenile salmonids using acoustic telemetry in the mainstem Klamath below the former Irong Gate Dam. A state-of-the-art survival and movement modeling framework is being developed to evaluate how environmental conditions affect juvenile Chinook salmon outmigration survival and movement before and after dam removal.

Klamath mainstem (adults): Cal Trout is also leading a crew to live capture fish just above the former Iron Gate dam. By tagging salmon with radio tags and passive integrated transponders, or PIT tags, they will be able to track them as they explore new habitats upstream. On October 25, 2024, the Caltrout team tagged their first Chinook salmon and steelhead followed by the first coho salmon on December 4. This information will be used to determine if active reintroduction will be necessary to repopulate habitat following the guidelines outlined in ODFW's Reintroduction Plan (2008), and the Implementation Plan for Reintroduction (2021).

Klamath headwaters: ODFW has initiated a project to tag hatchery-reared juvenile Chinook Salmon with VHF radio transmitters for release in streams within the Upper Klamath Basin and re-detected at key locations via radio receivers as well as mobile receivers (ODFW 2022). Detection data of released fish will identify the movement behavior and survival of radio-tagged fish as they migrate through the Upper Klamath Basin system. This project is part of a larger effort investigating a hypothetical outmigration of juvenile Chinook Salmon in the Upper Klamath Basin. A radio-tagged salmon was detected in the Williamson River (Oct. 10) along with multiple other salmon (CBB 10/24/25). In late October, tagged fish were found in tributaries on the west side of Upper Klamath Lake (Pelican Bay, Oct. 14) and in the Sprague River (Oct. 14).

1.10 Fisheries

Harvest of Klamath salmon is monitored by the respective fishery management authorities.

Ocean harvest of Chinook and coho is estimated by CDFW and ODFW from statistical angler survey programs for recreational fisheries and fishing landing reports for commercial fisheries. Catch is apportioned among stocks based on mark and coded wire tag information in subsampled catch.

The Hoopa Valley Tribal Fisheries Department conducts field surveys to estimate harvest and biological characteristics of Chinook salmon, coho salmon and steelhead in their gillnet, hook-and-line and weir fisheries during spring and fall seasons (NMFS 2022; HVTFD 2023). Fisheries are conducted by the Hoopa Tribe in the Trinity River from one mile above the confluence with the Klamath River upstream approximately 12 miles to the boundary of the Hoopa Valley Reservation. Net harvest sampling methods involve field collection of effort, catch and biological data and samples in a statistical sampling design. The tribal hook-and-line subsistence fishery is sampled on three randomly selected days per calendar week. Estimation of total harvest is based upon estimates for total anglers, angler fishing hours and catch per hour fished on sampled days within weeks. HVT staff are present at the weir 24 hours per day and empty traps each day releasing non-target fish above the weir.

In-river non-tribal recreational fisheries may occur in the Klamath and Trinity Rivers in some years depending on abundance. A survey has also been conducted by HVT since 1992 as a distinct subpart of a generalized recreational fishery survey including non-tribal anglers occurring in the lower 13-22 miles of Trinity River. The hatchery/natural composition in all fisheries is estimated through expansion of coded-wire-tags (CWTs) recovered in the fishery.

The Yurok Tribe similarly monitors catch, effort and catch composition in their subsistence, ceremonial and sometimes commercial fisheries within the lower 44 miles of the Klamath River (Williams 2015). The Tribe permits fishing with gill nets (set or drifting), dip nets, trigger nets, eel hooks, eel baskets (traps), and angling. Gillnets are the primary gear type. Fisheries are conducted during spring and fall seasons. Catch and biological data including marks and tags is collected by contact of Tribal fishers at their boats, riverside camps, area boat landings, the buying station at Requa or their residences. Monitoring occurs each day that the fishery is open.

The Karuk monitors its subsistence fishery.

CDFW conducts a creel survey of recreational anglers in the Lower Klamath from the Pacific Ocean to the Iron Gate damsite during fall in years when the fishery is open (Troxel & Lindke 2019, 2020, 2021).

Table 14. Fishery monitoring of anadromous salmonids in the Klamath Basin (current, pending and proposed).

Location	Participants	Gear	Season	Months	Species[1]	Lead
L. Klamath (RM 0-44)[2]	Yurok	Gillnet	Spring	May-Jul	CS	YTFP
L. Klamath (RM 0-44) [2]	Yurok	Gillnet	Fall	Aug-Nov	CF, CO, ST	YTFP
L. Klamath	Non-Tribal	Hook & Line	Fall	Aug-Nov	CF, CO, ST	CDFW
Klamath	Karuk					
L. Trinity (RM 1-12)	Hoopa	Gillnet	Spring	May-Jul	CS	HVTFD
L. Trinity (RM 1-12)	Hoopa	Gillnet	Fall	Aug-Nov	CF	HVTFD
L. Trinity (RM 1-12)	Hoopa	Hook & Line	Fall	Aug-Nov	CF, CO, ST	HVTFD
L. Trinity (RM 1-12)	Hoopa	Weir	Fall	Sep-Nov	CF, CO, ST	HVTFD
L. Trinity (RM 1-22)	Non-Tribal	Hook & Line	Fall	Aug-Dec	CF, ST	HVTFD

[1] CF = Fall Chinook, CS = Spring Chinook, CO = Coho, ST = Steelhead, LM = Lamprey

[2] Fishery includes one mile of the Trinty River upstream from the Klamath River/

1.11 Hatcheries

Hatcheries operate weirs and traps to collect adults for broodstock and sometimes to manage returns upstream from the hatchery. Swim-ins are predominately hatchery origin fish but may also include some natural-origin fish depending on hatchery location and practices. Biological sampling of the return provides information on age, sex and size of return. Tag and mark data where available provides information on abundance and survival.

Iron Gate Hatchery: CDFW's Klamath River Project (KRP) has historically conducted systematic sampling of fall-run Chinook and coho salmon returning to IGH (Giudice & Knechtle 2019). Monitoring was in accordance with the Monitoring and Evaluation Plan identified in the Hatchery and Genetic Management Plan (HGMP) for Iron Gate Hatchery (2014). Monitoring documents timing, age and sex composition, and to recover data from all coded wire tags (CWT) recovered from the heads of adipose fin clipped (AD) Chinook. Approximately 25% of all Chinook at IGH were AD and implanted with CWT's so they could be identified upon return to the hatchery or other locations during subsequent spawning seasons. Data from CWT fish provide a reference of known-age fish which is used, along with scale samples and analysis of length frequency distribution, to determine the age composition of the run. The CWT data are also used to evaluate Chinook release strategies, survival rates, ocean distribution and harvest as well as in-river migration timing, straying and harvest. Monitoring is also used to identify the prevalence of fish pathogens including Ich (*Ichtyophthirius multifillis*), columnaris (*Flavobacter columnare*) and copepods (*Salmincola californensis*).

KRP staff also sampled coho salmon that enter IGH, typically from mid-October through December. Biological data included tissue samples, fork length, sex, and clip/tag information. Tissue samples were sent via overnight mail to the National Oceanic and Atmospheric Administration (NOAA) for genetic analysis and the creation of a weekly spawning matrix designed to avoid the mating of closely related fish.

Fall Creek Hatchery Weir: Fish returns are monitored at a fishway picket barrier and fish ladder at the reconstructed Fall Creek Hatchery (KRRC 2022). Monitoring is in accordance with the Monitoring and Evaluation Plan identified in the 2024 Hatchery and Genetic Management Plan (HGMP) for Fall Creek Hatchery.

Trinity River Hatchery Trap: A fish ladder and trap is operated at the hatchery for the collection of broodstock which for coho are also collected at a downstream weir. Monitoring data of fish collected includes species, sex, and marks or tags. Monitoring at the hatchery is conducted as one element of a comprehensive Trinity River basin monitoring project for Chinook, coho and steelhead (Kier et al. 2023).

1.12 Fish Pathogens

The principal fish diseases affecting juvenile salmon in the Klamath are caused primarily by the myxozoan parasites *Ceratonova shasta* and *Parvicapsula minibicornis* (ESSA 2017). *C. shasta* and *P. minibicornis* are widespread in the lower mainstem of the Klamath River during certain time periods and in certain years and have been shown to adversely affect freshwater abundance of Chinook and coho salmon. While native salmonids exposed to low doses of the parasite exhibit some degree of resistance, they can become overwhelmed by high infectious doses that result in a diseased state and cause mortality (Some et al. 201a). Steelhead are generally resistant to or less affected by *C. shasta*.

Freshwater pathogens impact salmonids at different stages throughout their life histories. C. shasta is known to be a significant cause of juvenile salmonid mortality in the Klamath system (Ray et al. 2012). C. shasta causes enteronecrosis and is a significant contributor to morbidity and mortality of out-migrant juvenile Chinook and coho salmon in the lower Klamath River. Infection with *P. minibicornis* can progress to clinical disease (glomerulonephritis). Another parasite, *Ichthyophthirius multifiliis* (Ich) impacts returning adult salmon in the Klamath River. Heavy infection of the gills causes hyperplasia which can lead to asphyxiation and death. Low water flows, high water temperatures and high fish densities have contributed to disease outbreaks. This parasite was one of the causes of the 2002 die off event.

Both *C. shasta* and *P. minibicornis* alternate between two waterborne spore stages: myxospores and actinospores. Myxospores infect the polychaete worm *Manayunkia speciosa*. In this host parasites develop into actinospores and are released into the water column where they may encounter and infect salmonids. Transmission occurs through waterborne spore stages: actinospores released from annelid worms into the water column develop into myxospores in salmonid fishes. After salmonid infection, parasites develop into myxospores and are released either as they mature (P. minibicornis, shed along with urine) or upon death of infected fish (C. shasta). The polychaete invertebrate host is necessary for completion of the life cycle and neither horizontal (fish to fish), nor vertical (fish to egg) transmissions have been documented under laboratory conditions (Som et al. 2016).

Highly infectious disease zones for fish are associated with dense populations of the annelid polychaete host. *M. speciosa* feeds on particulate organic matter and its abundance is generally highest in the 100km reach of the Klamath River between the Shasta River and Independence Creek, which also has high abundance and diversity of other filter-feeding macroinvertebrates (Malakauskas and Wilzbach 2012).

One of the factors that needs to be resolved to achieve substantial gains in salmonid abundance and distribution is to change the hydrology, sediment movement, and spawning distribution to reduce disease incidences to levels that do not cause high mortality in juveniles or pre-spawning adults (Goodman et al. 2011). While dam removal is expected to decrease the prevalence of certain diseases such as Ceratonova shasta through changes in hydrology, sediment movement, and spawning distribution, there is still some level of uncertainty as to what the decrease in prevalence and severity of infection will be post dam removals considering flows will continue to be regulated under the Klamath Project with the new flow control points being Link River and Keno dams.

A basin wide fish disease monitoring program is currently led by the USFWS and Oregon State University in coordination with others including NOAA Fisheries, U.S. Bureau of Reclamation, CDFW, the Karuk Tribe, and the Yurok Tribe. The funding vehicle is by inter-agency agreement from BOR to USGS (pass though) to OSU. Funds are federal USBR obligation.

The three main approaches are based on the parasite's life cycle and include sentinel fish exposures, annelid host sampling and molecular quantification of parasite DNA in water samples. Extensive work has been conducted in

the Klamath River downstream from Iron Gate Dam. Efforts also included assessments upstream of Iron Gate Dam prior to dam removals and in Klamath headwaters upstream from Klamath Lake.

The pathogen monitored program is designed to better understand parasites and pathogens of salmonids to inform management actions and mitigate disease. A key objective is to determine how interactions between water flow, temperature and adult salmon returns affect infection and disease in juvenile and adult salmon. Where and when are outmigrating juveniles and resident fish become infected (spatial and temporal information on parasite infections)? How severe is infection under different environmental conditions (mainly water flow and temperature). What are the thresholds for disease for different salmon species/stocks.

This work will help predict how flow characteristics (managed water releases, high vs low water years) drive the distribution and density of worm hosts, and in turn salmon disease risk (hot spots, infectious zones, risk corridors). Ultimately results may inform recommendations for magnitude of discharge releases to reduce risk of salmon parasites (duration and timing as well as magnitude). Monitoring guides decisions on where and when to stock hatchery fish and helps focus habitat restoration efforts (in parasite hot spots). It is also used to parameterize S3 model estimates of juvenile production and parameterize models to predict times of disease impact. Results test/validate models for predicting annelid distribution and density based on discharge/flow manipulation events. Monitoring also helps interpret the water sample data and relationships with spore density (fish 'filter' many liters of water and experience environmental conditions).

Project results are documented on a fish pathogen monitoring webpage with summary of methods and results, in text and graphs;[8] annual reports, final reports, presentations at Klamath, regional and national meetings; and publications in peer reviewed scientific journals. Infection and mortality data are initially recorded in laboratory notebooks and then entered into Excel spreadsheets. All computers on which project data are stored or processed are password-protected and have back-up power supplies. Project data are backed up from these computers to the University data server as they are generated.

Juvenile Chinook Sampling

The prevalence of infection (POI) by *C. shasta* has been monitored in Klamath River juvenile Chinook Salmon since 2009 (Voss et al. 2024; Stone et al. 2025). This work examines POI and infection severity (parasite DNA quantity within fish tissue) each year and compares trends over time. Fish samples are collected at locations between Iron Gate and the estuary from rotary screw traps and beach seining from March to August by the USFWS, Karuk Tribe and Yurok Tribe. Samples are also collected from juvenile Chinook prior to release from Iron Gate Hatchery (2023) and Fall Creek Hatchery (2024). Sample analyses are conducted by the California-Nevada Fish Health Center has performed standardized monitoring of.

Sentinel Fish Monitoring

In sentinel fish exposures, fish highly susceptible to the parasite (out-of-basin rainbow trout) are placed in cages alongside fish of interest such as in-basin Chinook and coho salmon at index sites along the river for a three-day exposure. All fishes are transported to OSU's John L Fryer Aquatic Animal Health Lab and monitored for infection (~ 60 days). Severity of infection (percent morbidity and mean days to morbidity) are recorded through visual observations and molecular assay (PCR).

Sentinel fish monitoring occurs throughout the basin and has been extended into the upper basin including the Wood River, Williamson River and Keno Eddy. Sentinel fish have a known place and time of exposure, unlike free ranging fish. Susceptibility to different pathogens is being compared among different species and stocks of salmon, so they can be managed separately as necessary. Annual monitoring continues to add to a long-term dataset on

[8] *https://microbiology.oregonstate.edu/research/aquatic-microbiology-ecology/monitoring-studies*

disease severity for Chinook and coho salmon that encompasses years differing in (i) the magnitude, duration and timing of flows, (ii) river water temperatures during spring and summer, and (iii) adult salmon returns. Characterize infection severity in salmon - how many fish die and how quickly.

Key unknowns for the upper basin include the source of type II C. shasta; the relative susceptibility of Spring Chinook and Fall Chinook to upper basin pathogens; which lower basin pathogens (such as C. shasta type I (Chinook type)) will establish and how soon in the upper basin after those habitats are frequented by anadromous fishes; and how will Chinook fare to exposure to pathogens in the upper basin.

Water sampling

Long term index sites are established basin wide to determine parasite density in water samples that include data collection during spring out-migration and fall in-migration. To detect and quantify waterborne stages of C. shasta, river water samples are collected at five mainstem index sites; once a week all year round at two sites (KBC and KSV) and once per week from April through October at three other sites. Solar-powered automatic samplers (ISCOs) collect 1L water every 2 hours for 24 hours, from which 4 1L samples are manually taken. A quantitative PCR (qPCR) specific for *C. shasta* is used to detect and quantify any parasite DNA present. Cq values generated by the qPCR are converted to numbers of parasite spores per liter of water using reference samples with known quantities of spores. The Karuk and Yurok tribal biologists are integral to the collection and filtration of the water samples. Water samples are also taken in conjunction with the sentinel fish exposures; manual 'grab' samples are collected on the first and last day of the exposure. Data are presented as the average spores per liter of three replicate 1 liter water samples collected at each site and time.

In the upper basin, work is conducted monthly from March through October at Williamson River, Wood River and Keno Eddy. These data will address these - distribution and abundance of fish pathogens in the upper basin. And are environmental conditions such that these will cause disease in fish? Understanding of upper basin fish-pathogen dynamics lags behind lower basin knowledge base. Key uncertainties include is how does reconnection of the upper and lower basin affect distribution and abundance of fish pathogens? Are infection hot spots diminished? Are hot spots shifted (e.g. from base of IGH to FCH)? This effort will address those if we can fund.

Results are shared on OSU's fish disease monitoring website weekly during salmonid outmigration and at weekly RTO conference calls so that real-time management decisions with interested parties can be made. Water data are obtained more quickly than host data (fish or annelid) and thus enables responses sooner to poor water quality conditions. E.g. density of parasite in water samples has been used to influence release timing of hatchery fishes and emergency fish disease flow release events. Sample processing (DNA extraction, target testing and data interpretation) is expedited (<24 hours from sample receipt) during juvenile salmonid outmigration.

Annelid Sampling

To monitor abundance and prevalence of *C. shasta* infection in the invertebrate annelid host, *Manayunkia occidentalis*, benthic samples are collected at seven sites in the Klamath River in fall, winter, spring, and summer. Sites span a discharge gradient; 2 are located in the upper basin downstream from Keno Dam, 2 are in the hydroelectric reach, 3 are located in the middle basin downstream from Iron Gate Dam, and 2 are located in the lower basin downstream from the Scott River. Although samples are routinely collected in fall, winter, spring, and summer, they are also scheduled to occur prior to and after flooding or pulse flow events (when possible). Samples are processed to determine density, simple demographics, and the prevalence of myxozoan infections including *C. shasta* and *P. minibicornis*.

1.13 Environmental DNA

Environmental DNA (eDNA) sampling is another tool that can be used to monitor the presence of fish of all life stages (ESSA 2017). As organisms move through an environment, they shed material that contains genetic information. Environmental DNA is defined as "genetic material obtained directly from environmental samples without any obvious signs of biological source material" (Thomsen and Willersley 2015). Samples of eDNA are most collected by sampling water, soil, or sediment, or through surface swabs (Biomeme 2018) and is non-invasive and typically used to sample for presence or absence of a species. However, caution should be exercised as detections may not be localized or very localized and can occur a long distance from the target organism. To infer location or microhabitat preference, an improved understanding of how water currents redistribute eDNA is needed (Wildlife Management Institute 2016; Spence et al. 2020).

Humboldt State University (HSU) began a study in 2019 to test the efficacy of using eDNA to estimate weekly abundance of out-migrating Chinook salmon smolts in the Klamath River (Coyne and Kinziger 2020). Fifteen water samples were collected per week over a 16-week period from March to June while at the same time the rotary screw trap near the Kinsman Creek confluence with the Klamath River at RKM 237.6 (RM 147.5) was in operation. The two data sets (eDNA and rotary screw trap) were compared, and the authors concluded that "to utilize eDNA for standardized monitoring, further improvements of eDNA methods are needed for estimating smolt abundance" (Coyne and Kinziger 2020).

The sampling and analysis of eDNA could be a useful tool to determine presence alongside other methods or used independently, particularly in tributaries where access may be difficult, and presence/absence is the primary metric being assessed. This method could be paired with pathogen and/or water chemistry testing as these methods also require collecting water samples (Hallett et al. 2012; SWRCB 2018).

Environmental DNA (eDNA) sampling is considered the most simple, cost-effective approach for evaluating fish distribution at the basin scale across focal species. There is no basin-wide eDNA sampling network and this presents a good opportunity for the IFRMP to supplement the existing fish monitoring efforts. As living organisms complete their life processes their genetic material, or DNA, is shed exogenously into the surrounding environment. For aquatic and semi-aquatic species eDNA can be collected in water samples, filtered to extract eDNA, and effectively assayed to detect the presence of fish species without direct observation (Levi et al. 2018; Tillotson et al. 2018; Homel et al. 2020). For some species of concern useable DNA assays are already in place for the Klamath or already exist from other programs but for others it may require assay development or additional validation in the Klamath. eDNA methods can't currently differentiate all Klamath sub-species (fall vs. spring Chinook, steelhead vs. rainbow, Pacific lamprey from other resident lamprey), although it is hoped that this can be resolved over time. In the interim it may that eDNA would be used as an initial flag of species redistribution but would need follow-up field sampling of fish to determine actual sub-species.

Detailed eDNA protocols for the monitoring of aquatic organisms have been developed by a variety of agencies (e.g., Laramie et al. 2015; BCMOE 2017; Jerde et al. 2019; DFO 2020).

eDNA sampling is also being conducted to monitor the prevalence of fish pathogens as was described in the preceding section.

Trammel Nets: Adult Lost River suckers from the subpopulation that spawns at springs along the eastern shoreline of Upper Klamath Lake are sampled using 30-m trammel nets (Hewitt et al. 2018). Nets generally were set twice per week at each spawning area from February to May from 1999 to 2015. Additional trammel net sampling for pre-spawn adult suckers of both species was conducted from 1995 to 2017 at various staging areas in Upper Klamath Lake. Trammel nets were have also used to collect adult suckers of both species in Clear Lake for stock assessment and radio telemetry (Banet et al. 2021; Hewitt et al. 2021).

Tributary Weir: Lost River and shortnose suckers were also sampled at two locations in tributary rivers (Hewitt et al. 2018). Beginning in 2005, a resistance board weir was installed on the Williamson River at river kilometer 10 to improve capture rates of suckers during the spawning migrations. The weir restricted the passage of suckers to two short sections, each fitted with a live trap. An upstream trap was used to capture fish as they migrated upriver, and a downstream trap was left open to allow downriver migrating suckers to pass the weir. From 2000 to 2008, fish were sampled three times per week at the Chiloquin Dam fish ladder on the Sprague River. Chiloquin Dam and the associated fish ladder were removed from the river in the late summer and autumn of 2008.

Lake Ewauna Assessments: The USBR initiated as assessment of the sucker populations in Lake Ewauna and subsequently collected adults for translocation to Williamson River to augment existing spawning populations. with the goal of better understanding its population structure and demographics (ESSA 2017; Banet & Hewitt 2019). Suckers were collected by trammel net.

PIT Tagging: Suckers captured at all sample locations were identified to species and sex, measured for fork length (FL), and scanned for the presence of a passive integrated transponder (PIT) tag (Hewitt et al. 2018). If a PIT tag was not detected, one was inserted into the ventral abdominal musculature anterior to the pelvic girdle. From 1995 to 2004, suckers were tagged with 125 kHz full-duplex PIT tags. All subsequent tagging, beginning with the 2005 sampling season, has used 134.2 kHz full-duplex tags.

PIT Tag Detection Systems: Remote antennas are deployed in various locations throughout the Klamath headwaters basin to detect PIT-tagged fish (Hewitt et al. 2018; ODFW & KT 2021). Remote antennas were incorporated to improve the probability of re-encountering previously tagged suckers – data are incorporated into a capture-recapture program.[9] Suckers detected by these systems were not physically handled, but were confirmed to be alive and thus were considered live re-encounters in survival analyses. ODFW & KT (2021) also identified potential additional sites at Keno Dam, Wood River and additional Klamath headwater tributaries. PIT antenna arrays were also operated in the Clear Lake system (Banet et al. 2021).

Telemetry: Radio telemetry has long been used to identify distribution and movements of adult suckers in the upper Klamath system (Reiser et al. 2001; Banish et al. 2009). A multi-year radio telemetry study was used to assess seasonal distribution patterns for both sucker species two long-lived in Clear Lake Reservoir and its tributaries (Banet et al. 2021).

Juvenile Sampling: Suckers are sampled with trap nets to assess species-specific annual variability in production and growth, as well as annual and seasonal variability in survival of juvenile suckers in Upper Klamath and Clear Lakes (Burdick et al. 2016; Burdick & Martin 2017; Hereford et al. 2019; Bart et al. 2020; Burdick et al. 2020a, 2020b; Markle et al. 2020; Burdick et al. 2021; Hewitt et al. 2021; Martin et al. 2022; Martin et al. 2023; Martin et

[9] *Since 1995, USGS has implemented a long-term capture-recapture program to assess the status and dynamics of Lost River suckers and shortnose suckers (Hewitt et al. 2018, 2021; Martin et al. 2021; Krause et al. 2023). This program uses Cormack-Jolly-Seber (CJS) live-recapture models to obtain maximum likelihood estimates of apparent survival and re-encounter probabilities*

al. 2024). This program by USGS began in 2015. Sampling targets age-1 suckers in early June, the start of age-0 sucker catches in July, the peak of age-0 sucker catches in August, and the tail end of age-0 sucker catches in September. Wild-origin age-0 fish are also captured and brought into a hatchery for the Sucker Assisted Rearing Program.

Entrainment Monitoring: The USBR Klamath Basin Area office has been engaged in endangered sucker monitoring for nearly two decades (ESSA 2017). Monitoring of juveniles at the A Canal Fish Evaluation Station (FES) is a Monitoring and Reporting requirement within the 2013 Biological Opinion (BiOp) and is highly likely to be a component of Reclamation's Proposed Action during the current reinitiated consultation. Some level of monitoring has taken place at the FES since the A Canal fish screen and pumped bypass were constructed in 2003, though the level of sampling protocol and level of effort have only been consistent since 2012. Monitoring takes place between mid-July and late September each year with a level of effort sufficient to capture the peak of juvenile sucker abundance and estimate the number of juvenile suckers that encounter the A Canal headworks and fish screen. During this effort Reclamation crews collect bypassed age-0 and age-1 suckers at the A Canal headworks and record length, weight and affliction data for all collected suckers. In many years, FES monitoring results in the largest collection of juvenile sucker data from Upper Klamath Lake and Reclamation has partnered with the USFWS CA-NV Fish Health Center, USGS, and Oregon State University to provide samples (fish health samples, hard parts for aging/growth etc.) for additional hypothesis testing. Reclamation is providing juvenile suckers greater than 80mm standard length to the USFWS for inclusion in the Sucker Assisted Rearing Program with the goal of rearing to a larger size and treating for external parasites before reintroduction into Upper Klamath Lake.

Avian Predation: Predation by piscivorous colonial waterbirds in the Upper Klamath Basin is a source of mortality both sucker species (Banet et al. 2025). Predation rates are based on recoveries of PIT tags at breeding colonies of American White Pelicans (*Pelecanus erythrorhynchos*), Double-crested Cormorants (*Nannopterum auritum*), Caspian Terns (*Hydroprogne caspia*), California Gulls (*Larus californicus*), Ring-billed Gulls (*L. delawarensis*), Great Blue Herons (*Ardea herodias*), and Great Egrets (*A. alba*) at Upper Klamath Lake, Clear Lake Reservoir and Sheepy Lake).

Sucker Assisted Rearing Program Evaluations: Inception of the SARP in 2015 and the continued progress with captively rearing suckers was reported in Day et al. (2021). Significant monitoring and evaluation activities are conducted as part of this program.

Other studies: Investigations into the effects of disease, parasitism, and predation on survival of wild and hatchery-reared juveniles are ongoing (Markle et al. 2020; Martin et al. 2021; Evans et al. 2022). Multiple mesocosm studies were conducted using juvenile suckers to understand mortality in UKL and to inform net pen rearing operations (Hereford et al. 2019, Burdick et al. 2020, Burdick et al. 2021). A genetic tool to assist in sucker identification has been developed using restriction-site-associated DNA sequencing (Smith et al. 2020). A study by Kann and Walker (2020) analyzed a long-term data set to evaluate potential relationships between water level fluctuations and pH, un-ionized ammonia concentrations, dissolved oxygen, and chlorophyll-a . A review was also conducted to collate pertinent information on harmful cyanobacterial blooms and associated effects on juvenile LRS and SNS (Burdick et al. 2020).

3. OTHER FOCAL FISH SPECIES

3.1 Bull Trout

Bull trout monitoring in the upper Klamath Basin is limited to periodic assessments in key systems (USFWS 2015; ODFW 2016). Work is coordinated by a Klamath Recovery Unit Bull Trout Working Group which meets bi-monthly. The working group completed a bull trout reintroduction structured decision making model in 2024 through a FWS/USGS cooperative agreement. This work is directing current efforts to establish redundant populations in the Klamath Recovery unit. Key field tasks will include brook trout removal, bull trout monitoring, and reintroduction.

Sun Creek Restoration Assessment: Assessments are conducted in Sun Creek which currently supports the largest extant Bull Trout population in the Klamath Basin, located mostly within the boundaries Crater Lake National Park. Sun Creek has been a series of treatment and restoration efforts to protect and enhance the Bull Trout population.

Other Population assessments: Significant populations remain only in Sun Creek, Threemile Creek and Long Creeks (Z. Tiemann, USFWS, pers. comm. 9/17/2025). Population estimates in areas other than Sun Creek are approaching 20 years old. Population assessments were reported from 2005- 2006 for Long Creek and Boulder Creek (ODFW 2016). A mark-recapture assessment was conducted in 2008 and 2013-2014 in Long Creek (ODFW 2016). A spawning survey was conducted in 2015 in Long Creek. A mark-recapture population estimate was conducted in Threemile Creek during night snorkeling in August 2012.

PIT Tag studies were conducted in three tributaries of the Upper Sprague River in 2010-2016 (Martin et al. 2022). Fish were collected for tagging by electrofishing which provided information on distribution, relative abundance, size and growth. Detections of PIT tagged fish with portable and fixed PIT Tag arrays.

Genetics: Genetics of the Klamath bull trout populations were examined by Dehaan et al. (2008).

eDNA: Water samples were taken at 11 sites (10 Long and 1 Calahan) to monitor brook trout and bull trout in 2014 (Carim et al. 2015).

3.2 Redband Trout

Redband Trout occupy most accessible waterbodies in the upper Klamath and are subject to regular monitoring in some areas and a series of focused studies (ESSA 2017).

Spawning Surveys: Adfluvial Redband Trout populations in the Williamson River, Wood River, Crystal Creek watersheds and Kamkaun Springs on the Sprague River are monitored with annual spawning surveys (ODFW 2016).

Distribution Surveys: Redband trout distribution surveys are conducted in areas where fish habitat restoration, screening, fish passage, instream flow acquisition and rotenone treatment has occurred is planned (ODFW 2016). Priority streams include Deming Creek, Sun Creek, Annie Creek, Short Creek (Fort Creek), Upper Crooked Creek, Rock Creek (Crystal Creek) and Calahan Creek. Additionally, electrofishing surveys (two pass with blocknets) have continued (data back to 1995) as part of long term index sites on Cherry, Spencer, Long and Brownsworth creeks.

Relative Abundance Indexing: Monitoring of habitat restoration and gravel placement for adfluvial redband trout has been conducted annually in Spring Creek, Williamson River, Sunnybrook Creek, Wood River, Crooked Creek, Tecumseh Springs, Agency Creek, Wood River, Ranch Creek, and Sevenmile Creek (ODFW 2016) Relative abundance monitoring of redband trout has occurred in Sevenmile Creek and tributaries Crane and Short creeks.

PIT Tag Studies: USGS has PIT tagged adfluvial redband trout in Upper Klamath Lake and Williamson River to determine relative abundance and proportion of redband trout migrating into the three large river systems (Wood

River, Williamson River, and Sprague River) from Upper Klamath and Agency Lakes and obtain timing of movements out of Upper Klamath and Agency Lakes (ODFW 2016).

Telemetry: Telemetry studies in 2016 and 2017 tagged adults in upper Klamath Lake and monitored migration patterns.

3.3 Lamprey

There are no comprehensive monitoring programs for Pacific lamprey in the Klamath Basin (ESSA 2017). Pacific lampreys do not home strongly to streams where they were spawned which makes monitoring Pacific lamprey populations challenging. Most data comes from incidental observations during salmonid monitoring efforts. Juvenile lamprey data is available from outmigrant trapping efforts throughout the basin. They are also commonly observed during instream restoration projects, as well as during fish screen maintenance on water diversion structures.

In 2006, the Yurok Tribal Fisheries Program initiated a pilot study using sonic (acoustic) telemetry to assess the movements and distribution of migrating Pacific lamprey in the Klamath River and associated tributaries (McCovey and Benson 2006). Fourteen individuals were tagged, and no detections were made over the course of the study. Although the results suggest that acoustic telemetry may not be a feasible method to study Pacific lamprey, recent advances in acoustic telemetry technology (e.g., Jsat tags) have likely made it a feasible tool for use today.

In 2008, the Pacific Lamprey Conservation Initiative (PLCI) was formed by Native American Tribes, federal, state, and local agencies, and non-government organizations for the purposes of achieving long term persistence of Pacific lamprey and their habitats, and to support traditional Tribal uses of Pacific lamprey across their historical range (Pacific Lamprey Conservation Initiative 2022). The PLCI maintains a data repository with general Pacific lamprey distribution data, including the Klamath River Basin. This data is available on the PLCI web page at www.pacificlamprey.org/.

3.4 Green Sturgeon

Monitoring of Klamath Green Sturgeon is limited (Moser et al. 2016; ESSA 2017). Some data is available from annual Yurok tribal fishery harvest and associated work of a few hundred spawning adults. A Yurok Tribal subsistence fishery occurs in a 44 mile stretch of the Klamath River from the mouth to above the confluence with the Trinity River (Doukakis 2014).

Radio and/or sonic telemetry tagging and tracking studies were reported for 2007-2010 (Benson et al. 2007; McCovey et al. 2009, 2010).

Cooperative work used Dual Frequency Identification Sonar (DIDSON) surveys to obtain abundance estimates (Mora 2012).

3.5 Eulachon

Monitoring of Eulachon in the Klamath Basin is limited (ESSA 2017). Periodic survey data has been collected by the Yurok Tribal Fisheries Program.

PART 3 - MONITORING FRAMEWORK

Fish monitoring subjects are organized in this planning framework by basin area and species focus, based on the inventory of current monitoring activities in the basin (Figure 15). There are many different combinations of ways that monitoring activities might be grouped for planning purposes (key application questions, what is being measured, area of the basin, specific location, species, life stage, methodology, project implementers, funding program, funding source, etc.). None are perfect from every perspective. This plan used a subjectively hybrid approach to provide some semblance of organization to the complex of fish monitoring underway in the region. Tasks are defined by specific purpose, species/life stage and/or areas of focus. Activities identify specific monitoring types, life stages, seasons, locations and who is primarily responsible for the work. Specific species and key questions/applications addressed by the activity are identified for each activity.

1. Lower-Mid Klamath Salmon & Steelhead Adults

- ***Fall Chinook, Spring Chinook, Steelhead & Coho***

2. Lower-Mid Klamath Salmon & Steelhead Juveniles

- ***Juvenile migration, numbers, distribution & attributes***

3. Trinty Salmon & Steelhead Adults

- ***Fall Chinook, Spring Chinook, Steelhead & Coho***

4. Trinty Salmon & Steelhead Juveniles

- ***Juvenile migration, numbers, distribution & attributes***

5. Upper Klamath Salmon & Steelhead

- ***Adults & juveniles in the dam removal reach***

6. Klamath Headwaters Salmon & Steelhead

- ***Adults & juveniles throughout the upper basin***

7. Salmon & Steelhead Fisheries

- ***Spring & Fall Tribal & non-tribal catch & participation***

8. Salmon & Steelhead Hatcheries

- ***Fall Creek & Trinity River production & returns***

9. Lost River & Shortnose Suckers

- ***Stock status, recruitment factors & hatchery supplementation***

10. Other Focal Species

- ***Bull trout, Redband Trout, Lamprey, Green Sturgeon, Eulachon***

11. Coordination & Data Management

- ***Work group, workshop, databases***

Figure 15. Fish monitoring subjects identified for the purposes of this plan.

1. LOWER-MID KLAMATH SALMON & STEELHEAD ADULTS

Related Questions

- ✓ What is the status of anadromous fish species in relation to basin capacity, natural escapement and conservation objectives?
- ✓ What is the spatial distribution of spawning in the mainstem and tributaries?
- ✓ What are the trends in abundance, productivity and distribution over time?
- ✓ What are the biological characteristics of the Klamath Basin return?
- ✓ What is the hatchery:wild composition of the run?
- ✓ What factors limit and abundance and production of anadromous fish species?

1.1 Task: Monitor Fall Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin.[10]

Fall Chinook are intensively monitored throughout the basin in support of the long-term sustainability of this stock which is subject to high-value fisheries in freshwater and the ocean. The current monitoring program includes a comprehensive annual assessment of the Fall Chinook return to the river and to natural spawning escapements. All significant mainstem and tributary spawning areas are monitored in order to produce a census estimate of the entire run. Fish are counted by a combination spawning ground surveys and weirs equipped with video cameras or fish traps. Spawning ground surveys typically count live fish, fish redds and fish carcasses. Biological data on age hatchery:wild composition and pre-spawn mortality is collected in weir traps and carcasses encountered in spawning surveys. Comprehensive surveys identify spawning distribution throughout the basin. Productivity is estimated from spawners and corresponding brood year adult recruits in subsequent years.

Comprehensive monitoring data of Fall Chinook provide robust estimates of stock status and detailed information needed for sustainable fishery management. Spawning escapement is the essential metric for monitoring natural stock status while effective fishery requires a more comprehensive suite of information including the total basin return and biological composition. Tier 1 activities below are identified based on their applicability to stock status and fishery management. Tier 2 activities also contribute to comprehensive status and management assessments but potentially provide opportunities for scaling monitoring efforts in areas where other data are available or where fish numbers are relatively small in relation to the total run.

Numerous basin partners participate in annual escapement monitoring including the Hoopa Valley Tribe, Karuk Tribe, Mid-Klamath Watershed Council, Northern California Resource Center, Quartz Valley Indian Reservation, Siskiyou Resource Conservation District, Salmon River Restoration Council, U.S. Forest Service, USFWS, AmeriCorps Watershed Stewards Program, Yurok Tribe, and CDFW (CNRS & CDFW 2024, KRTT 2024).

1.1.1 Activity: Fall spawning ground surveys for Fall Chinook in the mainstem Klamath downstream from the Iron Gate site.

1.1.2 Activity: Fall spawning ground surveys for Fall Chinook in the Salmon River.

1.1.3 Activity: Fall spawning ground surveys for Fall Chinook in Shasta River, Scott River and Bogus Creek.

1.1.4 Activity: Fall spawning ground surveys for Fall Chinook in other lower Klamath tributaries.

1.1.5 Activity: Fall spawning ground surveys for Fall Chinook in other middle Klamath tributaries.

1.1.6 Activity: Fall adult video weir counts for Fall Chinook in the Shasta River, Scott River and Bogus Creek.

[10] *This task identifies long-standing Fall Chinook stock assessment activities in areas downstream from the Iron Gate damsite. Related activities upstream from the damsite are detailed under Section 5.*

1.2 Task: Monitor Coho adult abundance, distribution & attributes in the Lower-Mid Klamath Basin.[11]

For the purposes of recovery, NMFS (2014) categorizes Coho populations as core (Lower Klamath, Scott, Shasta, Upper Klamath, Lower Trinity, Upper Trinity) or non-core (Middle Klamath, Salmon, South Fork Trinity). The Recovery Plan recommends that, at a minimum, adults and juveniles should be monitored in all Core and Non-Core Klamath Coho populations.

Long-term population-level estimates of abundance are available only for the Shasta and Scott Rivers, both based on video counts at weirs. A weir has periodically also been operated on Bogus Creek. There are long-term population aggregate abundance estimates in the Trinity River based on mainstem weirs. Spawning surveys provide additional information on Coho escapements in other areas including the Klamath River mainstem, Klamath tributaries, and Trinity tributaries. Spawner surveys generally provide index rather than census level information on relative abundance and trends due to inclusion of only a portion of the distribution or run timing of the subject population. For instance, spawn timing of Coho extends later into the fall and even early winter than that of Fall Chinook which are the primary focus of many spawning ground surveys. Survey conditions in late fall are often unfavorable for Coho due to high flows and turbidity associated with fall rains which stimulate Coho spawning migrations.

1.2.1 Activity: Late Fall[12] spawning ground surveys for Coho in the mainstem Klamath downstream from the Iron Gate site.

1.2.2 Activity: Late Fall spawning ground surveys for Coho in the Salmon River.

1.2.3 Activity: Late Fall spawning ground surveys for Coho in the Shasta River, Scott River and Bogus Creek.

1.2.4 Activity: Late Fall spawning ground surveys for Coho in other lower-middle Klamath tributaries.

1.2.5 Activity: Late Fall adult video weir counts for Coho in the Shasta River, Scott River and Bogus Creek.

1.3 Task: Monitor Spring Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin.

The current monitoring program includes an annual assessment of the Spring Chinook return to the river and to natural spawning escapements. All significant mainstem and tributary spawning areas are monitored in order to produce a census estimate of the entire run. Fish are counted by a combination spawning ground surveys and weirs equipped with video cameras or fish traps. Spawning ground surveys typically count live fish, fish redds and fish carcasses. Biological data on age and hatchery:wild composition is collected in weir traps and carcasses encountered in spawning surveys. Stock assessments are a cooperative effort of a number of basin partners.

1.3.1 Activity: Summer snorkel survey of Spring Chinook in the Salmon River.

1.3.2 Activity: Summer spawning ground surveys for Spring Chinook in other lower Klamath tributaries.

[11] *This task identifies stock assessment activities in areas downstream from the Iron Gate damsite. Related activities upstream from the damsite are detailed under Question 4 for dam removal effects.*

[12] *Coho run timing identified as "late" Fall in recognition of later and more extended run timing of Coho than Fall Chinook which are often assessed with the same efforts.*

1.4 Task: Monitor Steelhead/O. mykiss adult abundance, distribution & attributes in the Lower-Mid Klamath Basin.

Current monitoring efforts focused on adult fall and winter Steelhead in the Klamath Basin are limited (CNRA & CDFW 2024). Video monitoring conducted by CDFW on the Shasta River, Scott River, and Bogus Creek provide adult fall and winter Steelhead counts but video monitoring is often terminated in December or January due to high flow events or other limitations and did not capture the full migration period. Since 1985, the USFS has conducted summer Steelhead holding counts by snorkeling in tributaries located on or adjacent to lands administered by the USFS Orleans and Happy Camp Ranger districts in the lower Klamath River. The Salmon River Restoration Council conducts annual snorkel surveys for spring-run Chinook salmon and summer Steelhead on the Salmon River.

1.4.1 Activity: Summer snorkel surveys in selected lower Klamath tributaries to count summer steelhead.

2. LOWER-MID KLAMATH SALMON & STEELHEAD JUVENILES

Related Questions

- ✓ Hom many juvenile salmonids are being produced by different areas of the basin?
- ✓ What are juvenile disease rates in spring?
- ✓ What is the adult disease rate in the late summer or fall?
- ✓ How is water management affecting fish management and behavior?
- ✓ How might water management actions affect chinook outmigrants survival and abundance to the ocean?
- ✓ What is the level of (insert species) disease during outmigration and how does this change over time?
- ✓ What changes to water quality has dam removal had in the basin?
- ✓ Higher flows, cooler temps encourage Fall chinook survival?
- ✓ Are multimillion dollar restoration projects moving the needle?
- ✓ What factors limit distribution and abundance of anadromous fish species?
- ✓ What areas do we still need to work on to improve habitat?
- ✓ Is restoration working and how do we know? What hard stick are we using to say whether the needle is being moved?
- ✓ What fish monitoring can we do that can inform us of the habitat (process and parts) necessary to support sustainable fish populations and communities?
- ✓ How has juvenile productivity changed over time in response to habitat status?

Monitoring juvenile outmigrants provides information on abundance, productivity and life history. This monitoring is also critical to assessment of the effects of water management including the response to implementation of the 2000 ROD (e.g., Pinnix et al 2022). Information is produced on Spring Chinook, Fall Chinook, Coho and Steelhead.

2.1 Task: Monitor juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath mainstem.

The Arcata Fish and Wildlife Office of the USFWS and its Tribal partners operate rotary screw traps and frame nets each spring and summer during the juvenile Chinook and Coho salmon emigration period to estimate the timing, abundance and condition of outmigrant juvenile salmon at locations on the Klamath River. Mark-recapture information estimates characteristics and abundance of outmigrant populations on a weekly-stratified basis, which are used to calibrate and validate a Stream Salmonid Simulator Population Dynamics Model (S3 Model). These data also inform managers in real-time on population levels and effects of infectious diseases for both Chinook and Coho salmon.

2.1.1 Activity: Juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey during spring and summer in the mainstem Klamath River at the Weitchpec site above the Trinity River confluence.

2.1.2 Activity: Juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey during spring and summer in the mainstem Klamath River at Kinsman and Big Bar sites between the Shasta and Trinity Rivers.

2.1.3 Activity: Juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey during spring and summer in the Mainstem Klamath River at I5 and Bogus Creek sites between the Iron Gate Dam site and the Shasta River.

2.1.4 Activity: Acoustic telemetry of juvenile Chinook in the mainstem Klamath to evaluate outmigration survival and timing.

2.2 Task: Monitor juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath tributaries.

Information on juvenile Coho distribution and relative abundance is also widely available in tributary and mainstem outmigrant trapping, snorkel surveys and habitat assessments. Stock assessments are a cooperative effort of several basin partners.

2.2.1 Activity: Spring juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey in Scott River, Shasta River and Bogus Creek.

2.2.2 Activity: Spring juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey in the Salmon River.

2.2.3 Activity: Spring juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey in lower Klamath tributaries (Blue, McGarvey, etc.).

2.3 Task: Monitor juvenile salmonid distribution & attributes in Lower-Mid Klamath tributaries.

2.3.1 Activity: Summer snorkel surveys of juvenile coho in Lower Klamath tributaries.

2.3.2 Activity: Monitor juvenile Coho in lower Klamath tributaries with PIT tags and tag detection arrays.

2.3.3 Activity: Summer snorkel surveys of juvenile Coho in middle Klamath tributaries.

2.3.4 Activity: Monitor juvenile Coho with seines and traps in middle Klamath tributaries for assessment of habitat restoration effectiveness.

2.3.5 Activity: Monitor juvenile Coho in middle Klamath tributaries with PIT tags and tag detection arrays.

2.3.6 Activity: Summer snorkel surveys in document distribution, relative abundance and habitat use of juvenile Chinook, Coho and O. mykiss in the Salmon, Scott and Shasta Rivers in relation to habitat restoration.

2.3.7 Activity: Monitor juvenile Coho and O. mykiss with seines and traps in the Salmon, Scott and Shasta Rivers to evaluate habitat use and life history.

2.3.8 Activity: Monitor juvenile Coho in the Shasta and Scott Rivers with PIT tags and tag detection arrays.

2.4 Task: Monitor & evaluate juvenile salmonid health in the Lower-Mid Klamath Basin.

A basin wide fish disease monitoring program is currently led by the USFWS and Oregon State University in coordination with others including NOAA Fisheries, U.S. Bureau of Reclamation, CDFW, the Karuk Tribe, and the Yurok Tribe. Prevalence of mortality estimates for juvenile Coho and Chinook collected and processing for *C. shasta* infection at juvenile monitoring sites completed by USFWS that are completed by Karuk and Yurok Tribes and Oregon State University. Monitoring is also conducted based on the parasite's life cycle including sentinel fish exposures, annelid host sampling and molecular quantification of parasite DNA in water samples.

2.4.1 Activity: Estimate prevalence of mortality in juvenile Coho and Fall Chinook sampled at Klamath River monitoring sites based on C. Shasta infection.

2.4.2 Activity: Conduct C. Shasta life cycle monitoring based on sentinel fish exposures, annelid host sampling and molecular quantification of parasite DNA in water samples.

2.5 Task: Evaluate juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath Basin.

The Stream Salmonid Simulator S3 Model was developed and implemented by the USGS as a decision-support tool to aid in water and basin management (Bartholow et al. 2002; Perry et al. 2018, 2019, 2023; Plumb et al. 2019). The tool consists of an integrated subset of models used to predict the effects of water management alternatives on movement, health, and production of juvenile Chinook salmon (ESSA 2017). The model tracks cause of mortality (i.e., red scour, habitat limitations, disease, water quality, etc.) over time throughout the sub-adult life history of Chinook salmon within the 223-mile section of the mainstem Klamath River spanning from Keno Dam in Oregon to its confluence with the Pacific Ocean in California. The 2024 Biop calls for continued funding by the USBR for updates to the S3 Population Dynamics Model with contemporary data on hatchery production and *C. shasta* spore concentrations.

2.5.1 Activity: Analysis of Stream Salmonid Simulator (S3) model based on annual juvenile salmonid outmigrant trap data to estimate production of Fall Chinook in the lower Klamath River.

2.5.2 Activity: Analysis of Stream Salmonid Simulator (S3) model based on annual juvenile salmonid outmigrant trap data to estimate production of Coho in the lower Klamath River.

3. TRINITY SALMON & STEELHEAD ADULTS

3.1 Task: Monitor Fall Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin.

3.1.1 Activity: Fall adult weir counts of Fall Chinook in the Trinity River mainstem near Willow Creek and Junction City.

3.1.2 Activity: Fall spawning ground surveys of Fall Chinook in the Trinity River mainstem downstream from Willow Creek Weir.

3.1.3 Activity: Fall spawning ground surveys of Fall Chinook in the Trinity River mainstem upstream from Willow Creek Weir.

3.2 Task: Monitor Coho adult abundance, distribution & attributes in the Lower-Mid Klamath Basin.

3.2.1 Activity: Late Fall adult weir counts of Coho in the Trinity River mainstem to assess Coho status.

3.2.2 Activity: Late Fall spawning ground surveys of Coho in Trinity River tributaries. *Error! Bookmark not defined.*

3.3 Task: Monitor Spring Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin.

3.3.1 Activity: Summer adult weir counts and mark-recapture estimates of Spring Chinook in the Trinity River mainstem.

3.3.2 Activity: Summer spawner surveys in the South Fork Trinity River to assess Spring Chinook status.

3.3.3 Activity: Summer spawner surveys in other Trinity River tributaries to assess Spring Chinook status.

3.4 Task: Monitor Steelhead/O. mykiss adult abundance, distribution & attributes in the Lower-Mid Klamath Basin.

3.4.1 Activity: Summer snorkel surveys in selected Trinity River tributaries to count summer steelhead.

4. Trinity Salmon & Steelhead Juveniles

4.1 Task: Monitor juvenile salmonid migration, numbers & attributes in the Trinity mainstem.

4.1.1 Activity: Juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey during spring and summer in the in Trinity River mainstem at Willow Creek.

4.1.2 Activity: Juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey during spring and summer in the Trinity River mainstem at Pear Tree Gulch.

4.2 Task: Monitor juvenile salmonid migration, distribution, numbers & attributes in the Trinity tributaries.

4.2.1 Activity: Juvenile outmigrant with fyke nets for out-migrating juvenile Chinook, Coho and Steelhead lower Trinity River tributaries (Campbell, Hostler, Mill, Pine, Soctish, Supply, and Tish Tang Creeks).

4.2.2 Activity: Summer snorkel surveys of juvenile Chinook, Coho and O. mykiss in upper Trinity and South Fork Trinity tributaries.

4.3 Task: Evaluate juvenile salmonid migration, numbers & attributes in the Trinity Basin

4.3.1 Activity: Analysis of Stream Salmonid Simulator (S3) model based on annual juvenile salmonid outmigrant trap data to estimate production of Fall Chinook in the lower Klamath River.

5. UPPER KLAMATH SALMON AND STEELHEAD (DAM REMOVAL REACH)

Related Questions

- ✓ Are adult anadromous fishes migrating upstream past the former dam sites, and if so, what is their abundance and species composition?
- ✓ What tributaries or parts of the river are being utilized and how are they arranged on the landscape?
- ✓ What thermal refugia areas are fish utilizing in the new reach?
- ✓ What is the timing and survival of outmigration?
- ✓ Are there fine scale differences in migration runs?
- ✓ What factors are affecting survival.
- ✓ How are recruits per spawner changing over time?
- ✓ How has the fall chinook population downstream responded to dam removal?
- ✓ Where are the bottlenecks for juvenile and adult salmon in the dam removal reach?
- ✓ What barriers exist to reintroduction of anadromous fishes - Are there limit barriers to success that we don't fully understand?
- ✓ What is the environmental condition of the river basin post dam removal, (water quality, riparian)?
- ✓ What actions might we take if they are trying to migrate during known poor water quality?

5.1 Task: Monitor anadromous adult abundance, distribution & attributes in the dam removal reach mainstem.

Returns of Fall Chinook, Coho, Steelhead and Lamprey to the mainstem and tributaries between the Iron Gate Dam site and Keno Dam are being or are planned to be assessed with a combination of spawning ground surveys, adult weirs, and sonar. Spawning ground surveys are generally effective for identifying presence, distribution, timing and relative abundance of returning adults. Carcass sampling in these surveys provides information on run characteristics (e.g., age, size, sex, prespawn mortality, hatchery contribution). A robust statistical design may also allow estimates of total return. Video weirs generally provide robust estimates of total escapement. Sonar is a promising technology for quantifying fish numbers in large rivers and is being tried in the Klamath.

5.1.1 Activity: Fall-Winter spawning ground surveys for Chinook, Coho, Steelhead and Lamprey in the Klamath River mainstem between the Iron Gate Dam site and Keno Dam to assess stock status.

5.1.2 Activity: Fall-Winter adult sonar counts of Chinook, Coho and Steelhead in the Klamath River mainstem near the Iron Gate damsite to assess stock status. [13]

5.1.3 Activity: Capture and release returning adult Chinook, Coho, and Steelhead near the Iron Gate damsite for species identification, PIT tagging and radio tagging.

5.1.4 Activity: Telemetry survey of Klamath mainstem and tributaries for the presence of returning adult salmon radio-tagged near the Iron Gate damsite.

[13] *Tier 2 recognizes the trial exploration of this technology and the corresponding challenges of species apportionment. Category could be modified if the methodology proves out.*

5.2 Task: Monitor anadromous adult abundance, distribution & attributes in the dam removal reach tributaries.

5.2.1 Activity: Fall-Winter spawning ground surveys for Chinook, Coho, Steelhead and Lamprey in California tributaries (Scotch, Camp, Jenny, Fall, Shovel creeks) to assess stock status.

5.2.2 Activity: Fall-Winter spawning ground surveys for Chinook, Coho, Steelhead and Lamprey in Oregon tributaries (e.g., Spencer Creek) to assess stock status.

5.2.3 Activity: Fall-Winter adult video weir counts for Chinook, Coho, Steelhead and Lamprey in California tributaries (Scotch/Camp, Jenny, Shovel Creeks) to assess stock status.

5.2.4 Activity: Fall-Winter adult video weir counts of Chinook, Coho, Steelhead and Lamprey in Oregon tributaries (Spencer Creek) to assess stock status.

5.2.5 Activity: Fall-Winter adult video weir counts of Chinook, Coho, Steelhead and Lamprey in Oregon portion of the Klamath River mainstem to assess stock status. [14]

5.3 Task: Monitor juvenile salmonid migration, numbers & attributes in the dam removal reach mainstem & tributaries.

Successful reproduction and productivity are estimated by juvenile outmigrant trapping and snorkel surveys. PIT tagging and PIT tag arrays provide information on juvenile survival and movements. Snorkel surveys are particularly useful for identifying successful reproduction, distribution, relative abundance, and habitat use. outmigrant traps provide robust estimates of total production of juveniles, juveniles per adult, migration timing and individual fish sampling opportunities when used in conjunction with adult escapement estimates.

5.3.1 Activity: Juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey in Klamath River mainstem between Shovel and Spencer Creeks to assess production.

5.3.2 Activity: Spring juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey in California tributaries (Scotch/Camp, Jenny, Fall, Shovel Creeks) to assess production.

5.3.3 Activity: Spring juvenile outmigrant trapping of Chinook, Coho, Steelhead and Lamprey in Oregon tributaries (e.g., Spencer Creek) to assess production.

5.4 Task: Monitor juvenile salmonid distribution & attributes in dam removal reach tributaries.

5.4.1 Activity: Summer juvenile snorkel surveys for Coho and O. mykiss in California tributaries (Scotch/Camp, Jenny, Fall, Shovel Creeks).

5.4.2 Activity: Summer Juvenile snorkel and/or electrofishing surveys for Coho and O. mykiss in Oregon tributaries (e.g., Spencer Creek).

5.4.3 Activity: Juvenile PIT tagging and tag detection arrays in California tributaries (Scotch/Camp, Jenny, Fall, Shovel Creeks).

5.4.4 Activity: Juvenile PIT tagging and tag detection arrays in Oregon tributaries (e.g., Spencer Creek).

[14] *Identified in the Oregon Plan but assumed to be secondary to Keno and Link River Dam counts.*

6. KLAMATH HEADWATERS SALMON & STEELHEAD

Related Questions

- ✓ Are anadromous fish reaching Keno and Link River Dams, and if so, how many, what species and when?
- ✓ Do fish ladders at Keno and Link River dams effectively pass adult salmon, Steelhead and lamprey upstream without significant delay or mortality?
- ✓ Are adult anadromous fishes migrating above Keno Dam and Link River Dam, through upper Klamath lake, and into headwater tributaries?
- ✓ What is the timing, distribution, abundance and species composition of anadromous adults in headwater subbasins?
- ✓ What is the productivity, emigration timing, and health of juvenile fishes in headwater subbasins?
- ✓ Are juvenile salmon and Steelhead tagged in the Klamath headwaters surviving to reach Keno and Link River Dams in their downstream migration?
- ✓ Are anadromous life histories being expressed by O. mykiss above the former dam sites?
- ✓ What life histories are expressed by anadromous fishes and which ones are dominant?
- ✓ What is the genetic diversity and characterization of anadromous fishes?
- ✓ How does genetic diversity of Pacific Lamprey and Steelhead trout compare to the resident populations?
- ✓ To what extent are the reintroduction plans being implemented in Oregon and California)?
- ✓ What is the success of re-introduction methods?
- ✓ What genetic considerations or questions in reintroduction strategies for these various species?
- ✓ In the case of active reintroduction/re-establishment from natural donor stocks, are there effects on natural stocks from management actions?
- ✓ How can we utilize information we are learning about habitat needs and life history of wild spring run from new genetic research to inform successful recolonization of the upper basin?
- ✓ What kind of diseases might salmon introduce and how might that affect suckers and trout?

6.1 Task: Assess anadromous fish adult runs to and through upper Klamath River dams.

Fish ladders can be effective counting structures for adult fish with the addition of video cameras or fish collection with the addition of traps. PIT tag arrays operated at or near dams allow for monitoring of adult and juvenile passage of fish tagged in upstream or downstream areas (numbers, timing, survival). Operation of PIT sonar arrays provide an indication of movements and survival of juvenile salmonids outmigrants from Klamath headwaters areas downstream through Klamath Lake. Given sufficient detection efficiencies and sample sizes, sequenced arrays potentially also have the capability of producing absolute estimates of juveniles Sampling power will likely depend on sample sizes due to limited tag numbers and detection efficiencies.

6.1.1 Activity: Daily video or trap counts of Chinook, Coho, O. mykiss and Lamprey in the Keno Dam fish ladder to assess passage.

6.1.2 Activity: Daily video or trap counts of Chinook, Coho, O. mykiss and Lamprey in the Link River Dam fish ladder to assess passage.

6.1.3 Activity: Radio tag and/or PIT tag a sample of adult of Chinook, Coho, and O. mykiss collected in fish ladders to monitor upstream distribution and movements.

6.1.4 Activity: PIT tag detection array for monitoring adult and juvenile salmonids at Link River Dam.

6.1.5 Activity: PIT tag detection array for monitoring adult and juvenile salmonids at Keno Dam.

6.2 Task: Monitor anadromous adult abundance, distribution & attributes in Klamath Basin headwaters.

While Fall Chinook, Coho, Steelhead and Lamprey may volitionally migrate into Klamath Basin headwater streams following mainstem dam removal, prospects for natural recovery are uncertain. Oregon and the Klamath Tribes have also developed an active reintroduction plan for spring-run Chinook Salmon (ODFW & KT 2021). The reintroduction plan describes a phased approach to monitoring based on how things unfold. Monitoring has been implemented to assess numbers and distribution of anadromous fish that migrate to and through Klamath Lake into suitable habitats upstream. Detection of migrating adults at Keno Dam and/or Link River Dam Fish Ladder will trigger the initiation of additional monitoring activities in Upper Klamath Lake and its tributaries. Ideally, a proportion, if not all, adults encountered at Keno Dam and/or Link River Dam fish ladders will be sampled and tagged with telemetry and/or PIT tags.

6.2.1 Activity: Fall-late Fall reconnaissance-level surveys for the presence of live or dead adult Chinook, Coho or O. mykiss in the Sprague, Williamson, and Wood Rivers.

6.2.2 Activity: Fall-late Fall spawning ground surveys for Chinook, Coho, Steelhead and Lamprey in the Sprague and Wood Rivers.

6.2.3 Activity: Fall-late Fall adult video weir counts in the Williamson River to assess stock status at such time as significant numbers of Chinook, Coho or Steelhead have been observed to return.

6.2.4 Activity: Survey Klamath Lake and tributaries for the presence of Chinook, Coho, or O. mykiss that were radio-tagged downstream.

6.3 Task: Monitor juvenile salmonid migration, distribution & attributes in Klamath Basin headwaters.

As fish populations become more widely established, monitoring will become more specific and focused on management objectives, such as determining the productivity and emigration timing of juveniles from each sub-basin (ODFW & KT 2021).

PIT tag arrays operated throughout Klamath Lake and tributaries for assessment of Lost River Suckers and Shortnose Suckers also provide the opportunity to monitor the presence, movements and distribution of adult and juvenile salmon throughout the system.

6.3.1 Activity: Spring juvenile outmigrant trapping of Chinook, Coho, O. mykiss and Lamprey in the Sprague, Williamson, and Wood Rivers.

6.3.2 Activity: Juvenile PIT tagging in the Sprague, Williamson, and Wood Rivers to monitor migration behavior and survival post release of Chinook, Coho, and O. mykiss.

6.3.3 Activity: Release PIT-tagged hatchery juvenile Spring Chinook in Klamath Lake tributaries to monitor migration behavior and survival post release.

6.3.4 Activity: PIT tag detection arrays in the Sprague, Williamson, and Wood Rivers to monitor migration behavior and survival.

6.3.5 Activity: PIT tag detection arrays in other Klamath Lake tributaries to monitor migration behavior and survival.

6.3.6 Activity: PIT tag detection arrays for Spring Chinook in Klamath Lake to monitor migration behavior and survival.

7. Salmon and Steelhead Fisheries

Related Questions

- ✓ How many salmon are harvested in Klamath Basin fisheries?
- ✓ Is harvest consistent with established objectives?

7.1 Task: Monitor and evaluate fall season fisheries for Klamath Fall Chinook & Coho.

Numbers and biological characteristics of fishery harvest are surveyed each year by the responsible management authorities. Surveys generally include counts of participants and interviews or questionnaires to determine catch, effort and catch composition. The Yurok Tribe monitors their primarily-gillnet subsistence, ceremonial and sometimes commercial fisheries within the lower 44 miles of the Klamath River (Williams 2015). The Hoopa Valley Tribal Fisheries Department surveys their gillnet, hook-and-line and weir fisheries within the Hoopa Valley Reservation in the Trinity River between miles 2 and 12 (NMFS 2022; HVTFD 2023). The HVT also surveys non-tribal recreational anglers in the lower 13-22 miles of Trinity River in years when they occur. CDFW conducts a creel survey of recreational anglers in the Lower Klamath from the Pacific Ocean to the Iron Gate damsite during fall in years when the fishery is open (Troxel & Lindke 2019, 2020, 2021).

7.1.1 Activity: Annual fall season harvest survey of Yurok Tribe fisheries for Fall Chinook and Coho.

7.1.2 Activity: Annual fall season harvest survey of Hoopa Valley Tribe fisheries for Fall Chinook and Coho.

7.1.3 Activity: Annual fall season harvest survey of other tribal fisheries for Fall Chinook and Coho.

7.1.4 Activity: Annual fall season harvest survey of non-tribal tribal fisheries for Fall Chinook and Coho.

7.1.5 Activity: Annual assessment of the Fall Chinook return to the Klamath River including natural escapement, hatchery escapement, in-river harvest and run to river.

7.1.6 Activity: Annual assessment of the Coho return to the Klamath River including run size, hatchery escapement, and harvest.

7.2 Task: Monitor and evaluate spring season fisheries for Klamath Spring Chinook.

Fisheries are surveyed each year by the responsible management authorities. Surveys generally include counts of participants and interviews or questionnaires to determine catch, effort and catch composition. Related assessments of numbers and harvest include run reconstructions based on estimate escapement of hatchery and natural spawners by area, in-river harvest by fishery and total run size of adults and jacks to the river. This information is compiled each year and reported in the form of a "megatable" by the CDFW.

7.2.1 Activity: Annual spring season harvest survey of Yurok Tribe fisheries for Spring Chinook.

7.2.2 Activity: Annual spring season harvest survey of Hoopa Valley Tribe fisheries for Spring Chinook.

7.2.3 Activity: Annual spring season harvest survey of non-tribal tribal fisheries for Spring Chinook.

7.2.4 Activity: Annual run reconstruction of Spring Chinook return to the Klamath River including natural escapement, hatchery escapement, in-river harvest and run to river.

8. Salmon & Steelhead Hatcheries

Related Questions

- ✓ What is the role and goal of hatcheries in the basin?
- ✓ What is the survival and return from hatchery releases?
- ✓ How many hatchery fish are needed to meet goals?
- ✓ Can natural production of chinook take the place of hatchery production at Fall Creek?

8.1 Task Fall Creek Hatchery Evaluation

8.1.1 Identify numbers of juvenile of Fall Chinook and Coho released from Fall Creek Hatchery by year and life stage.

8.1.2 Mark and/or coded wire tag samples of Fall Creek Hatchery juvenile releases of Fall Chinook and Coho for subsequent evaluation.

8.1.3 Document Fall Creek Hatchery broodstock and production processes for Fall Chinook and Coho relative to established genetic management plan requirements.

8.1.4 Count numbers of Fall Chinook and Coho returning to the Fall Creek Hatchery.

8.1.5 Collect age, sex, length, mark and coded wire tag information on Fall Chinook and Coho in Fall Creek Hatchery returns.

8.1.6 Identify Fall Creek Hatchery contributions of Fall Chinook and Coho in natural spawning areas.

8.1.7 Estimate the Fall Creek Hatchery return of Fall Chinook and Coho.

8.2 Task: Trinity River Hatchery Evaluation

8.2.1 Identify numbers of Spring Chinook, Fall Chinook, Coho and Steelhead juveniles released by year and life stage.

8.2.2 Mark and/or coded wire tag samples of Trinity Hatchery juvenile releases of Spring Chinook, Fall Chinook, Coho and Steelhead for subsequent evaluation.

8.2.3 Document hatchery broodstock and production processes relative to established genetic management plan requirements.

8.2.4 Count numbers of Spring Chinook, Fall Chinook, Coho and Steelhead returning to Trinity Hatchery.

8.2.5 Collect age, sex, length, mark and coded wire tag information for Spring Chinook, Fall Chinook, Coho and Steelhead in Trinity Hatchery returns.

8.2.6 Identify Trinity Hatchery contributions of Spring Chinook, Fall Chinook, Coho and Steelhead in natural spawning areas.

8.2.7 Estimate the Trinity River hatchery return of Spring Chinook, Fall Chinook, Coho and Steelhead.

9. LOST RIVER SUCKER & SHORTNOSE SUCKER

Related Questions

- What is the long-term viability of Lost River and Shortnose suckers in relation to ESA recovery criteria and goals?
- What are the status and trends in abundance and population dynamics?
- How are suckers arranged on the landscape?
- What is limiting sucker recruitment?
- Why are suckers dying and what can be done about it?
- What is the effectiveness of artificial propagation/assisted rearing for conservation?
- How are juvenile suckers from the hatchery contributing to the wild populations
- When could we phase out hatchery production? (Is this a goal?)
- How do we monitor to understand patterns of sucker movement in the Lost River system?
- How do suckers interact with large scale restoration projects?
- Salmon are now part of the upper basin, how are they interacting with suckers?

9.1 Task: Stock assessment – What is the abundance, productivity, spatial structure, diversity of Lost River Suckers and Shortnose Suckers in the Klamath Basin?

9.1.1 Activity: Annual adult sampling in upper Klamath Lake by trammel net to evaluate population characteristics & tag Lost River and Shortnose Suckers for population estimation

9.1.2 Activity: Annual juvenile sampling in upper Klamath Lake by trap net to evaluate Lost River and Shortnose Sucker juvenile production

9.1.3 Activity: Operation of PIT tag arrays continuously throughout upper Klamath Lake and tributaries for capture-recapture Lost River and Shortnose Sucker population estimates

9.1.4 Activity: Annual weir sampling in Williamson River in spring for Lost River and Shortnose Sucker population assessment.

9.1.5 Activity: Annual Lost River and Shortnose Sucker population assessments in Clear Lake by trammel and trap net.

9.1.6 Activity: Expand monitoring and assessment of Lost River and Shortnose Suckers in new places.

9.1.7 Activity: Complete comprehensive periodic Lost River and Shortnose Sucker stock status updates.

9.1.8 Activity: Acoustic Telemetry [Need reference information]

9.2 Task: Recruitment Factor Limitations – Habitat, disease, mortality, etc.

9.2.1 Activity: Investigations into ecological limitations including disease, parasitism, and predation on survival of wild and hatchery-reared juvenile Lost River and Shortnose Suckers.

9.2.2 Activity: Investigation into effects of environmental conditions (water level, water quality, etc.) and related management on juvenile survival of Lost River and Shortnose Suckers.

9.2.3 Activity: Assessment of waterbird predation on Lost River and Shortnose Suckers b33ased on abundance monitoring of colonial waterbird breeding colonies and recoveries of PIT tags.

9.3 Task: Action effectiveness – Hatchery reintroduction evaluation

9.3.1 Activity: Annual juvenile sampling in upper Klamath Lake to collect Lost River and Shortnose Sucker juveniles for hatchery-assisted rearing .

9.3.2 Activity: Post-release assessment of hatchery-origin abundance and survival of Lost River and Shortnose Suckers.

9.3.3 Activity: In-hatchery evaluations of effective for hatchery-assisted rearing practices for Lost River and Shortnose Suckers.

10. Other Focal Fish Species

10.1 Task: Monitor Bull Trout Status and Restoration Effectiveness

10.1.1 Activity: Periodic assessments of resident Bull Trout population status in the Klamath headwater tributaries.

10.1.2 Activity: Apply a bull trout reintroduction structured decision-making model to Identify restoration opportunities.

10.1.3 Activity: Assess effectiveness of Bull Trout conservation and restoration efforts.

10.2 Task: Monitor Redband Trout Status and Restoration Effectiveness

10.2.1 Activity: Periodic assessments of resident Redband Trout population status in the Klamath system.

10.2.2 Activity: Assess effectiveness of Redband Trout conservation and restoration efforts.

10.3 Task: Monitor Lamprey Status

10.3.1 Activity: Assess Lamprey population status in the Klamath basin.

10.4 Green Sturgeon

10.4.1 Activity: Assess Green Sturgeon population status in the Klamath River mainstem.

10.5 Eulachon

10.5.1 Activity: Assess Eulachon population status in the Lower Klamath River.

11. COORDINATION & DATA MANAGEMENT

11.1 Task: Facilitate cooperative information sharing and coordination of fish monitoring activities to optimize implementation effectiveness and efficiency.

The Klamath Basin has a long history of collaborative information sharing and cooperation activities including the Klamath Basin Monitoring Program (KBMP) which is focused on water quality monitoring and restoration, and the Klamath Dam Removal Science Collaboration (KDRSC) which was organized to coordinate dam removal science and monitoring focused on fisheries, water quality, and physical processes. These programs have sponsored and coordinated a series of workshops and annual meeting with broad participation by cooperators. Most recent the PSMFC has organized a collaborative work group process and workshops under the Klamath Basin Fisheries Collaborative project to develop this plan.

11.1.1 Activity: Continue to facilitate work group process of fish monitoring and evaluation entities to coordinate monitoring activities and provide guidance to funding agencies.

11.1.2 Activity: Hold annual fish monitoring workshops for information sharing and implementation coordination

11.2 Task: Facilitate access to fish monitoring data among state, federal, tribal, and non-profit organizations.

The Klamath Basin Fisheries Collaborative (KBFC) is a partnership of entities conducting research and monitoring using PIT technology throughout the Klamath Basin. Primary active partners include Karuk, Yurok, and Klamath Tribes, USGS, USFWS, CDFW and the Scott River Watershed Council. The KBFC replacing the 2017 Klamath River Basin (KRB) PIT Tagging Database with a new standardized and structured database system. The PIT Tag Network was created to house hundreds of thousands of records on tag releases and detections of endangered Coho Salmon and suckers and other species including bull trout, Chinook Salmon, Steelhead, and lamprey. PSMFC maintains a web-based data exchange portal to facilitate access and share PIT tag data.

11.2.1 Activity: Maintain a centralized, web-accessible PIT tag database.

11.2.2 Activity: Annual updates of new PIT tagging and detection data.

PART IV - STRATEGIC MONITORING PLAN

Anadromous fish have responded rapidly to the changed conditions created by the recent dam removals on the Klamath River. Tracking anadromous fish movements and utilization of new habitat areas presents significant challenges and opportunities to support fisheries management goals. The imperiled state of shortnose and lost river suckers also presents significant challenges in maintaining tribal trust resources and preventing extinction.

The following presents a Strategic Monitoring Plan (SMP) to guide future monitoring activities that address current and anticipated future fisheries challenges in the basin. The SMP outlines a series of focused initiatives intended to address emerging needs while supporting the goals of the IFRMP goals and the key management questions identified in Part 1 above. The SMP looks to build on the current monitoring activities while seeking efficiencies through improved coordination and increased use of technology. The SMP also looks to address critical data gaps and ensure rapid response to changing conditions.

1. Goals and Objectives
   Reference IFRMP goals. Insert table from IFRMP.
2. Guiding Principles
   See Box 1
3. Strategic Initiatives
   a. Advance Fisheries Management Goals in a Post Dam Removal Era
      Standardized spawning survey protocols.
      Fish in/fish out framework
      Hatchery practices
   b. Apply New Technologies and Artificial Intelligence to Improve Efficiencies and Knowledge
      Expanded genetics testing and use of Parentage Based Tagging (PBT)
      Expanded use of sonar and AI (including video monitoring)
      Expanded use of PIT tags and Acoustic Telemetry.
   c. Standardize Data Collection and Storage
      Advance KBFC initiatives
   d. Advance Real-time Data
      Continue supporting parasite and disease monitoring
   e. Improve Coordination and Collaboration
      KBFC Leadership Team
      Annual coordination workshop

Box 1. Fish Monitoring Assumptions

1. Monitoring is essential for effective fish conservation, management and restoration efforts. Current projects all address important needs.
2. A common understanding of the scope and needs for fish monitoring was a key outcome of this collaborative planning and prioritization effort by fish monitoring and evaluation partners.
3. The process assumes that priorities identified by monitoring and evaluation partners are a preferrable alternative to leaving it strictly up to the high-level funding sources.
4. A comprehensive monitoring plan will identify objectives, requirements, priorities, a core program and additional needs to address critical uncertainties and emerging issues.
5. Research and synthesis to understand key drivers and mechanisms are also critical to identification of effective conservation, management and restoration measures.
6. Information sharing and data archiving are important elements of a comprehensive plan.
7. Monitoring priorities are a product of legal obligations and management decisions informed by the corresponding information. Information can have immediate and longer-term management applications.
8. Reductions in monitoring will decrease precision and accuracy and accuracy of assessments and increase management uncertainty in a changing environment.
9. There are potential opportunities for scaling across many or most project areas. Even high importance activities can absorb some scaling reductions to make room for other priorities.
10. Projects can absorb incremental reductions only to a certain point beyond which incremental reductions critically impair function to the point where the project is no longer effective.
11. Keeping entities and partnerships intact over the long term is also essential for long-term success of conservation and restoration in the basin. Tribal presence is a key value for success over long term.
12. Even if the funding source of a particular project is not at risk, distribution of funds might be reconsidered to backfill in other areas (within the constraints of funding obligations of the source).
13. Some projects might also be candidates for skipping a few years – particularly where applications are more long term and not annual in application.

REFERENCES

Adams, C.C. 2013. Survival and Movement of Juvenile Coho Salmon (Oncorhynchus kisutch) in the Shasta River, California. MS Thesis. Humboldt State University, Arcata, California. https://scholarworks.calstate.edu/downloads/z603r066p

Aguilar, B. and coauthors. 1996. Trinity River Basin salmon and steelhead monitoring project 1993-1994 season. California Department of Fish and Wildlife. Sacramento CA.

Aguilar, B., L. D. Davis, B. W. Collins, L. Hanson, W. Sinnen, M. Zuspan and M. Dean. 1996. Trinity River Basin salmon and steelhead monitoring project 1994-1995 season. California Department of Fish and Wildlife. Sacramento CA.

Aguilar, B., M. Zuspan, L. Hanson, B. W. Collins, W. Sinnen, E. Miller, M. Dean and R. Reavis. 1995. Trinity River Basin salmon and steelhead monitoring project 1992-1993 season. California Department of Fish and Wildlife. Sacramento CA.

Anonymous. 2006. Spring Chinook and Summer Steelhead Count Salmon River, California, August 9 & 14, 2006 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84256

Anonymous. 2007. Salmon River Spring Chinook and Summer Steelhead Dives 2007, 7/25/2007 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84257

Anonymous. 2008. Salmon River Spring Chinook and Summer Steelhead Count 2008 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84258

Anonymous. 2009. Salmon River Spring Chinook and Summer Steelhead Dives 2009 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84259

Anonymous. 2010. Salmon River Spring Chinook and Summer Steelhead Dives 2010 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84260

Anonymous. 2011. Salmon River Spring Chinook and Summer Steelhead Dives 2011 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84261

Anonymous. 2012. Salmon River Spring Chinook and Summer Steelhead Dives 2012 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84262

Anonymous. 2013. Salmon River Spring Chinook and Summer Steelhead Dives 2013 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84263

Antonetti, A. 2009. Assessment of anadromous salmonid spawning in Blue Creek, Tributary to lower Klamath River during 2009. Yurok Tribal Fisheries Program. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84306

Antonetti, A. 2012. McGarvey Creek salmonid outmigration monitoring. Yurok Tribe Fisheries Program. Klamath, CA. https://www.yuroktribe.org/_files/ugd/23c897_468d606942b5459bbaf7365bae2fe079.pdf

Antonetti, A., and E. Partee. 2012. Assessment of anadromous salmonid spawning in Blue Creek, tributary to the lower Klamath River, during 2010. Yurok Tribe Fisheries Program. Klamath, CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84326

Antonetti, A., and E. Partee. 2012. Blue Creek Chinook outmigration monitoring. Yurok Tribe Fisheries Program. Klamath, CA. https://www.yuroktribe.org/_files/ugd/23c897_d6f7b5fff7ba463cbebdf1b8e6c086c5.pdf

Antonetti, A., and E. Partee. 2013. Assessment of anadromous salmonid spawning in Blue Creek, tributary to the lower Klamath River, during 2011-2012. Yurok Tribe Fisheries Program. Klamath, CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84327

Antonetti, A., E. Partee, M. Hiner, and S. Silloway. 2012. Assessment and Monitoring of Non-natal Rearing, Upstream Migration Patterns, and Life History Characteristics of Juvenile Coho and other Salmonids Utilizing McGarvey Creek (Lower Klamath River Sub-Basin) during 2010 and 2011. Yurok Tribal Fisheries Program, Klamath, California.

Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2015– 46, Arcata, California. 32 p.

Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2017– 54, Arcata, California.

Banet, N. B., Q. Payton, A. Evans, R. K. Paul-Wilson, J. R. Krause, B. S. Hayes, and E. M. Benham. 2025. Predation of Lost River and Shortnose suckers by piscivorous colonial waterbirds in the Upper Klamath Basin: An analysis of predation effects during 2021-2023. https://pubs.usgs.gov/publication/70263240

Banet, N. V., S. M. Burdick, R. J. Bart, A. C. Harris, and J. R. Krause. 2024. Effect of oxygenation and location on survival and growth of endangered Lost River Suckers in net pens. Journal of Fish and Wildlife Management. 15 (2): 361-379. https://doi.org/10.3996/JFWM-24-011

Bartholomew, J., S. Hallett, R. Holt, J. Alexander, S. Atkinson, R. Craig, D. Barrett, B. Americus. 2020. Klamath River Fish Health Studies: Salmon Disease Monitoring and Research FY2020 Annual Report. Oregon State University.

Bartholow, J., J. Heasley, J. Laake, J. Sandelin, B.A.K. Coughlan, and A. Moos. 2002. SALMOD, a population model for salmonids: user's manual. Version W3. U.S. Geological Survey, Fort Collins, Colorado.

Bedell, G. W. 1968. Trinity River salmon and steelhead hatchery annual report, 1968-69. California Department of Fish and Game.

Bedell, G. W. 1970. Trinity River salmon and steelhead hatchery annual report, 1969-70. California Department of Fish and Game.

Bedell, G. W. 1970. Trinity River salmon and steelhead hatchery annual report, 1970-71. California Department of Fish and Game.

Bedell, G. W. 1971. Trinity River salmon and steelhead hatchery annual report, 1971-72. California Department of Fish and Game.

Bedell, G. W. 1973. Trinity River salmon and steelhead hatchery annual report, 1972-73. California Department of Fish and Game.

Bedell, G. W. 1974. Trinity River salmon and steelhead hatchery annual report, 1973-74. California Department of Fish and Game.

Bedell, G. W. 1976. Trinity River salmon and steelhead hatchery annual report, 1974-75. California Department of Fish and Game.

Bedell, G. W. 1976. Trinity River salmon and steelhead hatchery annual report, 1975-76. California Department of Fish and Game.

Bedell, G. W. 1977. Trinity River salmon and steelhead hatchery annual report, 1976-77. California Department of Fish and Game.

Bedell, G. W. 1978. Trinity River salmon and steelhead hatchery annual report, 1977-78. California Department of Fish and Game.

Bedell, G. W. 1979. Trinity River salmon and steelhead hatchery annual report, 1978-79. California Department of Fish and Game.

Bedell, G. W. 1980. Trinity River salmon and steelhead hatchery annual report, 1979-80. California Department of Fish and Game.

Bedell, G. W. 1982. Trinity River salmon and steelhead hatchery annual report, 1981-82. California Department of Fish and Game.

Bedell, G. W. 1983. Trinity River salmon and steelhead hatchery annual report, 1980-81. California Department of Fish and Game.

Bedell, G. W. 1984. Trinity River salmon and steelhead hatchery annual report, 1984-85. California Department of Fish and Game.

Bedell, G. W. 1987. Trinity River salmon and steelhead hatchery annual report, 1985-86. California Department of Fish and Game.

Bedell, G. W. 1987. Trinity River salmon and steelhead hatchery annual report, 1986-87. California Department of Fish and Game.

Bedell, G. W. 1988. Trinity River salmon and steelhead hatchery annual report, 1987-88. California Department of Fish and Game.

Bedell, G. W. 1989. Trinity River salmon and steelhead hatchery annual report, 1988-89. California Department of Fish and Game.

Bedell, G. W. 1991. Trinity River salmon and steelhead hatchery annual report, 1989-90. California Department of Fish and Game.

Bedell, G. W. 1991. Trinity River salmon and steelhead hatchery annual report, 1990-91. California Department of Fish and Game.

Beeman, J. W., B. Hayes and K. Wright. 2012. Detection probability of an in-stream passive integrated transponder (PIT) tag detection system for juvenile salmonids in the Klamath River, Northern California, 2011. U.S. Geological Survey Open-File Report 2012-1001, 14 p. https://pubs.usgs.gov/of/2012/1001/pdf/ofr20121001.pdf

Beeman, J.W., 2008, Summary of survival data from juvenile coho salmon in the Klamath River, Northern California, 2007: U.S. Geological Survey Open-File Report 2008-1022, 6 p. http://pubs.usgs.gov/of/2008/1022/

Beeman, J.W., and Juhnke, S.D., 2009, Summary of survival data from juvenile coho salmon in the Klamath River, Northern California, 2009: U.S. Geological Survey Open-File Report 2009-1270, 8 p. http://pubs.usgs.gov/of/2009/1270/

Beeman, J.W., Juhnke, S., Stutzer, G., and Hetrick, N., 2008, Survival and migration behavior of juvenile coho salmon in the Klamath River relative to discharge at Iron Gate Dam, 2007: U.S. Geological Survey Open-File Report 2008-1332, 72 p. http://pubs.usgs.gov/of/2008/1332/

Beeman, J.W., Juhnke, S.D., and Hansel, H.C., 2009, Summary of survival data from juvenile coho salmon in the Klamath River, northern California, 2008: U.S. Geological Survey Open-File Report 2009-1019, 6 p. http://pubs.usgs.gov/of/2009/1019/

Beesley, S. 2017. Lower Klamath Sub-basin coordination & planning - FY 2015. Final Annual Progress Report: 10/01/16-09/30/17. Yurok Tribal Fisheries Program. Klamath, CA. https://www.yuroktribe.org/_files/ugd/23c897_0cfe533d3cfd4bd8907b1bb4e9562a85.pdf

Benson, R. L., S. Turo, and B. W. McCovey Jr. 2007. Migration and movement patterns of green sturgeon (Acipenser medirostris) in the Klamath and Trinity rivers, California, USA. Environmental Biology of Fishes 79:269-279.

Bolick, A., K. True, and J. S. Foott. 2012. Myxosporean parasite (Ceratomyxa shasta and Parvicapsula minibicornis) annual prevalence of infection in Klamath River Basin juvenile Chinook Salmon. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. no copy

Bolick, A., K. True, and J. S. Foott. 2013. Myxosporean parasite (Ceratomyxa shasta and Parvicapsula minibicornis) annual prevalence of infection in Klamath River Basin juvenile Chinook Salmon. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. no copy

Borok, S., and M. Hampton. 2004. 2002 Fall Chinook Salmon Run Size in the Scott River and Salmon Rivers and Miscellaneous Tributary Streams of the mid-Klamath Basin. California Department of Fish and Game, North Coast Region. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27051

Borok, S., M. Hampton and J. Richey. 2007. 2004 Fall Chinook Salmon Run Size in the Scott River and Salmon Rivers and Miscellaneous Tributary Streams of the mid-Klamath Basin. California Department of Fish and Game, North Coast Region. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27055

Borok, S., S. Cannata, A. Hill, J. Hileman and M. C. Kier. 2013. Trinity River basin salmon and steelhead monitoring project 2011-2012 season. Final annual report. California Department of Fish and Game. Redding CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=77807

Borok, S., S. Cannata, J. Hileman, A. Hill and M. C. Kier. 2014. Trinity River basin salmon and steelhead monitoring project 2012-2013 season. Final annual report. California Department of Fish and Game. Redding CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=102647

California Department of Fish and Game [CDFG]. 2003. Klamath River Project Chinook and Coho Salmon recovery at Iron Gate Hatchery, October 7, 2002 to January 3, 2003

California Department of Fish and Game [CDFG]. 2004. Klamath River Project Chinook and Coho Salmon recovery at Iron Gate Hatchery, October 6, 2003 to December 31, 2003

California Department of Fish and Wildlife (CDFW) & PacifiCorp. 2017. Hatchery and Genetic Management Plan for Iron Gate Hatchery Coho Salmon. Report prepared for National Oceanic and Atmospheric Administration National Marine Fisheries Service Arcata, California. 163 pp.

California Department of Fish and Wildlife (CDFW). 2016. 2016 Klamath Basin fall Chinook salmon spawner escapement, in-river harvest, and run-size estimates. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=122850

California Department of Fish and Wildlife (CDFW). 2016. Scott River Brood Year 2013 Juvenile PIT Tagging Study. Yreka Fisheries, Yreka, California. 72 pp.

California Department of Fish and Wildlife (CDFW). 2016. Shasta River Brood Year 2013 Juvenile Coho Salmon PIT Tagging Study. Yreka Fisheries Office, Yreka, CA. 72 pp.

California Department of Fish and Wildlife (CDFW). 2017. Klamath River cooperative spawner survey overview report. Prepared for the U. S. Fish and Wildlife Service in fulfillmet of Cooperative Agreement G159112. 42 pp.

California Department of Fish and Wildlife (CDFW). 2020. California Department of Fish and Wildlife use of sonar for fish conservation. https://wildlife.ca.gov/Conservation/Fishes/Sturgeon/DIDSON.

California Department of Fish and Wildlife (CDFW). 2021. Influence of Scott River in-stream flow on the distribution and migration timing of fall Chinook Salmon and Coho Salmon. California Department of Fish and Wildlife, Northern Region

California Department of Fish and Wildlife (CDFW). 2023. Klamath River basin fall Chinook Salmon spawner escapement, in-river harvest and run-size estimates, 1978-2022. California Department of Fish and Wildlife, Arcata, California. https://www.pcouncil.org/documents/2023/01/klamath-river-fall-chinook-salmon-age-specific-escapement-river-harvest-and-run-size-estimates-2021-run.pdf/

California Department of Fish and Wildlife (CDFW). 2024. Klamath River Project adult fish counting facility in-season update. California Department of Fish and Wildlife, Arcata, California. https://static1.squarespace.com/static/62489e807e383e4b1be9bc11/t/672ea21d47dced5394d3169f/1731109406079/11-8-24_In_season_update_KRP_Shasta_Scott_Bogus.pdf

California Department of Fish and Wildlife [CDFW]. 2016. Scott and Shasta River juvenile Chinook Salmon Outmigrant Study Multi-year Report, 2000-2015. California Department of Fish and Wildlife, Anadromous Fisheries Resource Assessment and Monitoring Program, 1625 South Main Street, Yreka, CA 96097

California Department of Fish and Wildlife [CDFW]. 2025. CA Upper Klamath River Tributary Juvenile Salmonid Outmigration Studies. In-season Update JW 22. June 6, 2025.

California Department of Fish and Wildlife [CDFW]. 2025. Shasta and Scott River juvenile salmonid outmigration monitoring. In-season Update JW 22. June 6, 2025.

Carter, K. 2005. The Effects of Temperature on Steelhead Trout, Coho Salmon, and Chinook Salmon Biology and Function by Life Stage - Implications for Klamath Basin TMDLs. Report prepared by the California Regional Water Quality Control Board. 27 p.

Chamberlain, C.D., Quinn, S., and Matilton, W., 2012. Distribution and abundance of Chinook salmon redds in the mainstem Trinity River 2002 to 2011: Arcata, California, U.S. Fish and Wildlife Service, Arcata Fisheries Technical Report TR 2012-16, 46 p. https://www.trrp.net/DataPort/doc.php?id=1511

Chesney, D. 2007. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery 2006. California Department of Fish and Game. Yreka CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27047

Chesney, D. 2008. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery 2007. California Department of Fish and Game. Yreka CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27048

Chesney, D. 2009. Shasta River Fish Counting Facility, Chinook and coho salmon observations in 2008-2009, Siskiyou County, CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27072

Chesney, D., and M. Knechtle. 2009. Shasta River Fish Counting Facility, Chinook and coho salmon observations in 2007-2008, Siskiyou County, CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27071

Chesney, D., and M. Knechtle. 2010. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery September 25, 2009 to December 15, 2009. California Department of Fish and Game. Yreka CA

Chesney, D., and M. Knechtle. 2012. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery October 4, 2011 to December 12, 2011. California Department of Fish and Game. Yreka CA

Chesney, D., and M. Knechtle. 2012. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery September 24, 2010 to December 1e, 2010. California Department of Fish and Game. Yreka CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=38208

Chesney, D., and M. Knechtle. 2013. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery September 6, 2012 to December 6, 2012. California Department of Fish and Wildlife. Yreka CA

Chesney, D., and M. Knechtle. 2016. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery October 8, 2015 to December 4, 2015. California Department of Fish and Wildlife. Yreka CA https://nrmsecure.dfg.ca.gov/FileHandler.ashx?DocumentID=153280

Chesney, D., and M. Knechtle. 2017. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery October 10, 2016 to December 1, 2016. California Department of Fish and Wildlife. Yreka CA https://nrmsecure.dfg.ca.gov/FileHandler.ashx?DocumentID=174874

Chesney, D., and M. Knetchle. 2011. Shasta River chinook and coho salmon observations in 2009-2010. Siskiyou County, CA. California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=77845

Chesney, D., and M. Knetchle. 2011. Shasta River chinook and coho salmon observations in 2010-2011. Siskiyou County, CA. California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=38205

Chesney, D., and M. Knetchle. 2012. Shasta River chinook and coho salmon observations in 2011-2012. Siskiyou County, CA. California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=77844

Chesney, D., and M. Knetchle. 2013. Shasta River chinook and coho salmon observations in 2012-2013. Siskiyou County, CA. California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=77847

Chesney, D., and M. Knetchle. 2017. 2016 Shasta River chinook and coho salmon observations. Siskiyou County, CA. California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=153279

Chesney, W. R. 2000. Shasta and Scott River juvenile steelhead trapping 2000. California Department of Fish and Game. Yreka, CA. https://www.krisweb.com/biblio/klamath_cdfg_chesney_2000_scottshasta.pdf

Chesney, W. R. and E. M. Yokel. 2003. Shasta and Scott River juvenile salmonid outmigrant study, 2002. CDFG Annual Report, Project 2a1. Yreka, CA. 39 p. https://www.krisweb.com/biblio/klamath_cdfg_chesney_2002_scottshastajuvs.pdf

Chesney, W. R., B. J. Cook, W. B. Crombie, H. D. Langendorf, and J. M. Reader. 2007. Annual Report, Shasta and Scott River Juvenile Salmonid Outmigrant Study, 2006. California Department of Fish and Wildlife, Anadromous Fisheries Resource Assessment and Monitoring Program. https://www.siskiyourcd.com/_files/ugd/87211c_189eeeee029b44feb2646a013a743f33.pdf

Chesney, W. R., C. C. Adams, W. B. Crombie, H. D. Langendorf, S.A. Stenhouse and K. M. Kirkby. 2009. Shasta River Juvenile Coho Habitat & Migration Study. Report prepared for U. S. Bureau of Reclamation, Klamath Area Office. Funded by U.S. Bureau of Reclamation, National Oceanic and Atmospheric Administration and California Department of Fish and Wildlife. California Department of Fish and Wildlife, Yreka, California. https://www.waterboards.ca.gov/waterrights/water_issues/programs/hearings/marblemountain/exhibits/nat_marine_fs_exhibits/nmfs_21.pdf

Chesney, W. R., W. B. Crombie and H. D. Langendorf. 2009. Shasta and Scott River Juvenile Salmonid Outmigration Monitoring Project, 2008. CDFG Annual Report. Yreka, CA. 60 p.

Clayton, T. 2006. 2005 Fall Chinook Salmon spawning ground survey. U. U. Forest Service, Klamath National Forest. https://www.siskiyourcd.com/_files/ugd/87211c_9aa3061d8aec447380641a0860463f87.pdf

CNRA & CDFW (California Natural Resource Agency and California Department of Fish and Game). 2024 Klamath River Anadromous Fishery Reintroduction and Restoration Monitoring Plan. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=225455&inline

CNRA & CDFW (California Natural Resource Agency and California Department of Fish and Game). 2024 Klamath River Anadromous Fishery Reintroduction and Restoration Monitoring Plan. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=225455&inline

Cohn, L. and W.R. Chesney. 2017. Shasta River Juvenile Salmonid Outmigrant Study, 2017. California Department of Fish and Wildlife, Anadromous Fisheries Resource Assessment and Monitoring Program.

Craig, J. 1989. Klamath River Basin Juvenile Salmonid Fisheries Investigation 1989. U.S. Fish and Wildlife Service, AFF-1-FRO-91-3, Arcata, CA.

Craig, J. L. 1992. Juvenile Salmonid Trapping on the Mainstem Trinity River at Willow Creek and on the Klamath River at Big Bar 1990. U.S. Fish and Wildlife Service, AFF-1-FRO-92-13, Arcata, CA.

Cyr, L. 2004. 2004 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84295

Cyr, L. 2005. 2005 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84296

Cyr, L. 2006. 2006 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84297

Cyr, L. 2007. 2007 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84298

Cyr, L. 2008. 2008 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84299

Cyr, L. 2009. 2009 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84300

Cyr, L. 2010. 2010 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84301

Cyr, L. 2011. 2011 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84302

Cyr, L. 2012. 2012 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84303

Cyr, L. 2013. 2013 steelhead surveys by watershed data collected by the USFS Orleans/Happy Camp Ranger Districts. U. S. Forest Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84304

Daley, T. T., and A. A. Adams. 2025. Klamath Basin Water Temperature Summary, Water Year 2020 and 2021. U. S. Fish and Wildlife Service. Arcata Fisheries Data Series Report DS 2024-70. https://www.fws.gov/sites/default/files/documents/2025-04/2020_2021_watertemprpt-508_final_14march2025_1.pdf

David, A. T., S. G. Gough and W. D. Pinnix. 2018. Summary Of Catch And Biological Data Collected During Juvenile Salmonid Monitoring On The Mainstem Klamath River Below Iron Gate Dam, California, 2017. U.S. Fish and Wildlife Service. Arcata Fisheries Data Series Report DS 2018-60 https://www.fws.gov/sites/default/files/documents/2017_KlamathOutmigrantReport_final.pdf

David, A.T., S.A. Gough, and W.D. Pinnix. 2016. Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2014. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2016-47, Arcata, California.

David, A.T., S.A. Gough, and W.D. Pinnix. 2017. Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2015. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2017-48.

Davids, N., P. Petros, W. D. Pinnix, and A. D. Heacock. 2013. Juvenile Salmonid Monitoring on the Mainstem Trinity River, California, 2012. Page 39. U.S. Fish and Wildlife Service, DS 2012-34, Arcata, CA. Faukner presentation 5/14/25 workshop

Deas, M.L., and S.K. Tanaka. 2006. Klamath River thermal refuge study: flow and temperature characterization - final project temperature report. Watercourse Engineering, Inc., prepared for U.S. Bureau of Reclamation in cooperation with the U.S. Bureau of Reclamation, Karuk Tribe, and Yurok Tribe. Klamath Falls, Oregon.

Debrick, A., and S. Stenhouse. 2014. Final Report Shasta and Scott River juvenile salmonid outmigrant study, 2014. California Department of Fish and Game and the Shasta Valley Resource Conservation District. https://www.siskiyourcd.com/_files/ugd/87211c_f3696aef015342b3a9aef662bb9c6db6.pdf

DeHaan, P., M. Diggs, and W. Ardren. 2008. Genetic analysis of bull trout in the Upper Klamath River Basin, Oregon. USFWS Progress Report, Longview, WA. 26p.

Dickson, J. A., and J. R. Krause. 2024. Analysis of fish PIT tag detections from 2008-2024 at the Link River Dam fish ladder in the Upper Klamath River Basin, Oregon: U.S. Geological Survey data release, https://doi.org/10.5066/P1PB2QM3. https://www.usgs.gov/data/analysis-fish-pit-tag-detections-2008-2024-link-river-dam-fish-ladder-upper-klamath-river

Dodrill, M. J., R.W Perry, N.A. Som, C.V. Manhard, and J.D. Alexander. 2022. Extending the Stream Salmonid Simulator to Accommodate the Life History of Coho Salmon (Oncorhynchus kisutch) in the Klamath River Basin, Northern California. U.S. Geological Survey Open-File Report 2022-1071, 70p. https://www.usgs.gov/publications/extending-stream-salmonid-simulator-accommodate-life-history-coho-salmon-oncorhynchus

Dodrill, M. J., R.W Perry, N.A. Som, C.V. Manhard, and J.D. Alexander. 2022. Extending the Stream Salmonid Simulator to Accommodate the Life History of Coho Salmon (Oncorhynchus kisutch) in the Klamath River Basin, Northern California. U.S. Geological Survey Open-File Report 2022-1071, 70p.

Doukakis, P. 2014. 2014 informal status review for the Northern Distinct Population Segment of the North American green sturgeon (*Acipenser medirostris*). Protected Resources Division, West Coast Region, NOAA Fisheries).

Doyle, T., and J. Maloney. 2024. Stream inventory report Scott River 2023/2024. Siskiyou Resource Conservation District. https://www.siskiyourcd.com/_files/ugd/87211c_39e3bd9f895a46699b4f809966d504ce.pdf

Dutra, B. L. and S.A. Thomas. 1999. 1998-99 Chinook and coho spawning report. Lower Trinity Ranger District, Six Rivers National Forest, Willow Creek, California. April 1999. https://www.krisweb.com/biblio/trinity_usdafs_dutraetal_1999.pdf

Elder, D., B. Olson, A. Olson, J. Villeponteaux, and P. Brucker. 2002. Salmon River sub-basin restoration strategy: Steps to recovery and conservation of aquatic resources. Report prepared for the Klamath River Basin Fisheries Restoration Task Force and U.S. Fish and Wildlife Service, Yreka, California. 53 p. Retrieved from: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5110056.pdf

Elder, D., B. Olson, A. Olson, J. Villeponteaux, and P. Brucker. 2002. Salmon River sub-basin restoration strategy: Steps to recovery and conservation of aquatic resources. Report prepared for the Klamath River Basin Fisheries Restoration Task Force and U.S. Fish and Wildlife Service, Yreka, California. 53 p. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5110056.pdf

ESSA (Environmental and Social Systems Analysts) and Klamath Basin Working Groups. 2023. Klamath Basin Integrated Fisheries Restoration and Monitoring Plan (IFRMP): Plan Document. Prepared for the Pacific States Marine Fisheries Commission (PSMFC) and the U.S. Fish and Wildlife Service (USFWS). https://ifrmp.org/wp-content/uploads/2023/02/KlamathIFRMP_PlanDocument_20230212_FINAL2.pdf

ESSA (Environmental and Social Systems Analysts) and Klamath Basin Working Groups. 2023. Klamath Basin Integrated Fisheries Restoration and Monitoring Plan (IFRMP): Plan Document. Prepared for the Pacific States Marine Fisheries Commission (PSMFC) and the U.S. Fish and Wildlife Service (USFWS). https://ifrmp.org/wp-content/uploads/2023/02/KlamathIFRMP_PlanDocument_20230212_FINAL2.pdf

ESSA (Environmental and Social Systems Analysts). 2017. Klamath Basin Integrated Fisheries Restoration and Monitoring (IFRM) Synthesis Report. 416 pp + Appendices. https://ifrmp.org/wp-content/uploads/2022/09/Klamath_Synthesis_Report_20170814_FINAL.pdf

ESSA (Environmental and Social Systems Analysts). 2017. Klamath Basin Integrated Fisheries Restoration and Monitoring (IFRM) Synthesis Report. 416 pp + Appendices. https://ifrmp.org/wp-content/uploads/2022/09/Klamath_Synthesis_Report_20170814_FINAL.pdf

ESSA Technologies Ltd. 2009. Trinity River Restoration Program. Integrated Assessment Plan, Version 1.0 – September 2009. Draft report prepared for the Trinity River Restoration Program, Weaverville, California, 285 pp.

Faukner, J., S. Silloway, A. Antonetti, T. Soto, A. Corum, E. Tripp, and L. Lestelle. 2019. The role of the Klamath River mainstem corridor in life history and performance of juvenile coho salmon (Oncorhynchus kisutch). Period Covered: September 2011-June 2017. Report submitted to the U.S. Bureau of Reclamation, Klamath Falls, OR. https://www.researchgate.net/publication/336265164_The_Role_Of_The_Klamath_River_Mainstem_Corridor_In_The_Life_History_And_Performance_Of_Juvenile_Coho_Salmon_Oncorhynchus_kisutch_Bureau_of_Reclamation_Mid-Pacific_Region_Klamath_Area_Office_6600_Washb

Faukner, J., S. Silloway, M. Sparkman, and P. Drobny. 2017. A previously undocumented life history behavior in juvenile coho salmon (Oncorhynchus kisutch) from the Klamath River, California. California Fish and Game 103:72-78.

Foott 2004

Foott et al. 2016

Franklin, T. 2012. Scott River adult spawning ground surveys 2011 season. Siskiyou Resource Conservation District for the U. S. Fish and Wildlife Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84324

Gale, D. 2009. Assessment of anadromous salmonid spawning in Blue Creek, Tributary to lower Klamath River 1999-2008. Yurok Tribal Fisheries Program. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84305

Gale, D. B., T. R. Hayden, L. S. Harris, and H. N. Voight. 1998. Assessment of anadromous fish stocks in Blue Creek, Lower Klamath River, California https://www.krisweb.com/biblio/klamath_yuroktfp_galeetal_1998_4.pdf

Garrison, P. 2002. 2000-2001 Annual Report Trinity River tributaries winter-run steelhead spawning survey report Project 1d1. California Department of Fish and Game. Steelhead Research and Monitoring Program. https://www.krisweb.com/biblio/trinity_cdfg_garrison_2002_0001tribscarc.pdf

Garrison, P. 2002. 2000-2001 Annual Report Trinity River tributary juvenile steelhead index reach project, 2000-2001 Project 2c2. California Department of Fish and Game. Steelhead Research and Monitoring Program. https://www.krisweb.com/biblio/trinity_cdfg_garrison_2002_0001juvabund.pdf

Garrison, P. 2002. 2001-2002 Annual Report Trinity River tributaries winter-run steelhead spawning survey report Project 1d1. California Department of Fish and Game. Steelhead Research and Monitoring Program. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84317

Garrison, P. 2002. Annual Report Trinity River tributary juvenile steelhead index reach project, 2000-2001 Project 2c2. California Department of Fish and Game. Steelhead Research and Monitoring Program. https://www.krisweb.com/biblio/trinity_cdfg_garrison_2003_tribshdefish.pdf

Garrison, P. 2003. 2003 South Fork Trinity River Spring Chinook/Summer Steelhead snorkel survey totals. California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84293

Garrison, P. 2004. 2003-2004 Annual Report Trinity River tributaries winter-run steelhead spawning survey report Project 1d1. California Department of Fish and Game. Steelhead Research and Monitoring Program. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84318

Garrison, P. 2004. 2004 South Fork Trinity River Spring Chinook/Summer Steelhead Snorkel Survey Totals. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84284

Garrison, P. 2005. 2004-2005 Annual Report Trinity River tributaries winter-run steelhead spawning survey report Project 1d1. California Department of Fish and Game. Steelhead Research and Monitoring Program. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84319

Garrison, P. 2005. 2005 South Fork Trinity River Spring Chinook/Summer Steelhead Snorkel Survey Totals. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84285

Garrison, P. 2006. 2006 South Fork Trinity River Spring Chinook/Summer Steelhead Snorkel Survey Totals. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84286

Genzoli, L., Bandrowski, D.J., Fricke, S., McCovey, B., Hillemeier, D., Belchik, M., and Soto, T., Eds. 2021. Klamath Dam Removal Science Coordination Workshop Summary Report. Workshop Proceedings, Medford, Oregon, February 12-13, 2020. Yurok Tribe Fisheries Department. 65 p.

Genzoli, L., Bandrowski, D.J., Fricke, S., McCovey, B., Hillemeier, D., Belchik, M., and Soto, T., Eds. 2021. Klamath Dam Removal Science Coordination Workshop Summary Report. Workshop Proceedings, Medford, Oregon, February 12-13, 2020. Yurok Tribe Fisheries Department. 65 p.

Giudice, D., and M. Knechtle. 2017. Recovery of Fall-run Chinook and Coho at Iron Gate Hatchery October 10, 2016 to December 1, 2016. Klamath River Project. California Department of Fish and Wildlife. Yreka CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174874

Giudice, D., and M. Knechtle. 2018. Recovery of Fall-run Chinook and Coho at Iron Gate Hatchery October 9, 2017 to January 5, 2018. Klamath River Project. California Department of Fish and Wildlife. Yreka CA https://nrmsecure.dfg.ca.gov/FileHandler.ashx?DocumentID=174876

Giudice, D., and M. Knechtle. 2018. Shasta River Salmonid Monitoring 2017. Siskiyou County, California. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174882

Giudice, D., and M. Knechtle. 2019. Recovery of Fall-run Chinook and Coho at Iron Gate Hatchery October 8, 2018 to December 18, 2018. Klamath River Project. California Department of Fish and Wildlife. Yreka CA https://nrmsecure.dfg.ca.gov/FileHandler.ashx?DocumentID=174877

Giudice, D., and M. Knechtle. 2019. Shasta River Salmonid Monitoring 2018. Siskiyou County, California. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174881

Giudice, D., and M. Knechtle. 2021. Shasta River Salmonid Monitoring 2020. Siskiyou County, California. California Department of Fish and Wildlife.

Giudice, D., and M. Knechtle. 2022. Shasta River Chinook and Coho observations in 2021-2022. Siskiyou County, California. California Department of Fish and Wildlife. Yreka CA

Goldsmith, G. H. 1993. Juvenile Salmonid Monitoring on the Trinity and Klamath Rivers 1991. U.S. Fish and Wildlife Service, AFF-1-FRO-93-14, Arcata, CA.

Gorman, M.P. 2016. Juvenile Survival and Adult Return as a Function of Function of Freshwater Rearing Life History for Coho Salmon in the Klamath River Basin. MS Thesis. Humboldt State University, Arcata, California.

Gough, S. A., and N. A. Som. 2015. Fall Chinook Salmon run characteristics and escapement for the mainstem Klamath River, 2012. U.S. Fish and Wildlife Service.

Gough, S. A., and N. A. Som. 2017. Fall Chinook Salmon run characteristics and escapement for the mainstem Klamath River, 2016. U.S. Fish and Wildlife Service,

Gough, S. A., and S. C. Williamson. 2012. Fall Chinook Salmon run characteristics and escapement for the main-stem Klamath River, 2001–2010. U.S. Fish and Wildlife

Gough, S. A., K. I. Wilcox, T. T. Daley and N. A. Som. 2020. Fall-run Chinook salmon run characteristics and escapement in the mainstem Klamath River below Iron Gate Dam, 2019. U. S. Fish and Wildlife Service. Data

Series Report Number DS 2020-64. https://www.fws.gov/sites/default/files/documents/2019%20klamath%20spawn%20survey%20report%20final.pdf

Gough, S. A., N. A. Som, C. Laskodi, B. C. Matilton, A. M. Hill, and A. Fleitz. 2021. Mainstem Trinity River Chinook Salmon Spawning Survey, 2018: Arcata, California, U.S. Fish and Wildlife Service, Report DS 2021-65, 50 p.

Gough, S. A., N. A. Som, S. Quinn, W. C. Matilton, A.M. Hill W. and Brock. 2019. Mainstem Trinity River Chinook salmon spawning survey, 2017: Arcata, California, U.S. Fish and Wildlife Service, Report DS 2019-62, 50 p.

Gough, S. A., N. A. Som, T. T. Daley, C. Laskodi, B. Lester, A. M. Hill, and E. Wiseman.2021. Mainstem Trinity River Chinook Salmon Spawning Survey, 2019. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2021–66, Arcata, California. https://www.fws.gov/sites/default/files/documents/2019%20Trinity%20Spawning%20Survey%20Report_FINAL%206_14_2021.pdf

Gough, S. A., R. Smit, K. Lindke, K. De Juilio, C. Laskodi, G. Kautsky, and B. C. Matilton. 2024. Assessment of adult salmonid spawning in the Trinity River. Arcata Fisheries Technical Report TR 2024-71. U.S. Fish and Wildlife Service, Arcata, California. https://www.trrp.net/library/document/?id=2708

Gough, S.A. 2014. Fall Chinook Salmon Run Characteristics and Escapement for the Mainstem Klamath River, 2011. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2014-35, Arcata, California.

Gough, S.A., A.T. David, and W.D. Pinnix. 2015. Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring in the Mainstem Klamath River Below Iron Gate Dam, California, 2000-2013. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2015-43, Arcata, California.

Gough, S.A., and N.A. Som. 2016. Fall Chinook Salmon Run Characteristics and Escapement for the Mainstem Klamath River, 2013-2015. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office. Arcata Fisheries Data Series Report Number DS 2017-50, Arcata, California.

Green, J., and P. Petros. 2004. Estimation of Abundance of Outmigrating Juvenile Salmonids n the Trinity River using Rotary Screw Traps in 2004. Report to the Bureau of Reclamation, Trinity River Restoration Program. Hoopa Valley Tribal Fisheries Department, Hoopa, CA.

Green, J., E. Logan, D. Zajanc, and P. Petros. 2004. Estimation of Abundance of Outmigrating Juvenile Salmonids n the Trinity River using Rotary Screw Traps in 2002 and 2003. Report to the Bureau of Reclamation, Trinity River Restoration Program. Hoopa Valley Tribal Fisheries Department, Hoopa, CA.

Hampton, M. 2003. Shasta River Fish Counting Facility, Chinook and coho salmon observations in 2002, Siskiyou County, CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27066

Hampton, M. 2004. Shasta River Fish Counting Facility, Chinook and coho salmon observations in 2003, Siskiyou County, CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27067

Hampton, M. 2005. Recovery of Chinook and Coho Salmon at Iron Gate Hatchery, October 4, 2004 to December 20, 2004. California Department of Fish and Game. Yreka CA

Hampton, M. 2005. Shasta River Fish Counting Facility, Chinook and coho salmon observations in 2004, Siskiyou County, CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27068

Hampton, M. 2006. Shasta River Fish Counting Facility, Chinook and coho salmon observations in 2005, Siskiyou County, CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27069

Harris, N. J., Petros, P., and W.D. Pinnix. 2016. Juvenile Salmonid Monitoring on the Mainstem Trinity River, California, 2015. Yurok Tribal Fisheries Program, Hoopa Valley Tribal Fisheries Department, and U. S. Fish and

Wildlife Service, Arcata Fish and Wildlife Office. Arcata Fisheries Data Series Report Number DS 2016-46, Arcata, California. https://www.fws.gov/sites/default/files/documents/2015_tr_outmigrant_monitoring.pdf

Harris, N., P. Petros, and W. Pinnix. 2012. Juvenile Salmonid Emigration Monitoring on the Mainstem Trinity River, California, 2009. Page 52. U.S. Fish and Wildlife Service, DS 2012-27, Arcata, CA.

Harris, N., P. Petros, and W. Pinnix. 2012. Juvenile salmonid emigration monitoring on the mainstem Trinity River, California, 2009. Yurok Tribal Fisheries Program, Hoopa

Hereford, M. 2023. Upper Klamath Basin juvenile Spring-run Chinook Salmon outmigration studies. July 2023 Report on initial findings from year 2022. Prepared for California Department of Fish and Wildlife. Prepared by Oregon Department of Fish and Wildlife. Mark Hereford, Klamath Reintroduction Biologist. In collaboration with UC Davis, Cal Poly Humboldt, Oregon State University, NOAA, CDFW, nd The Klamath Tribes.

Hewitt, D. A., E. C. Janney, B. S. Hayes and A. C. Harris. 2018. Status and Trends of Adult Lost River (Deltistes luxatus) and Shortnose (Chasmistes brevirostris) Sucker Populations in Upper Klamath Lake, Oregon, 2017. U. S. Geological Survey. Open-File Report 2018. https://pubs.usgs.gov/of/2018/1064/ofr20181064.pdf

Hill, A. 2008. Trinity River tributaries steelhead spawning survey report. 2006 report. Anadromous Fisheries Resource Assessment Monitoring Program. Northern Region, California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=47880

Hill, A. 2008. Trinity River tributaries steelhead spawning survey report. 2007 report. Anadromous Fisheries Resource Assessment Monitoring Program. Northern Region, California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=47879

Hill, A. 2008. Trinity River tributaries steelhead spawning survey report. 2008 report. Anadromous Fisheries Resource Assessment Monitoring Program. Northern Region, California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=47881

Hill, A. 2009. Trinity River tributaries steelhead spawning survey report. 2009 report. Anadromous Fisheries Resource Assessment Monitoring Program. Northern Region, California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=47882

Hill, A. 2010. Trinity River tributaries steelhead spawning survey report. 2010 report. Anadromous Fisheries Resource Assessment Monitoring Program. Northern Region, California Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=62336

Hill, A. M. 2016. South Fork Trinity River 2015 Summer temperature report https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174879

Hill, A. M., R. M. Sullivan and E. Wiseman. 2015. Trinity River tributary summer steelhead and spring Chinook snorkel surveys 1990-2014: Canyon Creek, North Fork Trinity River, South Fork Trinity River, and New River. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=137218

Hillemeier, D., T. Soto, S. Silloway, A. Corum, M. Kleeman, and L. Lestelle. 2009. The role of the Klamath River mainstem corridor in the life history and performance of juvenile coho salmon (Oncorhynchus kisutch) - May 2007 - May 2008. Report submitted to the U.S. Bureau of Reclamation, Klamath Area Office, Klamath Falls, Oregon.

Hillemeier, D., T. Soto, S. Silloway, A. Corum, M. Kleeman, and L. Lestelle. 2009. The role of the Klamath River mainstem corridor in the life history and performance of juvenile coho salmon (Oncorhynchus kisutch) - May 2007 – May 2008. Report submitted to the U.S. Bureau of Reclamation, Klamath Area Office, Klamath Falls, Oregon.

Hotaling, T., and P. Brucker. 2010. Salmon River community weak stocks assessment program - 2008. Draft Final Report, Agreement #P0710302 00, August 27, 2008 through March 31, 2010. Prepared by Salmon River

Restoration Council for the California Department of Fish and Game. https://srrc.org/publications/programs/fisheries/SRRC%20Weak%20Stocks%202008%20Report.pdf

Jetter, C.N. and W.R. Chesney. 2016. Shasta and Scott River Juvenile Salmonid Outmigration Study, 2016. California Department of Fish and Wildlife, Anadromous Fisheries Resource Assessment and Monitoring Program.

Keel, D. J., Chase, D., Genzoli, L., Bandrowski, D. J., McCovey, B., Belchick, M., Johnson, G., Oberholzer Dent, J. R., Soto, T., O'Dowd, A., and C. Anderson. Eds. 2023. 2023 Klamath Dam Removal Science Collaboration Workshop Summary Report. Workshop Proceedings, Arcata, California, January 10-11, 2023. Yurok Tribe Fisheries Department. 84p.

Keel, D. J., Chase, D., Genzoli, L., Bandrowski, D. J., McCovey, B., Belchick, M., Johnson, G., Oberholzer Dent, J. R., Soto, T., O'Dowd, A., and C. Anderson. Eds. 2023. 2023 Klamath Dam Removal Science Collaboration Workshop Summary Report. Workshop Proceedings, Arcata, California, January 10-11, 2023. Yurok Tribe Fisheries Department. 84p.

Kier Associates. 1999. Mid-term evaluation of the Klamath River Basin fisheries restoration program. Prepared for the Klamath River Basin Fisheries Task Force. https://www.krisweb.com/biblio/klamath_usfws_kierassc_1999_evaluation.pdf

Kier, M. C., and J. Hileman. 2016. Trinity River Basin Salmon and Steelhead Montioring Project Annual Report: Chinook and Coho Salmon and Fall-run Steelhead Run-size Estimates Using Mark-recapture Methods 2015-16 Season. California Department of Fish and Game, Northern Region, Redding, CA." http://www.trrp.net/library/document?id=2299.

Kier, M. C., J. Hileman, and K. Lindke. 2017. Annual report, Trinity River basin salmon and steelhead monitoring project: chinook and coho salmon and fall-run steelhead run-size estimates using mark-recapture methods, 2016-17 season. Report for the Trinity River Restoration Program (TRRP). California Department of Fish and Wildlife, Redding, California. http://www.trrp.net/library/document?id=2397.

Kier, M. C., J. Hileman, and K. Lindke. 2018. Annual report, Trinity River basin salmon and steelhead monitoring project: chinook and coho salmon and fall-run steelhad run-size estimates using mark-recapture methods 2017-2018 season. Report for the Trinity River Restoration Program (TRRP). California Department of Fish and Wildlife (CDFW), Redding, California. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174531

Kier, M. C., J. Hileman, and K. Lindke. 2019. Chinook Salmon and Coho Salmon and fall-run steelhead run-size estimates using mark-recapture methods, 2018-19 season. Report for the Trinity River Restoration Program (TRRP). California Department of Fish and Wildlife (CDFW), Redding, California. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=162843

Kier, M. C., J. Hileman, and K. Lindke. 2020. Chinook salmon, coho salmon, and fall steelhead run-size estimates using mark-recapture methods; 2019-2020 season. Final report of the California Department of Fish and Wildlife, Trinity River Basin Salmon and Steelhead Monitoring Project. Arcata, California. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=210765

Kier, M. C., J. Hileman, and K. Lindke. 2021. Chinook salmon, coho salmon, and fall steelhead run-size estimates using mark-recapture methods; 2020-2021 season. Final report of the California Department of Fish and Wildlife, Trinity River Basin Salmon and Steelhead Monitoring Project. Arcata, California. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=199127

Kier, M. C., J. Hileman, and K. Lindke. 2022. Chinook salmon, coho salmon, and fall steelhead run-size estimates using mark-recapture methods; 2021-2022 season. Final report of the California Department of Fish and Wildlife, Trinity River Basin Salmon and Steelhead Monitoring Project. Arcata, California. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=210764

Kier, M. C., J. Hileman, and K. Lindke. 2023. Chinook salmon, coho salmon, and fall steelhead run-size estimates using mark-recapture methods; 2022-2023 season. Final report of the California Department of Fish and Wildlife, Trinity River Basin Salmon and Steelhead Monitoring Project. Arcata, California. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=218202

Kier, M. C., J. Hileman, and S. Cannata. 2014. Trinity River Basin Salmon and Steelhead Monitoring Project Annual Report: Chinook and Coho Salmon and Fall-run Steelhead Run-size Estimates Using Mark-recapture Methods 2013-14 Season. California Department of Fish and Game, Northern Region, Redding, CA." https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=102646

Kier, M. C., J. Hileman, and S. Cannata. 2015. Trinity River Basin Salmon and Steelhead Monitoring Project Annual Report: Chinook and Coho Salmon and Fall-run Steelhead Run-size Estimates Using Mark-recapture Methods 2014-15 Season. California Department of Fish and Game, Northern Region, Redding, CA." https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=124554

Knechtle, M. 2009. 2008 Scott River Salmon Studies, Final Report, Siskiyou County, CA. California Department of Fish and Wildlife, Klamath River Project. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27056

Knechtle, M., and D. Chesney. 2011. 2009 Scott River Salmon Studies, Final Report, Siskiyou County, CA. California Department of Fish and Wildlife, Klamath River Project. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=77837

Knechtle, M., and D. Chesney. 2011. 2009 Scott River Salmon Studies, Final Report, Siskiyou County, CA. California Department of Fish and Wildlife, Klamath River Project. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=77845

Knechtle, M., and D. Chesney. 2011. 2010 Scott River Salmon Studies, Final Report, Siskiyou County, CA. California Department of Fish and Wildlife, Klamath River Project. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=38204

Knechtle, M., and D. Chesney. 2011. 2010 Scott River Salmon Studies, Final Report, Siskiyou County, CA. California Department of Fish and Wildlife, Klamath River Project. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=38204

Knechtle, M., and D. Chesney. 2011. Bogus Creek salmon studies 2010 final report. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=38206

Knechtle, M., and D. Chesney. 2012. 2011 Scott River Salmon Studies, Final Report, Siskiyou County, CA. California Department of Fish and Wildlife, Klamath River Project. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=77835

Knechtle, M., and D. Chesney. 2013. 2012 Scott River Salmon Studies, Final Report, Siskiyou County, CA. California Department of Fish and Wildlife, Klamath River Project. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=77836

Knechtle, M., and D. Chesney. 2016. 2015 Scott River Salmon Studies, Final Report, Siskiyou County, CA. California Department of Fish and Wildlife, Klamath River Project. https://www.siskiyourcd.com/_files/ugd/87211c_49b1caa7b34343059021dcd2af5a3f2f.pdf

Knechtle, M., and D. Giudice. 2016. 2015. Bogus Creek salmon studies final report. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174873

Knechtle, M., and D. Giudice. 2017. 2016 Bogus Creek salmon studies final report. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174871

Knechtle, M., and D. Giudice. 2017. 2016 Scott River Salmon Studies- Final Report. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=153278

Knechtle, M., and D. Giudice. 2018. 2017 Scott River Salmon Studies- Final Report. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174878

Knechtle, M., and D. Giudice. 2018. 2017. Bogus Creek salmon studies final report. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174872

Knechtle, M., and D. Giudice. 2019. 2018 Scott River Salmon Studies- Final Report. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=174880

Knechtle, M., and D. Giudice. 2021. 2020 Bogus Creek Salmon Studies- Final Report. California Department of Fish and Wildlife

Knechtle, M., and D. Giudice. 2021. 2020 Scott River Salmon Studies- Final Report. California Department of Fish and Wildlife.

Knechtle, M., and D. Giudice. 2023. 2022 Scott River salmon studies final report. California Department of Fish and Wildlife.
https://static1.squarespace.com/static/62489e807e383e4b1be9bc11/t/65a03672df54eb1958a085a4/1704998515862/CDFW_Scott+2022+Report_FINAL.pdf

Knechtle. 2009. 2008 Scott River Salmon Studies, Final Report, Siskiyou County, CA. California Department of Fish and Wildlife, Klamath River Project. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27056

Krause, J.R., and Paul-Wilson, R.K., 2024. Status and trends of adult Lost River (Deltistes luxatus) and shortnose (Chasmistes brevirostris) sucker populations in Upper Klamath Lake, Oregon, 2024 (ver. 2.0, October 2024). U.S. Geological Survey data release, https://doi.org/10.5066/P14AZJX5.

Krause, J.R., Paul-Wilson, R.K., and Hayes, B.S., 2025, PIT Tags Encountered by Klamath Falls Field Station Equipment in the Upper Klamath Basin 1993-2025 (ver. 5.0, March 2025). U.S. Geological Survey data release, https://doi.org/10.5066/P1ZDKTQG. https://www.usgs.gov/data/pit-tags-encountered-klamath-falls-field-station-equipment-upper-klamath-basin-1993-2025-ver

KRRC (Klamath River Renewal Corporation). 2022. Hatcheries Management and Operations Plan. Report by McMillen Jacobs Associates. Lower Klamath Project FERC Project No. 14803 https://klamathrenewal.org/wp-content/uploads/2022/12/20221202-5208_HMOP-Dec-2022-FERC-14803.pdf

KRTT (Klamath River Technical Team). 2023. Klamath River Fall Chinook Salmon Age-Specific Escapement, River Harvest, and Run Size Estimates, 2022 Run. Pacific Fishery Management Council. https://www.pcouncil.org/documents/2023/05/2022-run-klamath-river-fall-chinook-salmon-age-specific-escapement-river-harvest-and-run-size-estimates-2022-run-krtt-17-february-2023.pdf/

KRTT (Klamath River Technical Team). 2024. Klamath River Fall Chinook Salmon Age-Specific Escapement, River Harvest, and Run Size Estimates, 1978-2023 Run. Pacific Fishery Management Council.

Lang, J. S., A. E. Gray, C. L. Jackson, R. F. McLeod, and G. G. Phalen. 1998. Juvenile Salmonid Monitoring on the Mainstem Klamath River at Big Bar and Mainstem Trinity River at Willow Creek 1992-1995. U.S. Fish and Wildlife Service, Arcata, CA.

Lestelle, L. C. 2007. Coho Salmon (Oncorhynchus kisutch) Life History Patterns in the Pacific Northwest and California. Biostream Environmental, Poulsbo, WA.

Lestelle, L. C. 2007. Coho Salmon (Oncorhynchus kisutch) Life History Patterns in the Pacific Northwest and California. Biostream Environmental, Poulsbo, WA.

Magneson, M. D. 2014. Mainstem Klamath River Fall Chinook Salmon Redd Survey 2012. U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2014-39, Arcata, California.

Magranet, L. 2015. 2014 Fall Chinook Salmon spawning ground survey. Siskyyou Rescource Conservation District report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_0f954da4d4e544eaa9fb11e67191af84.pdf

Magranet, L. 2015. Scott River adult coho spawning ground surveys 2014-2015 season. Report by the Siskiyou Resource Conservation District for the U. S. Forest Service, Klamath National Forest. https://www.siskiyourcd.com/_files/ugd/87211c_462c0a819c7b45599d5e4393500b7cda.pdf

Magranet, L. 2017. 2016 Fall Chinook Salmon spawning ground survey. Siskyyou Rescource Conservation District report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_0f954da4d4e544eaa9fb11e67191af84.pdf

Magranet, L. 2017. Scott River adult coho spawning ground surveys 2016-2017 season. Report by the Siskiyou Resource Conservation District for the U. S. Forest Service, Klamath National Forest. https://www.siskiyourcd.com/_files/ugd/87211c_edaa64f95cb54af38320c5805bfd6f0c.pdf

Magranet, L. 2018. 2017 Fall Chinook Salmon spawning ground survey. Siskyyou Rescource Conservation District report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_a7089b6e5a91483eb2169698dc9c0307.pdf

Manhard, C.V., N.A. Som, R.W. Perry, J.R. Faukner, and T.L. Soto. 2018. Estimating freshwater productivity, overwinter survival, and migration patterns of Klamath River Coho Salmon. U.S. Fish and Widlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Technical Report Number TR 2018-33, Arcata, California. https://www.fws.gov/sites/default/files/documents/EstimatingFreshwaterProductivityOverwinterSurvivalandMigrationPatternsofKlamathRiverCohoSalmon.pdf

Martel, C. 2021. Emigrant surveys and rotary screw trap operation. Outmigrating juvenile salmonid monitoring in the Trinity River using rotary screw traps in 2020. Hoopa Valley Tribal Fisheries Department. Report to the Bureau of Reclamation Trinity River Restoration Program

Martel, C. 2023. Emigrant surveys and rotary screw trap operation. Outmigrating juvenile salmonid monitoring in the Trinity River using rotary screw traps in 2022. Hoopa Valley Tribal Fisheries Department. Report to the Bureau of Reclamation Trinity River Restoration Program https://www.trrp.net/DataPort/doc.php?id=2688

Martel, C. 2024. Emigrant surveys and rotary screw trap operation. Outmigrating juvenile salmonid monitoring in the Trinity River using rotary screw traps in 2023. Hoopa Valley Tribal Fisheries Department. Report to the Bureau of Reclamation Trinity River Restoration Program https://www.trrp.net/DataPort/doc.php?id=2682

Martin, B. A., J. M. Caldwell, J. R. Krause and A. C. Harris. 2024. Growth, Survival, and Cohort Formation of Juvenile Lost River (Deltistes luxatus) and Shortnose Suckers (Chasmistes brevirostris) in Upper Klamath Lake, Oregon, and Clear Lake Reservoir, California—2021–22 Monitoring Report. U.S. Geological Survey. Open-File Report 2024-1013. https://pubs.usgs.gov/of/2024/1013/ofr20241013.pdf

Martin, B.A., Banish, N., Hewitt, D.A., Hayes, B.S., Dolan-Caret, A., Harris, A.C., and Kelsey, C., 2022, Distribution of bull trout (Salvelinus confluentus) in conjunction with habitat and trout assemblages in creeks within the Klamath Basin, Oregon 2010-16: U.S. Geological Survey Open-File Report 2022-1022, 28 p., https://doi.org/10.3133/ ofr20221022 https://www.usgs.gov/publications/distribution-bull-trout-salvelinus-confluentus-conjunction-habitat-and-trout

Massie, M., and H, Morrow. 2021. 2020 Scott River juvenile salmonid outmigrant study. California Department of Fish and Wildlife, Fisheries Restoration Grants Program. https://static1.squarespace.com/static/62489e807e383e4b1be9bc11/t/625703c9d839f061502b9318/1649869771730/2020-Scott-Salmon+report+CDFW.pdf

Mauer, S. 2002. Adult steelhead spawning survey report - Scott River Tributaries. U.S. Forest Service. https://www.siskiyourcd.com/_files/ugd/87211c_f7a2953bc6ef4c548d5f39d7a7159607.pdf

Mauer, S. 2002. Scott River watershed adult coho salmon spawning survey December 2001-January 2002. U. S. Forest Service, Klamath National Forest, Scott River Ranger District. Fort Jones, CA. https://www.siskiyourcd.com/_files/ugd/87211c_2146745d23ca418b9f6fcc896460d58d.pdf

Mauer, S. 2003. Scott River watershed adult coho salmon spawning survey December 2002-January 2003. U. S. Forest Service, Klamath National Forest, Scott River Ranger District. Fort Jones, CA. https://www.siskiyourcd.com/_files/ugd/87211c_e82e794700544f15b3c77277b3f45a04.pdf

McLeod, R., J. Craig, M. Prall, and J. Williamson. 1999. Juvenile Salmonid Monitoring on the Mainstem Klamath River at Big Bar and Mainstem Trinity River at Willow Creek 1996. U.S. Fish and Wildlife Service, Arcata, CA.

McCovey, BW Jr. 2010. Klamath River Green Sturgeon Acoustic Tagging and Biotelemetry Monitoring, 2009 Final Technical Report. March 2010. Yurok Tribal Fisheries Program

McCovey, BW Jr. 2009.Klamath River Green Sturgeon Acoustic Biotelemetry Monitoring 2008 FINAL Technical Memorandum Barry W. McCovey Jr. January 2009. Yurok Tribal Fisheries Program.

Meneks, M. 2011. 2010 Fall Chinook Salmon spawning ground survey. Salmon-Scott Rivers Ranger District, Klamath National Forest, U. S. Forest Service. Fort Jones, CA. https://www.siskiyourcd.com/_files/ugd/87211c_712d51ca40274334becc2cb1e11164a0.pdf

Meneks, M. 2012. 2011 Fall Chinook Salmon spawning ground survey. Salmon-Scott Rivers Ranger District, Klamath National Forest, U. S. Forest Service. Fort Jones, CA. https://www.siskiyourcd.com/_files/ugd/87211c_e9d4f450ea1147388b00bd3e35cbdf45.pdf

Meneks, M. 2013. 2012 Fall Chinook Salmon spawning ground survey. Salmon-Scott Rivers Ranger District, Klamath National Forest, U. S. Forest Service. Fort Jones, CA. https://www.siskiyourcd.com/_files/ugd/87211c_819c20abc1064e13aa17bb7ea04182bd.pdf

Meneks, M. 2014. 2013 Fall Chinook Salmon spawning ground survey. Salmon-Scott Rivers Ranger District, Klamath National Forest, U. S. Forest Service. Fort Jones, CA. https://www.siskiyourcd.com/_files/ugd/87211c_00c482f51eff436ba8584980304b6a66.pdf

Miller, E. E. 1975. A steelhead spawning survey of the tributaries of the upper Trinity River and upper Hayfork Creek drainages, 1973. Administrative Report No. 75-5.Caliornia Department of Fish and Game. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=16176

MKWC (Mid Klamath Watershed Council). 2015. Alexander Pond Monitoring Report. https://www.mkwc.org/s/Alexander-Pond-Case-Study-Final.pdf

MKWC (Mid Klamath Watershed Council). 2019. DeCoursey off-channel pond monitoring case study. https://www.mkwc.org/s/DeCoursey-Off-Channel-Pond-Monitoring-Report_Final-10-1-2020-1.pdf

MKWC (Mid Klamath Watershed Council). 2019. May pond monitoring report. https://www.mkwc.org/s/May_Pond_Case_Study_Final.pdf

MKWC (Mid Klamath Watershed Council). 2022. Goodman off-channel pond monitoring report. https://www.mkwc.org/s/Goodman-Off-Channel-Pond-Monitoring-Report-Final-2022.pdf

Mora, E. A. 2012. Direct submission in response to Federal Register on October 24, 2012 (77 FR 64959).

Morris, E., C. Voigt and L. Magranet. 2020. 2019 Fall Chinook Salmon spawning ground survey. Siskyyou Rescource Conservation District report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_61dfbda2f7d9403dbb69e52a928fc5e5.pdf

Morrow, H., and A. Bachteler. 2023. 2022 Scott River juvenile outmigration study. California Department of Fish and Wildlife. Yreka CA. https://static1.squarespace.com/static/62489e807e383e4b1be9bc11/t/65a03627b1135f0a18a0b591/1704998441916/2022_Scott_River_Juvenile_Salmonid_Outmigrant_Study_FINAL.docx+%281%29.pdf

Moser, M. L., J. A. Israel, M. Neuman, S. T. Lindley, D. L. Erickson, B. W. McCovey Jr., and A. P. Klimley. 2016. Biology and life history of green sturgeon (*Acipenser medirostris* Ayres, 1854): state of the science. Journal of Applied Ichthyology 32 (Suppl. 1): 67-86.

Munsch, S.H., T.R. Bennett, J. Faukner, M.J. Halloran, K.M. Halloran, K.M. Hanson, M.C. Liermann, M.L. McHenry, J.R. McMillan, R.E. Moses, B. Pagliuco, G.R. Pess, K.R. Stonecypher, and D.M. Ward. 2025. Juvenile salmoinds traverse coastal meta-nurseries that connect rivers via the sea. Frontiers In Ecology and the Environment (https://doi.org/10.1002/fee.2848).

Munsch, S.H., T.R. Bennett, J. Faukner, M.J. Halloran, K.M. Halloran, K.M. Hanson, M.C. Liermann, M.L. McHenry, J.R. McMillan, R.E. Moses, B. Pagliuco, G.R. Pess, K.R. Stonecypher, and D.M. Ward. 2025. Juvenile salmoinds traverse coastal meta-nurseries that connect rivers via the sea. Frontiers In Ecology and the Environment (https://doi.org/10.1002/fee.2848).

Murphy, J., and R. Parrish. 2008. Juvenile fish emigration in the Wood, Williamson, and Sprague rivers. U. S. Fish and Wildlife Service, Klamath Falls Fish and Wildlife Office, Klamath Falls, Oregon.

Nichols K, K. True, R. Fogerty, and L. Ratcliff. 2008. Klamath River juvenile salmonid health monitoring, April-August 2007. FY 2007 Investigational report. US Fish and Wildlife Service, CA-NV Fish Health Center

Nichols, K., and K. True. 2007. Monitoring incidence and severity of Ceratomyxa shasta and Parvicapsula minibicornis infections in juvenile Chinook Salmon (Oncorhynchus tshawytscha) and Coho Salmon (Oncorhynchus kisutch) in the Klamath River, 2006. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. no copy

Nichols, K., K. True, R. Fogerty, L. Ratcliff, and A. Bolick. 2009. Myxosporean parasite (Ceratomyxa shasta and Parvicapsula minibicornis) incidence and severity in Klamath River Basin juvenile Chinook and Coho Salmon, April-August 2008. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. no copy

NMFS (National Marine Fisheries Service). 2014. Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (Oncorhynchus kisutch). National Marine Fisheries Service. Arcata, CA. https://repository.library.noaa.gov/view/noaa/15985

NMFS (National Marine Fisheries Service). 2014. Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (Oncorhynchus kisutch). National Marine Fisheries Service. Arcata, CA. https://repository.library.noaa.gov/view/noaa/15985

NMFS (National Marine Fisheries Service). 2021. Endangered Species Act Section 7(a)(2). Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Surrender and Decommissioning of the Lower Klamath Hydroelectric Project No. 14803-001, Klamath County, Oregon and Siskiyou County, California. Refer to NMFS No: WCRO-2021-01946. December 17, 2021.

NMFS (National Marine Fisheries Service). 2022. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response. Issuance of a Tribal 4(d) Rule Determination for a Tribal Resource Management Plan as submitted by the Hoopa Valley Tribe. NMFS Consultation Number: WCRO-2020-03718.

NMFS (National Marine Fisheries Service).2023. Final Environmental Assessment. Issuance of an Endangered Species Act Section 10(a)(1)(A) Enhancement Permit to the California Department of Fish and Wildlife for the Operation of the Fall Creek Coho Salmon Hatchery Program. West Coast Region.

NMFS (National Marine Fisheries Service). 2024. Endangered Species Act Section 7(a)(2). Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response. Klamath Project Operations from October 1, 2024 through September 30, 2029. NMFS Consultation No: WCRO-2024-01599. Action Agency: U.S. Bureau of Reclamation.

NOAA. 2017. Rotary screw trap operations on Klamath River at Big Bar and Lower Salmon River. Pacific Coastal Salmon Recovery Fund Project and Performance Metrics Database. KARUK-2017-2 https://www.webapps.nwfsc.noaa.gov/apex/f?p=309:19:::::P19_PROJECTID:43239567

NOAA. 2022. FY2022 Adult summer steelhead and spring Chinook census on mid-Klamath Tributaries - Karuk https://www.webapps.nwfsc.noaa.gov/apex/f?p=309:19:::::P19_PROJECTID:52640581

NOAA. 2023. Shasta and Scott River salmonid outmigration monitoring. Pacific Coastal Salmon Recovery Fund Project and Performance Metrics Database. https://www.webapps.nwfsc.noaa.gov/apex/f?p=309:19:::::P19_PROJECTID:54494942

NOAA. 2024. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion, and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response. Klamath Project Operations from October 1, 2024 through September 30, 2029, NMFS Consultation Number: WCRO-2024-01599. Action Agency: U.S. Bureau of Reclamation. https://www.fisheries.noaa.gov/s3//2024-11/biological-opinion-klamath-project-operations-2024.pdf

NOAA. 2025. Out-migrant monitoring of juvenile salmonds - Hoopa Reservation. Pacific Coastal Salmon Recovery Fund Project and Performance Metrics Database.

O'Keefe, C., Pagliuco, B., Scott, N., Cianciolo, T., Holycross, B. 2022. Klamath Reservoir Reach Restoration Prioritization: A Summary of Habitat Conditions and Restoration Actions in the Mainstem Klamath River and Tributaries Between Iron Gate Dam and Link River Dam. Prepared by NOAA Fisheries, Pacific States Marine Fisheries Commission, and Trout Unlimited. 67 pp.

ODFW & TKT (Oregon Department of Fish and Wildlife and The Klamath Tribes). 2021. Implementation plan for the reintroduction of anadromous fishes into the Oregon portion of the Upper Klamath Basin. Prepared by M.E. Hereford, T.G. Wise, and A. Gonyaw. https://www.dfw.state.or.us/fish/CRP/docs/klamath_reintroduction_plan/ODFW%20and%20The%20Klamath%20Tribes_Upper%20Klamath%20Basin%20anadromous%20reintroduction%20implementation%20plan_Final%202021.pdf

ODFW & TKT (Oregon Department of Fish and Wildlife and The Klamath Tribes). 2021. Implementation plan for the reintroduction of anadromous fishes into the Oregon portion of the Upper Klamath Basin. Prepared by M.E. Hereford, T.G. Wise, and A. Gonyaw. https://www.dfw.state.or.us/fish/CRP/docs/klamath_reintroduction_plan/ODFW%20and%20The%20Klamath%20Tribes_Upper%20Klamath%20Basin%20anadromous%20reintroduction%20implementation%20plan_Final%202021.pdf

O'Keefe, C., Pagliuco, B., Scott, N., Cianciolo, T., Holycross, B. 2022. Klamath Reservoir Reach Restoration Prioritization: A Summary of Habitat Conditions and Restoration Actions in the Mainstem Klamath River and Tributaries Between Iron Gate Dam and Link River Dam. Prepared by NOAA Fisheries, Pacific States Marine Fisheries Commission, and Trout Unlimited. 67 pp.

ODFW (Oregon Department of Fish and Wildlife) and The Klamath Tribes. 2021. Implementation plan for the reintroduction of anadromous fishes into the Oregon portion of the Upper Klamath Basin. Prepared by M.E. Hereford, T.G. Wise, and A. Gonyaw. https://www.dfw.state.or.us/fish/CRP/docs/klamath_reintroduction_plan/ODFW%20and%20The%20Klamath%20Tribes_Upper%20Klamath%20Basin%20anadromous%20reintroduction%20implementation%20plan_Final%202021.pdf

ODFW (Oregon Department of Fish and Wildlife). 2016. Klamath Watershed District Stock Status: Review of native fishes. Klamath Fish District, January 2016.

ODFW (Oregon Department of Fish and Wildlife). 2022. Upper Klamath Basin Juvenile Chinook Salmon Release Study https://www.dfw.state.or.us/conservationstrategy/OCRF/projects/2020-2/Round%202%20March_OCRF%202020-02_ODFW%20Klamath%20Fish%20Grant%20Report%20.pdf

Payton, Q., W. D. Pinnix, and S. P. Boyle. In preparation. Reconstruction of 1989-2002 Juvenile Chinook Salmon Abundance Estimates Using River Discharge to Approximate Detection Efficiency on the Trinity River at Willow Creek, California. U.S. Fish and Wildlife Service, TS 202 1-XX, Arcata, CA.

Perry, R. W., Plumb, J. M., Dodrill, M. J., Som, N. A., Robinson, H. E., and Hetrick, N. J., 2023. Simulating post-dam removal effects of hatchery operations and disease on juvenile Chinook salmon (Oncorhynchus tshawytscha) production in the Lower Klamath River, California: U.S. Geological Survey Open-File Report 2022-1106, 33 p., https://doi.org/10.3133/ofr20221106 https://pubs.usgs.gov/of/2022/1106/ofr20221106.pdf

Perry, R.W., Jones, E.C., Plumb, J.M., Som, N.A., Hetrick, N.J., Hardy, T.B., Polos, J.C., Martin, A.C., Alvarez, J.S., and De Juilio, K.P., 2018. Application of the Stream Salmonid Simulator (S3) to the restoration reach of the Trinity River, California-Parameterization and calibration: U.S. Geological Survey Open-File Report 2018-1174, 64 p.

Perry, R.W., Plumb, J.M., Jones, E.C., Som, N.A., Hetrick, N.J., and Hardy, T.B., 2018. Application of the Stream Salmonid Simulator (S3) to Klamath River fall Chinook salmon: U.S. Geological Survey Open-File Report 2018-1056, 32 p.

Perry, R.W., Plumb, J.M., Jones, E.C., Som, N.A., Hetrick, N.J., and Hardy, T.B., 2018. Model structure of the Stream Salmonid Simulator (S3)-A dynamic model for simulating growth, movement, and survival of juvenile salmonids: U.S. Geological Survey Open-File Report 2018-1056, 32 p.

Perry, R.W., Risley, J.C., Brewer, S.J., Jones, E.C., and Rondorf, D.W., 2011, Simulating daily water temperatures of the Klamath River under dam removal and climate change scenarios: U.S. Geological Survey Open-File Report 2011-1243, 78 p.

Petros, P. 2011. Salmonid emigrant trapping 2006-2008, Trinity River emigration monitoring at Pear Tree Bar. Hoopa Valley Tribal Fisheries Department. Faukner presentation 5/14/25 workshop

Petros, P., A. D. Heacock, and W. D. Pinnix. 2014. Juvenile Salmonid Monitoring on the Mainstem Trinity River, California, 2013. Page 45. U.S. Fish and Wildlife Service, DS 2014-38, Arcata, CA. Faukner presentation 5/14/25 workshop

Petros, P., N. Harris, and W. Pinnix. 2013. Juvenile Salmonid Monitoring on the Mainstem Trinity River, California, 2010. Page 40. U.S. Fish and Wildlife Service, DS 2013-28, Arcata, CA. Faukner presentation 5/14/25 workshop

Petros, P., N.J. Harris, and W.D. Pinnix. 2015. Juvenile Salmonid Monitoring on the Mainstem Trinity River, California, 2014. Hoopa Valley Tribal Fisheries Department, Yurok Tribal Fisheries Program, and U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. Arcata Fisheries Data Series Report Number DS 2015-44, Arcata, California. https://www.fws.gov/sites/default/files/documents/2014_tr_outmigrant_monitoring.pdf

Petros, P., W.D. Pinnix, and N.J. Harris. 2017. Juvenile Salmonid Monitoring on the Mainstem Trinity River, California, 2016. Hoopa Valley Tribal Fisheries Department, Yurok Tribal Fisheries Program, and U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office. Arcata Fisheries Data Series Report Number DS 2017-51, Arcata, California. https://www.fws.gov/sites/default/files/documents/2016_TR_outmigrant_monitoring.pdf

Peura, H. 2001. 2000-2001 Horse Linto Creek anadromous monitoring project. Lower Trinity Ranger District. https://www.krisweb.com/biblio/trinity_usdafs_peura_2001_horselinto.pdf

PFMC (Pacific Fishery Management Council). 2007. Final Environmental Assessment for Pacific Coast Salmon Plan Amendment 15: An Initiative to Provide for De Minimis Fishing Opportunity for Klamath River Fall-run Chinook Salmon. (Document prepared by the Pacific Fishery Management Council and National Marine Fisheries Service.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-

1384. https://www.pcouncil.org/documents/2007/03/final-environmental-assessment-for-salmon-fmp-amendment-16.pdf/

PFMC (Pacific Fishery Management Council). 2019. Salmon Rebuilding Plan for Klamath River Fall Chinook. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384. https://www.pcouncil.org/documents/2019/07/klamath-river-fall-chinook-salmon-rebuilding-plan-regulatory-identifier-number-0648-bi04-july-2019.pdf/

PFMC (Pacific Fishery Management Council). 2021. Southern Oregon/Northern California Coast Coho Salmon: Fishery Harvest Control Rule Risk Assessment. Ad-Hoc Southern Oregon/ Northern California Coast Coho Salmon Technical Workgroup Supplemental Report 1.

PFMC (Pacific Fishery Management Council). 2025. Preseason Report I: Stock Abundance Analysis and Environmental Assessment Part 1 for 2025 Ocean Salmon Fishery Regulations. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384. https://www.pcouncil.org/documents/2025/03/2025-preseason-report-i.pdf/

PFMC (Pacific Fishery Management Council). 2025. Review of 2024 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan.

Pickard, D. (Ed.), J. Alvarez, K. De Julio, L. Gogan, J. Lee, K. Lindke, S. Naman, C. Smith, N. Som, and P. Zedonis. (2022). Trinity River Restoration Program: Science Plan. Weaverville, California. https://www.trrp.net/DataPort/doc.php?id=2605

Pickard, D., J. Alvarez, K. De Juilio, L. Gogan, J. Lee, K. Lindke, S. Naman, C. Smith, N. Som, and P. Zedonis. 2023. Trinity River Restoration Program: Science Plan. Report for the Trinity River Restoration Program (TRRP). TRRP, Weaverville, California. https://www.trrp.net/library/document?id=2605.

Pinnix, W. D., A. Heacock, and P. Petros. 2013. Juvenile Salmonid Monitoring on the Mainstem Trinity River, California, 2011. Page 39. U.S. Fish and Wildlife Service, DS 2013-29, Arcata, CA. Faukner presentation 5/14/25 workshop

Pinnix, W. D., and S. Quinn. 2009. Juvenile Salmonid Monitoring on the Mainstem Trinity River at Willow Creek, California, 2006-2007. Page 58. U.S. Fish and Wildlife Service, DS 2009-16, Arcata, CA.

Pinnix, W., J. Polos, A. Scheiff, S. Quinn, and T. Hayden. 2007. Juvenile Salmonid Monitoring on the Mainstem Trinity River at Willow Creek, California, 2001-2005. U.S. Fish and Wildlife Service, DS 2007-09, Arcata, CA.

Pinnix, W., N. Harris, and S. Quinn. 2011. Juvenile Salmonid Monitoring on the Mainstem Trinity River at Willow Creek, California, 2008. Page 40. U.S. Fish and Wildlife Service, DS 2011-20, Arcata, CA. Faukner presentation 5/14/25 workshop

Pinnix, W.D., S. P. Boyle, T. Wallin, T., Daley, and N. A. Som, 2022. Long-term analyses of estimates of abundance of juvenile Chinook salmon on the Trinity River, 1989-2018: Arcata, California, U.S. Fish and Wildlife Service Arcata Fisheries Technical Series Report TS 2022-40, 90 p. https://www.trrp.net/DataPort/doc.php?id=2571

Plumb, J. M., R. W. Perry and K. De Juilio. 2024. Calibration of the Stream Salmonid Simulator (S3) Model to Estimate Annual Survival, Movement, and Food Consumption by Juvenile Chinook Salmon (Oncorhynchus tshawytscha) in the Restoration Reach of the Trinity River, California, 2006-18. U. S. Geological Survey. Open File Report 2024-1070. https://pubs.usgs.gov/of/2024/1070/ofr20241070.pdf

Plumb, J.M., Perry, R.W., Som, N.A., Alexander, J., and Hetrick, N.J., 2019, Using the stream salmonid simulator (S3) to assess juvenile Chinook Salmon (Oncorhynchus tshawytscha) production under historical and proposed action flows in the Klamath River, California: U.S. Geological Survey Open-File Report 2019-1099, 43 p.

Plumb, J.M., Perry, R.W., Som, N.A., Goodman, D.H., Martin, A.C., Alvarez, J.S., and Hetrick, N.J., 2023, Calibration of the Trinity River Stream Salmonid Simulator (S3) with extension to the Klamath River, California, 2006-17.

U.S. Geological Survey Open-File Report 2023-1023 54 p https://www.usgs.gov/publications/calibration-trinity-river-stream-salmonid-simulator-s3-extension-klamath-river

Quigley, D. 2004. Final report Scott River adult coho assessment. Siskiyou Resource Conservation District. https://www.siskiyourcd.com/_files/ugd/87211c_a367c597eb8a4008920eb84ccd863058.pdf

Quigley, D. 2005. Scott River watershed adult coho spawning ground surveys November 2004-January 2005. Siskiyou Resource Conservation District report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_097b54bdf2404946b607f06a6b37fbde.pdf

Quigley, D. 2006. Final report adult coho spawning ground surveys November 2005-January 2006. Siskiyou Resource Conservation District for the California Department of Fish and Gam and U. S. Fish and Wildlife Service. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84320

Quigley, D. 2007. Final report adult coho spawning ground surveys 2006-2007. Siskiyou Resource Conservation District. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84321

Quinn, S., C. Laskodi and N. Harris. 2017. Upper Trinity River tributary Coho Salmon spawning survey summary, 2014/14 & 2015/16. Yourok Tribal Fisheries Program. Hoopa, CA.

Ramsden, G. R. 1993. Trinity River salmon and steelhead hatchery annual report, 1991-92. California Department of Fish and Game.

Richey, J. 2006. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery 2002. California Department of Fish and Game. Yreka CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27043

Richey, J. 2006. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery 2005. California Department of Fish and Game. Yreka CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27046

Richey, J. 2007. Klamath River Project Recovery of Fall-run Chinook and Coho Salmon at Iron Gate Hatchery 2003. California Department of Fish and Game. Yreka CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27044

Robinson HE, Alexander JD, Bartholomew JL, Hallett SL, Hetrick NJ, Perry RW, Som NA. 2022. Using a mechanistic framework to model the density of an aquatic parasite Ceratonova shasta. PeerJ 10:e13183 https://doi.org/10.7717/peerj.13183 https://www.usgs.gov/publications/using-a-mechanistic-framework-model-density-aquatic-parasite-ceratonova-shasta

Romberger, C. Z., and S. V. Bell. 2017. Mainstem Klamath River Fall Chinook Salmon Redd Survey 2014-2016. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 201753, Arcata, California.

Romero, R. 2024. Klamath Anadromous fishery reintroduction and restoration, conceptual plan and current implementation. Klamath Basin Monitoring Program workshop presentation. https://kbmp.net/images/stories/pdf/Meeting_Materials/Meeting_33/5_Romero_KBMP_CDFW_PostDamRemovalMonitoring.pdf

Romero, R., and C. Robinson. 2025. 2024 Scott River juvenile salmonid outmigrant study. Fisheries Restoration Grants Program, #CMP-23R1005. California Department of Fish and Game, Yreka, CA.

Romero, R., and C. Robinson. 2025. 2024 Shasta River juvenile salmonid outmigrant study. Fisheries Restoration Grants Program, #CMP-23R1005. California Department of Fish and Game, Yreka, CA.

Royer, C. F., and A. P. Stubblefield. 2016. Klamath Basin Water Quality Monitoring Plan. Prepared for the Klamath Basin Monitoring Program by the Klamath Watershed Institute, Humboldt State University. https://kbmp.net/images/stories/pdf/KBMP_Monitoring_Plan_2016_Update.pdf

Royer, C. F., and A. P. Stubblefield. 2016. Klamath Basin Water Quality Monitoring Plan. Prepared for the Klamath Basin Monitoring Program by the Klamath Watershed Institute, Humboldt State University. https://kbmp.net/images/stories/pdf/KBMP_Monitoring_Plan_2016_Update.pdf

Rupert, D.L., Chamberlain, C.D., Gough, S.A., Som, N.A., Davids, N.J., Matilton, B.C., Hill, A.M., and Wiseman, E.R. 2017. Mainstem Trinity River Chinook salmon spawning distribution 2012-2014: Arcata, California, U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2017-52, 86 p.

Rupert, D.L., Gough, S.A., Som, N.A., Davids, N.J., Matilton, B.C., Hill, A.M., and Pabich, J.L., 2017, Mainstem Trinity River chinook salmon spawning survey, 2015 and 2016: Arcata, California, U.S. Fish and Wildlife Service, Arcata Fisheries Data Series Report Number DS 2017-56, 53 p. https://www.trrp.net/DataPort/doc.php?id=2344

Scheiff, A. J., J. S. Lang and W. D. Pinnix. 2001. Juvenile salmonid monitoring on the mainstem Klamath River at Big Bar and mainstem Trinity River at Willow Creek 1997-2000. Klamath River Fisheries Assessment Program. U, S. Fish and Wildlife Service. Arcata, CA. file:///C:/A%20work/PSMFC/8.%20Klamath%201/References/USFWS/Juvenile_Salmonid_Monitoring_on_the_Mainstem_Klamath_River_at_Big_Bar_and_Mainstem_Trinity_River_at_Willow_Creek_1997-2000.pdf

Schwarz, C., D. Pickard, K. Marine, and S. Bonner. 2009. Juvenile Salmonid Outmigrant Monitoring Evaluation, Phase II - December 2009. Page 228. Trinity River Restoration Program, Weaverville, CA.

Scott River Watershed Council (SRWC). 2005. Initial Phase of the Scott River Watershed Council Strategic Action Plan (October 2005 update). Fiscal Administrator: Siskiyou Resource Conservation District, Etna, CA. https://scottriver.org/wp-content/uploads/2024/06/Scott-River-Strategic-Action-Plan.pdf

Senf, E. 2025. SRCD Scott River Coho main-stem flow and water quality monitoring project (2023-2025). Siskiyou Resource Conservation District. https://www.siskiyourcd.com/_files/ugd/87211c_4e9f5ee74a6348508fd7fc84809c72a7.pdf

Senf, E. 2025. SRCD Scott River Coho Salmon Spawning Ground Surveys 2024-2025 Final Report. Siskiyou Resource Conservation District. https://www.siskiyourcd.com/_files/ugd/87211c_8d99b5ae6bf747d88e74f951a1990282.pdf

Senf, E. and C. Jankowski. 2023. 2022 Fall Chinook Salmon spawning ground survey. Siskyyou Rescource Conservation District report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_907860771b8a4039b0deeab71a4cd1d8.pdf

Senf, E. and C. Jankowski. 2024. Fall Chinook Salmon spawning ground surveys 2023 Final Report. Siskyyou Rescource Conservation District report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_38533c75415b4dfd859abded21dc6335.pdf

Senf, E. and C. Jankowski. 2025. Fall Chinook Salmon spawning ground surveys 2024 Final Report. Siskyyou Rescource Conservation District report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_649f232209184ce083c7ecae8412417b.pdf

Service, Arcata Fish and Wildlife Office, Arcata Fisheries Technical Report Number TR 2012–14, Arcata, California. 52 p.

Shasta Valley Resource Conservation District (SVRCD), Klamath Basin Monitoring Program (KBMP), and North Coast Regional Water Quality Control Board (NCRWQCB). 2018. Shasta River Watershed Stewardship Report. 184 pp. Available from: https://ifrmp.net/file/shasta-river-watershed-stewardship-report/

Shasta Valley Resource Conservation District (SVRCD), Klamath Basin Monitoring Program (KBMP), and North Coast Regional Water Quality Control Board (NCRWQCB). 2018. Shasta River Watershed Stewardship Report. 184 pp. Available from: https://ifrmp.net/file/shasta-river-watershed-stewardship-report/

Sinnen, W., A. Hill, J. Hileman, S. Borok and M. C. Kier. 2010. Trinity River basin salmon and steelhead monitoring project: 2008-2009 season. Annual report. California Department of Fish and Game, Northern Region, Redding, CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=28777

Sinnen, W., C. Reese, B. Null, P. Garrison, and S. Borok. 2002. Trinity River basin salmon and steelhead monitoring project: 2000-2001 season. Annual report. California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84330

Sinnen, W., M. C. Kier, A. Hill, J. Hileman, and S. Borok. 2010. Trinity River basin salmon and steelhead monitoring project: 2007-2008 season. Annual report. California Department of Fish and Game, Northern Region, Redding, CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=25156

Sinnen, W., P. Garrison, M. Knechtle, A. Hill, J. Hileman, and S. Borok. 2009. Trinity River basin salmon and steelhead monitoring project: 2006-2007 season. Annual report. California Department of Fish and Game, Northern Region, Redding, CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=16206

Sinnen, W., S. Borok, A. Hill, J. Hileman and M.C. Kier. 2011. Final Annual Report Trinity River Basin Salmon and Steelhead Monitoring Project 2009-2010 Season. California Department of Fish and Game, Northern Region, Redding, CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=47604

Sinnen, W., S. Borok, S. Cannata, A. Hill, J. Hileman, and M.C. Kier. 2013. Final Annual Report Trinity River Basin Salmon and Steelhead Monitoring Project 2010-2011 Season. California Department of Fish and Game, Northern Region, Redding, CA. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=68319

Som, N. A., and N. J. Hetrick. 2017.

Som, N. A., and W. D. Pinnix. 2014. Evaluation of Reductions in Sampling and Mark-Recapture Effort on the Bias and Precision of Juvenile Chinook Salmon Outmigrant Estimates on the Trinity River, California. U.S. Fish and Wildlife Service, TR 2014-20, Arcata, CA.

Som, N. A., N. J. Hetrick and J. Alexander. 2016. Response to request for technical assistance - Polychaete distribution and infections. Arcata Fish and Wildlife Office Technical Memorandum. Arcata, California.

Som, N. A., N. J. Hetrick, S. Foott and K. True. 2016. Response to request for technical assistance - Prevalence of C. shasta Infections in juvenile and adult salmonids. Arcata Fish and Wildlife Office Technical Memorandum. Arcata, California.

Som, N.A., Alvarez, J., and Martin, A., 2018, Assessment of Chinook salmon smolt habitat use in the lower Trinity River: Arcata, California Hoopa Valley Tribal Fisheries Department, Yurok Tribal Fisheries Program, and U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2018-57, 11 p.

Som, N.A., Perry, R.W., Jones, E.C., De Juilio, K., Petros, P., Pinnix, W.D., and Rupert, D.L., 2018. N-mix for fish-Estimating riverine salmonid habitat selection via N-mixture models: Canadian Journal of Fisheries and Aquatic Sciences, v. 75, no. 7, p. 1048-1058, accessed January 2019, at https://www.nrcresearchpress.com/doi/ 10.1139/cjfas-2017-0027.

Soto, T. M. Hentz, and W. Harling. 2008. Mid-Klamath Sub-basin Fisheries Resource Recovery Plan, Final Draft. Funded by: US Fish and Wildlife Service, Yreka Office. https://static1.squarespace.com/static/5e013c51bf487105fe2e858f/t/617debdd963e4d79e5692ef5/1635642357782/Mid-Klamath_Subbasin_Fisheries_Resource_Recovery_Plan_Final.pdf

Soto, T. M. Hentz, and W. Harling. 2008. Mid-Klamath Sub-basin Fisheries Resource Recovery Plan, Final Draft. Funded by: US Fish and Wildlife Service, Yreka Office. https://www.mkwc.org/s/Mid-Klamath_Subbasin_Fisheries_Resource_Recovery_Plan_Final.pdf

Soto, T., A. Corum, H. Voight, D. Hillemeir, and L. Lestelle. 2008. The role of the Klamath River mainstem corridor in the life history and performance of juvenile coho salmon (Oncorhynchus kisutch). Phase 1 Report 2006-07 Winter. Prepared for Bureau of Reclamation Mid-Pacific Region, Klamath area Office, Klamath Falls, OR.

Soto, T., D. Hillemeier, S. Silloway, A. Corum, A. Antonetti, M. Kleeman, and L. Lestelle. 2016. The Role of the Klamath River Mainstem Corridor in the Life History and Performance of Juvenile Coho Salmon (Oncorhynchus kisutch), Period Covered: May 2007-August 2011. Report submitted to the U.S. Bureau of Reclamation, Klamath Falls, OR.

SRCD, QVIR & SRWC. 2024. Scott River coho salmon spawning ground surveys 2023-2024 season. https://www.siskiyourcd.com/_files/ugd/87211c_60fc838b156140c89c9af0936c81a6f1.pdf

SRCD, QVIR & SRWC. 2025. Scott River Chinook Salmon spawning ground surveys 2024 final report. https://www.siskiyourcd.com/_files/ugd/87211c_649f232209184ce083c7ecae8412417b.pdf

SRCD. 2010. Scott River adult spawning ground surveys December 2009-January 2010. Siskiyou Resource Conservation District. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84322

SRCD. 2024. Scott River coho salmon spawning ground surveys 2022-2023 season. Report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_56e556811d5c4fa0827e97194dc463c8.pdf

SRRC (Salmon River Restoration Council). 2007. Salmon River weak stocks assessment program 2008. Final Report Grant #P0510314, June 1, 2006 through September 30, 2007. https://srrc.org/publications/programs/fisheries/SRRC%20Weak%20Stocks%202006%20Report.pdf

SRRC (Salmon River Restoration Council). 2024. Spring Chinook/Summer Steelhead Dive Salmon River, California. https://srrc.org/publications/programs/fisheries/2024_SalmonRiverDives-Results.pdf

SRWC (Scott River Watershed Council). 2005. Initial Phase of the Scott River Watershed Council Strategic Action Plan (October 2005 update). Fiscal Administrator: Siskiyou Resource Conservation District, Etna, CA. https://scottriver.org/wp-content/uploads/2024/06/Scott-River-Strategic-Action-Plan.pdf

SRWC (Scott River Watershed Council). 2023. 2022-2023 - Coho Salmon Spawning Ground Surveys https://scottriver.org/wp-content/uploads/2024/04/2022_2023_ScottRiver_SpawningGroundSurveyReport_SRWC.pdf

SRWC (Scott River Watershed Council). 2023. 2022-2023 Fish monitoring summary report. https://scottriver.org/wp-content/uploads/2024/04/2022-2023FishMonitoringReport_SRWC.pdf

SRWC (Scott River Watershed Council). 2024. Direct observation summary report, Scott River Watershed 2024. https://scottriver.org/wp-content/uploads/2024/10/Final_2024_SR-Direct-Observation.pdf

SRWC (Scott River Watershed Council). 2024. Juvenile fish sampling report 2023-2024 season. https://scottriver.org/wp-content/uploads/2024/10/2023-2024-Fish-Sampling-Report-240523.pdf

SRWC (Scott River Watershed Council). 2024. Passive Integrated Transponder (PIT) Program 2023/2024. https://scottriver.org/wp-content/uploads/2024/04/2023-24AdultCohoSalmonPITDetections_compressed.pdf

SRWC (Scott River Watershed Council). 2024. Scott River coho salmon spawning ground surveys 2023-2024 season. https://scottriver.org/wp-content/uploads/2024/04/Scott-River-Spawning-Ground-Survey_2023_2024_Final-Report_compressed.pdf

SRWC (Scott River Watershed Council). 2025. Scott River coho salmon spawning ground surveys 2024-2025 season. https://scottriver.org/wp-content/uploads/2025/03/Scott-River-Coho-Salmon-Spawning-Ground-Survey-2024-2025-Season.pdf

Starcevich, S. J., S. E. Jacobs and W. Tinniswood.. 2006. Effects of Dams on Redband Trout Life History in the Upper Klamath River: A Summary and Synthesis of Past and Recent Studies. Oregon Department of Fish and Wildlife. https://digitalcollections.library.oregon.gov/nodes/view/122114

Stenhouse, S. A., Debrick, A. J. & Chesney, W. R., 2016. Scott and Shasta River Juvenile Chinook Salmon Out-Migrant Study: Multiyear Report, 2000-2015, Yreka, CA: California Department of Fish and Wildlife Anadromous Fisheries Resource Assessment and Monitoring Program.

Stenhouse, S., Albanese, R. & Chesney, W. R., 2016. Three Year Report 2013-2015 Shasta and Scott River Juvenile Salmonid Outmigrant Study, CDFW.

Stone et al. 2017

Stone, R., S. Freund and J. S. Foott. 2025. Ceratonova shasta Prevalence of Infection in Klamath River Juvenile Chinook Salmon, March – August 2024. U.S. Fish & Wildlife Service. California – Nevada Fish Health Center, Anderson, CA. https://www.fws.gov/sites/default/files/documents/2025-05/kr2024-final-report.pdf

Sutton, R. 2007. Klamath River thermal refugia study, 2006. Technical Memorandum No. 8668290-01-07, U.S. Bureau of Reclamation, Technical Service Center, Denver, Colorado.

Sutton, R. 2009. Klamath River thermal refugia studies, 2006-2008. Draft Technical Memorandum No. 86-68290-09-03, U.S. Bureau of Reclamation, Fisheries and Wildlife Resources Group, 86-68290.

Sutton, R., M. Deas, M.R. Belchik, and S.M. Turo. 2002. Klamath River thermal refugia study. Report for the United States Bureau of Reclamation, Mid-Pacific Region, Klamath Falls, Oregon.

SWFSC (NOAA Fisheries Southwest Fisheries Science Center). 2022. Viability assessment for Pacific salmon and steelhead listed under the Endangered Species Act: Southwest. 11 July 2022. Report to National Marine Fisheries Service – West Coast Region from Southwest Fisheries Science Center, Fisheries Ecology Division 110 McAllister Way, Santa Cruz, California 95060.

TGA (Thomas Gast & Associates). 2021. Analysis and model evaluation of long-term data collected at the Willow Creek outmigrant trap. Report 20190910YTFP for the Trinity River Restoration Program (TRRP). Thomas Gast & Associates Environmental Consultants, Arcata, California. https://www.trrp.net/DataPort/doc.php?id=2492

True, K. Foott, J. S.; Bolick, A.; Benson, S.; and Fogerty, R. 2010. Myxosporean parasite (Ceratomyxa shasta and Parvicapsula minibicornis) incidence and severity in Klamath River basin juvenile Chinook salmon, April-August 2009.

True, K., A. Bolick, and J. S. Foott. 2011, 2013. Myxosporean parasite (Ceratomyxa shasta and Parvicapsula minibicornis) annual prevalence of infection in Klamath River Basin juvenile Chinook Salmon, 2 reports. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. no copy

True, K., A. Voss, and J. S. Foott. 2016. Myxosporean parasite (Ceratonova shasta and Parvicapsula minibicornis) prevalence of infection in Klamath River Basin juvenile Chinook Salmon, March – August 2016. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. no copy

True, K., J. S. Foott, A. Bolick, S. Benson, and R. Fogerty. 2010. Myxosporean parasite (Ceratomyxa shasta and Parvicapsula minibicornis) incidence and severity in Klamath River Basin juvenile Chinook Salmon, April–August 2009. U.S. Fish and Wildlife Service California-Nevada Fish Health Center, Anderson, California. no copy

UKBWAPT (Upper Klamath Basin Watershed Action Plan Team). 2021. The Upper Klamath Basin Watershed Action Plan, March 2021. Prepared by U.S. Fish and Wildlife Service, Trout Unlimited, Klamath Watershed Partnership, The Klamath Tribes, Oregon Department of Environmental Quality, The Nature Conservancy, and the North Coast Regional Water Quality Control Board of California. https://www.ukbwap.com/downloads

UKBWAPT (Upper Klamath Basin Watershed Action Plan Team). 2021. The Upper Klamath Basin Watershed Action Plan, March 2021. Prepared by U.S. Fish and Wildlife Service, Trout Unlimited, Klamath Watershed Partnership, The Klamath Tribes, Oregon Department of Environmental Quality, The Nature Conservancy, and the North Coast Regional Water Quality Control Board of California. https://www.ukbwap.com/downloads

USBLM. 2025. Categorical exclusion for Trinity River Tributary Remote Stream Incubation (RSI) and carcass supplementation. Redding, CA. Trinity River Tributary Remote Stream Incubation (RSI) and Carcass Supplementation_ROW_Categorical Exclusion

USBR and CDFW. 2017. Hatchery and Genetics Management Plan for Trinity River Hatchery coho salmon.

USFWS (U.S. Fish and Wildlife Service). 2012. Revised recovery plan for the Lost River sucker (Deltistes luxatus) and shortnose sucker (Chasmistes brevirostris). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. xviii + 122 pp. https://ecos.fws.gov/docs/recovery_plan/RRP.LstRvrSckr&ShrtnsSckr_1.pdf

USFWS (U.S. Fish and Wildlife Service). 2012. Revised recovery plan for the Lost River sucker (Deltistes luxatus) and shortnose sucker (Chasmistes brevirostris). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. xviii + 122 pp. https://ecos.fws.gov/docs/recovery_plan/RRP.LstRvrSckr&ShrtnsSckr_1.pdf

USFWS (U.S. Fish and Wildlife Service). 2015. Recovery plan for the coterminous United States population of bull trout (Salvelinus confluentus). Portland, Oregon. xii + 179 pages. https://ecos.fws.gov/docs/recovery_plan/Final_Bull_Trout_Recovery_Plan_092915-corrected.pdf

USFWS (U.S. Fish and Wildlife Service). 2015. Recovery plan for the coterminous United States population of bull trout (Salvelinus confluentus). Portland, Oregon. xii + 179 pages. https://ecos.fws.gov/docs/recovery_plan/Final_Bull_Trout_Recovery_Plan_092915-corrected.pdf

USFWS, 2024. Lost River Sucker (Deltistes luxatus) 5-Year Review: Summary and Evaluation. Klamath Falls Fish and Wildlife Office.

USFWS. 1989. Klamath River fisheries assessment program juvenile salmonid production monitoring 1988 Annual Report. Report No. AFF-FAO-89-12. Fisheries Assistance Office. Arcata CA.

USFWS. 2023. Biological Opinion on the Effects of the Proposed Interim Klamath Projects Operations Plan, effective October 1, 2023, through October 31, 2024, on the Lost River sucker and shortnose sucker. USFWS Klamath Falls Fish and Wildlife Office, Klamath Falls, Oregon.

USFWS. 2024. Klamath River Carcass and Redd Surveys Update – December 20, 2024. Arcata Fish and Wildlife Office Fish and Aquatic Conservation Program." https://www.fws.gov/sites/default/files/documents/2024-12/klamath-spawn-update-20dec2024.pdf

USFWS. 2024. Klamath River outmigrant monitoring update – May 31, 2024. Arcata Fish and Wildlife Office Fish and Aquatic Conservation Program." https://www.fws.gov/sites/default/files/documents/2024-06/klamath.trap_.update.05.31.2024.pdf

USFWS (U.S. Fish and Wildlife Service).2024. Species Status Assessment for the Coterminous Distinct Population Segment of Bull Trout (*Salvelinus confluentus*). Version 1.1, September 3, 2024. Boise, Idaho. 182 pp.

Valley Tribal Fisheries Department, and U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2012–27, Arcata, California. 52 p.

Voight, H. 1999. Assessment of juvenile salmonid populations in two index reaches of McGarvey Creek, a tributary to the lower Klamath River. First year of incestiations - 1998. Yurok Tribal Fisheries Program Technical Report 7. https://www.krisweb.com/biblio/klamath_yuroktfp_voight_1999_7.pdf

Voigt, C. 2021. Scott River adult coho spawning ground surveys 2020-2021 season. Report by the Siskiyou Resource Conservation District for the U. S. Forest Service, Klamath National Forest.

Voigt, C. 2022. 2021 Fall Chinook Salmon spawning ground survey. Siskyyou Rescource Conservation District report to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_4329dbc2f75c4e2baaff89ad847d67f6.pdf

Voigt, C., and L. MagranetL. 2020. Scott River adult coho spawning ground surveys 2019-2020 season. Report by the Siskiyou Resource Conservation District for the U. S. Forest Service, Klamath National Forest. https://www.siskiyourcd.com/_files/ugd/87211c_c2e97d0446e24ed98c5eefcdae89f786.pdf

Voss, A., R. Stone and S. Freund. 2024. California-Nevada Fish Health Center Investigational Report: Myxosporean Parasite (Ceratonova shasta) Prevalence of Infection in Klamath River Basin Juvenile Chinook Salmon, March – August 2023. U.S. Fish & Wildlife Service. California – Nevada Fish Health Center, Anderson, CA. https://www.fws.gov/sites/default/files/documents/final-kr23-report-2-26-24.pdf

Walker, C. A. 1998. 1998 Willow Creek downstream migrant trap report. Lower Trinity Ranger District, Six River National Forest. https://www.krisweb.com/biblio/trinity_usdafs_walker_1998_98wcdmtdraft.pdf

Wallace, M. 1993. Distribution, abundance, size, and coded-wire tag recovery of juvenile Chinook salmon in the Klamath River estuary, 1986-1989. Final Performance Report. Federal Aid in Sport Fish Restoration Act. Project No. F-51-R; Subproject IX: Study No. 10; Job No. 3.

Wallace, M. 1995. The emigration timing of juvenile salmonids through the Klamath River estuary. Pages 54-72 in: T.J. Hassler, editor. Proceedings Klamath Basin Fisheries Symposium. March 23-24, 1994. Eureka, California. https://www.krisweb.com/biblio/klamath_cdfg_wallace_1994_wqannual.pdf

Wallace, M. 1998. Seasonal water quality monitoring in the Klamath River estuary, 1991-1994. California Department of Fish and Game, Inland Fisheries Administrative Report No. 989. https://www.krisweb.com/biblio/klamath_cdfg_wallace_1998_wqfinal.pdf

Wallace, M. 2000. Length of residency of juvenile Chinook salmon in the Klamath River estuary. Final Performance Report. Federal Aid in Sport Fish Restoration Act. Project No. F-51-R; Project No. 17; Job No. 5. 21pp. https://www.krisweb.com/biblio/klamath_cdfg_wallace_2000_lor.pdf

Wallace, M. 2002. Klamath River Basin Juvenile Salmonid Intestigations: Natural vs hatchery proportions of juvenile salmonids migrating through the Klamath River estuary and monitor natural and hatchery juvenile salmonid emigration from the Klamath Basin, July 1, 2001, through June 30, 2002. California Department of Fish and Game. Federal Aid in Sport Fish Restoration Act Project Number F-51-R-6. https://www.krisweb.com/biblio/klamath_cdfg_wallace_2002_emigrationsurvey.pdf

Wallace, M. 2003. Klamath River Basin Juvenile Salmonid Intestigations: Natural vs hatchery proportions of juvenile salmonids migrating through the Klamath River estuary and monitor natural and hatchery juvenile salmonid emigration from the Klamath Basin, July 1, 1998, through June 30, 2003. California Department of Fish and Game. Federal Aid in Sport Fish Restoration Act Project Number F-51-R-6. https://www.krisweb.com/biblio/klamath_cdfg_wallace_2003_finalemigration.pdf

Wallace, M., and B.W. Collins. 1997. Variation in use of the Klamath River estuary by juvenile Chinook salmon. California Fish and Game 83(4):132-143.

Wallin, T. J., W. D. Pinnix, and N. A. Som. 2021. Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2021. U.S. Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2021-67.

Wallin, T. J., W. D. Pinnix, and N. A. Som. 2023. Summary of Abundance and Biological Data Collected During Juvenile Salmonid Monitoring on the Mainstem Klamath River Below Iron Gate Dam, California, 2022. U.S.

Fish and Wildlife Service. Arcata Fish and Wildlife Office, Arcata Fisheries Data Series Report Number DS 2023-69. https://www.fws.gov/sites/default/files/documents/508_KlamathOutmigrantReport2022_final.pdf

Walsh, B. 2008. Scott River adult coho spawning ground surveys 2007-2008 season. Report by Siskiyou Resource Conservation District to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_780bdf6014384ef981b4764485c4aaf2.pdf

Walsh, B., and D. Yokel. 2010. Scott River adult coho spawning ground surveys 2008-2009 season. Report by Siskiyou Resource Conservation District to the U. S. Fish and Wildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_d81743e96a3c4742a1dd190dce2940e8.pdf

Walsh, B., and M. Hampton. 2007. Shasta River Fish Counting Facility, Chinook and coho salmon observations in 2006, Siskiyou County, CA https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27070

Weskamp, D.R., and H.N. Voight. 2001. Juvenile salmonid emigration monitoring on the lower Klamath and lower Trinity Rivers, California, 1998. Yurok Tribal Fisheries Program, Habitat Assessment and Biological Monitoring Division Technical Report No. 8, Klamath California.

Weskamp, D.R., H.N. Voight, and D.B. Gale. 1998. Juvenile salmonid emigration monitoring on the lower Klamath River, California, 1997. Yurok Tribal Fisheries Program, Habitat Assessment and Biological Monitoring Division Technical Report No. 5, Klamath California.

West, J. R. 1988. Steelhead spawner escapement and habitat utilization in selected Scott River tributaries. 1988. U. S. Forest Service. Etna, CA. https://www.siskiyourcd.com/_files/ugd/87211c_2202f8e1759348bdaf5170d5fcd26c87.pdf

West, J. R., O. J. Dix, A. D. Olson, M. V. Anderson, S. A. Fox and J. H. Power. 1990. Evaluation of fish hatbitat condition and utilization in Salmon, Scott, Shasta, an mid-Klamath sub-basin tributaries 1988/1989. Annual Report for Interagency Agreement 14-16-0001-89508. U. S. Forest Service, Klamath National Forest. Yreka, CA. https://www.siskiyourcd.com/_files/ugd/87211c_9588e7ee72fb4a90998d7efaca520bfc.pdf

Whitmore, S. K. 2014. Seasonal growth, retention, and movement of juvenile coho salmon in natural and constructed habitats of the mid-Klamath River. Master's Thesis. Humboldt State University. http://humboldt-dspace.calstate.edu/handle/10211.3/124018

Wickman, C., M. Wickman, W. Harling and J. Peterson. 2020. Durazo Pond Monitoring Report. Mid Klamath Watershed Council. https://www.mkwc.org/s/Durazo_Final.pdf

Williams, D. 2015. Yurok Tribal fall fishery monitoring, 2013. Report to the Trinity River Restoration Program. Yurok Tribal Fisheries Program, Klamath, California. https://www.trrp.net/library/document?id=2242

Wiseman, E. 2000. 2000 Hayfork Creek summer snorkel surveys. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84292

Wiseman, E. 2000. South Fork Trinity River mains stem, summer snorkel surveys 2000. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84281

Wiseman, E. 2003. South Fork Trinity River mains stem, summer snorkel surveys 2003. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84283

Wiseman, E. 2006. Canyon Creek Summer Snorkel Surveys 2006 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84273

Wiseman, E. 2006. New River Summer Snorkel Surveys 2006 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84265

Wiseman, E. 2006. North Fork Trinity River Summer Snorkel Surveys 2006. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84278

Wiseman, E. 2007. 2007 Hayfork Creek summer snorkel surveys. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84294

Wiseman, E. 2007. New River Summer Steelhead Surveys 2007 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84266

Wiseman, E. 2007. South Fork Trinity River mains stem, summer snorkel surveys 2007. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84287

Wiseman, E. 2007. Trinity River Tributary Annual Summer Snorkel Survey 2007 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84274

Wiseman, E. 2008. Canyon Creek Summer Snorkel Surveys 2008 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84275

Wiseman, E. 2008. New River Summer Snorkel Surveys 2008 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84267

Wiseman, E. 2008. North Fork Trinity River Summer Snorkel Surveys 2008. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84279

Wiseman, E. 2009. Trinity River Tributary Annual Summer Snorkel Survey 2009 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84268

Wiseman, E. 2010. Trinity River Tributary Annual Summer Snorkel Survey 2010 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84269

Wiseman, E. 2011. New River Snorkel Survey 2011 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84270

Wiseman, E. 2011. Trinity River Tributary Annual Summer Snorkel Survey 2011 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84276

Wiseman, E. 2012. Canyon Creek Summer Snorkel Surveys 2012 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84277

Wiseman, E. 2012. New River Snorkel Survey 2012 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84271

Wiseman, E. 2012. North Fork Trinity River Summer Snorkel Surveys 2012. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84280

Wiseman, E. 2013. Trinity River Tributary Annual Summer Snorkel Survey 2013 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84272

Wiseman, E. 2013. Trinity River Tributary Annual Summer Snorkel Survey Anadromous Fish Counts 1978-2013. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84264

Yokel, E. 2006. Scott River summer habitat utilization study. Report by Siskiyou Rescource Conservation District to the U. S. Fish and Eildlife Service. https://www.siskiyourcd.com/_files/ugd/87211c_ac21bbc2bcb049bebf0b98d54305505e.pdf

Yorkel, D. 2010. Scott River adult coho survey table VI. Redds by survey year 2001-2008. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84328

Yorkel, D. 2011. Scott River adult spawning ground surveys December 2010-January 2011. Siskiyou Resource Conservation District. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84323

Yorkel, D. 2013. Scott River adult spawning ground surveys 2012-2013 season. Siskiyou Resource Conservation District. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84325

Yorkel, D. 2014. Scott River adult spawning ground surveys 2013-2014 season. Siskiyou Resource Conservation District for the Klamath National Forest. https://www.siskiyourcd.com/_files/ugd/87211c_3791f343ff2a4ee0b46c26fc765a8338.pdf

YTFP and YTWRP (Yurok Tribal Fisheries Program and Yurok Tribal Watershed Restoration Program). 2000. Lower Klamath River Sub-basin Watershed Restoration Plan. Prepared by Dan B. Gale (YTFP) and D.B. Randolph (YTWRP). 77 p https://ifrmp.org/file/lower-klamath-river-sub-basin-watershed-restoration-plan/

YTFP and YTWRP (Yurok Tribal Fisheries Program and Yurok Tribal Watershed Restoration Program). 2000. Lower Klamath River Sub-basin Watershed Restoration Plan. Prepared by Dan B. Gale (YTFP) and D.B. Randolph (YTWRP). 77 p https://ifrmp.org/file/lower-klamath-river-sub-basin-watershed-restoration-plan/

Yurok Tribal Fisheries Program. 2009. A complete life history monitoring of salmonids in McGarvey Creek, Lower Klamath River Sub-Basin, 2006-2009. Yurok Tribal Fisheries Program, Klamath, California.

Zuspan, M., B. Collins, C. Wilson, M. Lau, B. Heubach, E. Miller, B. Aguilar, M. Dean and R. Reavis. 1994. Trinity River Basin salmon and steelhead monitoring project 1991-1992 season. California Department of Fish and Wildlife. Sacramento CA.

Zuspan, M., B. Heubach, C. Wilson, B. Aguilar, M. Dean, B. Collins, M. Lau, and E. Miller. 1992. Trinity River Basin salmon and steelhead monitoring project 1990-1991 season. California Department of Fish and Wildlife. Sacramento CA.

Zuspan, M., B. Heubach, M. Lau, M. Boucke, C. Wilson, T. Mills, and B. Aguilar. 1992. Trinity River Basin salmon and steelhead monitoring project 1989-1990 season. California Department of Fish and Wildlife. Sacramento CA.

ACRONYMS & ABBREVIATIONS

BDA	Beaver Dam Analogues
BI	Biological Interactions
BiOp	Biological Opinion
BLM	US Bureau of Land Management
CDFW	California Department of Fish & Wildlife
cfs	Cubic Feet Per Second
CPI	Core Performance Indicator
CRMP	Coordinated Resources Management Planning
CWA	Clean Water Act
DDP	Definite Decommissioning Plan
DO	Dissolved Oxygen
DQO	Data Quality Objectives
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
FCFH	Fall Creek Fish Hatchery
FERC	Federal Energy Regulatory Commission
FG	Fluvial Geomorphic
FP	Fish Populations
H	Habitat
HAB	Harmful Algae Bloom
HCP	Habitat Conservation Plan
HUC	Hydrologic Unit Code
IFRMP	Integrated Fisheries Restoration and Monitoring Plan
IRPT	IFRMP Restoration Prioritization Tool
IGD	Iron Gate Dam
IGFH	Iron Gate Fish Hatchery
IRCT	Interior Redband Conservation Team
KBMP	Klamath Basin Water Quality Monitoring Plan
KDNR	Karuk Department of Natural Resources
KHSA	Klamath Hydroelectric Settlement Agreement
KRRC	Klamath River Renewal Corporation
LKR	Lower Klamath River
LKRP	Lower Klamath River Restoration Plan
LWD	Large Woody Debris
MDAT	Mean Daily Average Temperature
MDMT	Maximum Daily Maximum Temperature
MKR	Mid-Klamath River
MKSFRP	Mid Klamath Sub-basin Fisheries Recovery Plan
MKWC	Mid Klamath Watershed Council
MUK	Mid-Upper Klamath
MWAT	Mean Weekly Average Temperature
MWMT	Mean Weekly Maximum Temperature
N	Nitrogen
NAIP	National Agricultural Imagery Program
NCRWQCB	North Coast Regional Water Quality Control Board

NGO	Non Governmental Organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic & Atmospheric Administration
NRC	National Research Council
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OSU	Oregon State University
OWL	Open Water Likelihood
OWRD	Oregon Water Resources Department
P	Phosphorus
PCR	Principle Component Regression
PCSRF	Pacific Coastal Salmon Recovery Fund
PHWA	Preliminary Healthy Watersheds Assessments (EPA program)
PIT	Passive Integrated Transponder
PSMFC	Pacific States Marine Fisheries Commission
PWA	Pacific Watershed Associates
QA / QC	Quality Assurance / Quality Control
RM	River Mile
ROD	Record of Decision
SET	Stream Evolution Triangle
SFT	South Fork Trinity
SONCC	Southern Oregon/Northern California Coast Coho Salmon
SOP	Standard Operating Procedure
SRCD	Siskiyou Resource Conservation District
SRRS	Salmon River Restoration Plan
SRWC	Scott River Watershed Council
SRWSR	Shasta Watershed Stewardship Plan
SVRCD	Shasta Valley Resource Conservation District
TAMWG	Trinity Adaptive Management Working Group
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TRRP	Trinity River Restoration Plan
TSS	Total Suspended Solids
UAV	Unmanned Aerial Vehicles
UKBWAP	Upper Klamath Basin Watershed Action Plan
UKL	Upper Klamath Lake
UKR	Upper Klamath River
USBR	US Bureau of Reclamation
USDC	US Department of Commerce
USDI	US Department of the Interior
USFWS	US Fish & Wildlife Service
USGS	United States Geological Survey
WI	Watershed Inputs
WRTC	Watershed Research and Training Center
YTEP	Yurok Tribe Environmental Program
YTFD	Yurok Tribal Fisheries Department

APPENDIX A: KEY ENTITIES & RELATED ACTIVITIES

This section reviews key entities involved in Klamath Basin monitoring, research and related regulatory or coordination activities.

COLLABORATION BODIES

Klamath Basin Monitoring Program (KBMP)

The KBMP was developed to facilitate coordination and implementation of water quality monitoring within the Klamath River watershed, with the goal of restoring water quality (https://kbmp.net/). Participants include tribes, non-profit organizations, and federal, state and local governments.

The program was formalized in 2006 when the North Coast Regional Water Quality Control Board with support from the U. S. Environmental Protection Agency and the California Non-point Source Program proposed a contract to facilitate the development of the coordinated monitoring and assessment plan within the Klamath Basin. The Klamath Basin Water Quality Monitoring Plan was adopted in 2010 and updated in 2016 (Royer & Stubblefield 2016).

The program was initially coordinated by the Klamath Watershed Institute, an affiliate of Humboldt State University and beginning in 2014, the San Francisco Estuary Institute (SFEI). Ongoing activities include maintaining a web-based portal to water quality monitoring data, supporting an online repository of documents relevant to the water quality and fisheries of the Klamath River and facilitation of annual meetings for networking and information exchange.

Klamath Dam Removal Science Collaboration (KDRSC)

This program was initiated in 2020 by the Yurok and Karuk Tribes to coordinate dam removal science and monitoring focused on fisheries, water quality, and physical processes. This initiative sponsored a series of workshops in 2020, 2023 and 2024 to share information and perspectives on research, monitoring, and restoration on the Klamath River and other large dam removals (Genzoli et al. 2021; Keel et al. 2023). Workshops included subject-specific breakout groups who identified lists of current projects, gaps in research and monitoring, top research and monitoring priorities, and opportunities for collaboration.

Klamath Basin Fisheries Collaborative (KBFC)

The KBFC is a partnership of entities conducting research and monitoring using PIT technology throughout the Klamath Basin. The Collaborative facilitates access to fisheries data among state, federal, tribal, and non-profit organizations through a PIT tag monitoring and database project administered by the Pacific States Marine Fisheries Commission. Primary active partners include Karuk, Yurok, and Klamath Tribes, USGS, USFWS, CDFW and the Scott River Watershed Council.

The KBFC replaced the 2017 Klamath River Basin (KRB) PIT Tagging Database with a new standardized and structured database system. The PIT Tag Network was created to house hundreds of thousands of records on tag releases and detections of endangered Coho Salmon and suckers and other species including bull trout, Chinook Salmon, steelhead, and lamprey. PSMFC maintains a web-based data exchange portal to facilitate access and share PIT tag data. PSMFC also maintains a website for the Klamath Basin Integrated Fisheries Restoration and Monitoring Plan (IFRMP) developed for the US Fish and Wildlife Service.

The KBFC held annual meetings beginning in 2022 and is expected to play a significant role in continuing monitoring and research and coordination and planning efforts in the Klamath Basin. https://www.kbfishc.org/

Trinity River Restoration Program

The Trinity River Restoration Program (TRRP) implements the 2000 U.S. Department of Interior Record of Decision to restore the fisheries of the Trinity River impacted by dam construction and related diversions of the Trinity River Diversion of the Central Valley Project (Trinity River Restoration Program [TRRP] 2021). The TRRP is a multi-agency program with eight partners forming the Trinity Management Council including the U.S. Bureau of Reclamation, USFWS, Hoopa Valley Tribe, Yurok Tribe, California Natural Resources Agency, NOAA Fisheries, USFS, and Trinity County. The TRRP also includes many other collaborators. The TRRP Focal Reach for restoration includes the Trinity River from Lewiston Dam downstream to the confluence of the North Fork Trinity River (TRRP 2021).

TRIBES

There are six federally recognized Tribes in the Klamath Basin: Yurok Tribe, Pulikla Tribe of Yurok People, Hoopa Valley Tribe, Karuk Tribe, Quartz Valley Indian Community of the Quartz Valley Reservation, and The Klamath Tribes. Klamath Basin tribes work to co-manage their fisheries resources with their federal trustee under federal law and provisions established through key consultation policies, including the U.S. Department of Interior's Policy on Consultation with Indian Tribes and the USFWS's Native American Policy.

Hoopa Tribe

The Hoopa Valley Tribe's (HVT) Fisheries Department co-manages tribal trust fisheries resources for the benefit of tribal members on the mainstem Klamath and Trinity Rivers as well as key tributaries. HVT is a signatory to the Trinity River Record of Decision (ROD) (USDI 2000) that broadly speaking aims to restore Trinity River fish populations to pre-dam levels. The HVT is a participating member of Trinity Management Council (TMC) where the Tribe holds a unique co-management role in relationship to the Trinity River Restoration Program (TRRP). HVT coordinates with USBR and other state, federal, and tribal agencies within the basin to manage flow releases on the Trinity River, plan and implement landscape level restoration efforts to restore fish habitat, augment coarse sediment, monitor and manage fish populations and their recovery, and engage in watershed restoration to promote fish passage and reduce fine sediment inputs. HVT also works to regulate and monitor water quality to reduce the prevalence of fish disease, nuisance algae, and other detrimental factors impacting the health of the fishery.

Subsistence fishing continues to be a vital element of the Hoopa culture and economy. Tribal fishing is actively monitored and managed by the HVT Fisheries Department, which participates in annual Pacific States Fisheries Management Council (PSFMC) technical collaborative fisheries management for the broader Klamath Basin, along with CDFW, NMFS, USFWS, and other tribes. HVT also actively co-manages the hatchery on the Trinity River.

Karuk Tribe

The mission of the Karuk Tribe's Department of Natural Resources is to protect, enhance, and restore cultural and natural resources, as well as ecological processes, upon which Karuk people depend. Subsistence fishing by Karuk Tribal members continues to this day at Ishi Pishi Falls and has strong ceremonial significance. The Karuk Tribe's Fisheries Department works to protect the health and abundance of tribal trust fisheries resources throughout the Klamath Basin, including harvest management. Overarching goals include better understanding ecological processes that support the fishery as well as enhancing the fisheries through restoration (Karuk Department of Natural Resources 2015).

The Karuk Tribe actively monitors water quality and fisheries resources on the Klamath River as well as key tributaries, including the Scott, Shasta, Salmon Rivers and numerous creeks. They have worked with state and federal agencies, as well as tribal partners to remove the Klamath River dams and comprehensively restore the basin, including its hydrology, for the benefit of the fishery. The Karuk Tribe also works to restore fish passage throughout the basin (e.g., Dwinnel Dam on the Shasta River), protect instream flows, assess and better manage impacts from groundwater utilization, and implement numerous restoration projects to improve fish habitat. The Karuk Tribe also actively manages forest resources and fire-related issues throughout the mid-Klamath Basin.

The Karuk Tribe conducts spawner surveys, carcass surveys, outmigrating juvenile trapping, fish disease monitoring, and runs PIT-tag arrays for coho and lamprey located throughout the Mid-Klamath. The Tribe also conducts monitoring of coldwater refugia and off channel ponds for coho use/abundance.

The Klamath Tribes

The Klamath Tribes are based in the upper Klamath Basin and serve a membership of Klamath, Modoc, and Yahooskin Peoples. They actively monitor and manage water quality and quantity within the upper basin. The 2013 adjudication of their water right resulted in significant instream flow protections for the upper basin (UKBCA 2014). The Klamath Tribes' Fisheries Department is currently working with ODFW to develop a salmon reintroduction plan. They are also developing comprehensive planning to guide restoration throughout the entire upper basin.

The Klamath Tribes suffered the loss of their historic salmon fishery after the construction of the dams began in 1918. Despite this loss, they continue to coordinate with USBR, USFWS, and other state and federal agencies to promote the management and restoration of other non-anadromous upper basin species. Their water quality monitoring program is extensive and includes key upper basin tributaries such as the Williamson and Sprague rivers.

The Klamath Tribes' fishery management program consists of cooperative interagency monitoring of Lost River and shortnose sucker populations in Upper Klamath Lake and its tributaries. The Klamath Tribes also provides technical support to population recovery efforts through captive propagation of approximately 1 million larval suckers each year in addition to cooperative planning for the reintroduction of Chinook salmon to the upper Klamath Basin. The Klamath Tribes also monitors fish populations and actively promotes habitat enhancement and restoration on 1 million acres of former reservation land.

Quartz Valley Indian Reservation

The Quartz Valley Indian Community is a federally recognized tribe of the Klamath, Karuk, and Shasta Peoples in Siskiyou County, California, with tribal offices headquartered in Fort Jones, CA, near the Scott River. Quartz Valley's Environmental Department works to protect and restore the natural environment for current and future generations. They have an active water quality monitoring program and have participated in basin-wide fisheries management and restoration-related forums.

Yurok Tribe

Since the late 1990s, the Yurok Tribe's Lower Klamath Division of Fisheries (YTFP-LKD) has been conducting comprehensive watershed and physical habitat assessments to guide watershed restoration and species recovery efforts in the Lower Klamath River sub-basin. Initial restoration planning efforts included development of the Lower Klamath Sub-Basin Watershed Restoration Plan that prioritized upslope restoration and identified tributary-specific restoration objectives for each lower Klamath tributary (Gale and Randolph 2000). Sub-basin restoration objectives include: (1) reducing sediment inputs from upslope sources by decommissioning priority road segments and stream crossings; (2) restoring native, conifer-dominated riparian forests; and (3) enhancing aquatic habitats

and associated floodplains. YTFP-LKD works closely with the CDFW and the NMFS to identify and implement priority Southern Oregon/Northern California Coast (SONCC) coho salmon recovery actions for the sub-basin (CDFW 2004a; NMFS 2014). YTFP-LKD also conducts performance monitoring to assess effectiveness of implemented restoration actions to guide their adaptive management approach and to ensure knowledge transfer to basin partners. YTFP-LKD continues implementing priorities outlined in the Lower Klamath Plan as well as using real-time restoration performance, watershed, and biological assessments to guide restoration actions in an adaptive, collaborative, and long-term stewardship approach.

The Yurok Tribal Fisheries Department conducts numerous anadromous fish monitoring projects throughout the Klamath Basin for both juvenile and adult life stages of coho and Chinook salmon. The Tribe typically works alone within the Yurok Reservation, while off-reservation monitoring usually involves co-managed efforts with the Karuk Tribe, Hoopa Tribe, USFWS, CDFW, and USFS.

Yurok juvenile salmonid monitoring provides long-term data for abundance, timing, health, and size of juveniles emigrating from key tributaries such as Blue Creek, McGarvey Creek, and the Trinity River (since early to mid-1990s). For the past ten years the Tribe estimated emigration abundance from additional tributaries in the Lower Klamath River, including Waukel Creek, Salt Creek, and Panther Creek. These projects quantify juvenile production from tributary salmonid populations, facilitating status and trend monitoring of various populations and their life history strategies. Yurok Fisheries has also seined for juveniles in the Lower Klamath River for the past several years to collect known-origin fish (coded wire tagged from one of the two hatcheries in the basin) so the California-Nevada Fish Health Center can assess these fish for the presence of disease.

Since 2006, with funding from the U.S. Bureau of Reclamation and in coordination with the Karuk Tribe, the Yurok Tribe has conducted a juvenile coho salmon ecology project. This project involves implementation of PIT tags to track the fate of individual fish at downstream migrant traps and PIT tag receiver stations in Lower Klamath tributaries. The Yurok Tribe currently runs PIT tag detection stations in McGarvey, Terwer, Waukel, Salt, and Panther creeks. This project also includes mark-recapture population estimates in natural and human-made wetland/pond habitats of the Lower Klamath River. A key finding of the coho ecology projects is that lower Klamath tributaries provide substantial habitat, especially over-wintering habitat, to non-natal juvenile coho salmon from throughout basin.

Adult salmonid monitoring efforts include harvest and escapement monitoring for fall run Chinook salmon and, to some extent, coho salmon. These projects resulted in long-term data (>20 years) for adult fall Chinook in the Upper Klamath River, several mid-Klamath tributaries, the Upper Trinity River, and Blue Creek. The data are critical for salmon management, since fall Chinook population trends often drive ocean management along the coast of California and Oregon. Collected data also provide information necessary to assess population dynamics of Klamath fall Chinook, various modeling efforts, and the trajectory of different populations throughout the basin.

Yurok Fisheries also conducts a fall Chinook salmon age composition project. Staff mount and age scales from adult salmon. This project is essential for harvest management because it provides cohort-specific abundance estimates and permits assessment of relationships between adult abundance and environmental conditions/management activities. Yurok Fisheries staff also participate in adult spring Chinook and summer steelhead survey dives in the Salmon River, South Fork Trinity River, and the New River.

Non-salmonid fish species such as green sturgeon, lamprey, and eulachon, are important components of the diet and culture for Yurok People. With the exception of eulachon, these species have neared extirpation in recent decades. The Tribe has conducted 15 years of projects to assess the status, life history and/or habitat requirements of these species. The Tribe has tagged adult green sturgeon (Acipenser medirostus) intermittently since the early 2000s, initially using radio tags and then switching to acoustic tags for detection by acoustic receivers that were

deployed by other entities along the Pacific Coast. This study yielded useful information regarding the life history of green sturgeon. For example, sturgeon adults tagged in the Klamath River were detected as far north as Vancouver Island, British Columbia, and in bay/estuarine environments along the Oregon and Washington coasts. Green sturgeon adults were typically found to return to the Klamath River every two to four years to spawn, and distinct migration patterns were observed among adults, such as emigration to the ocean in the spring rather than October/November when the fall freshet begins. In collaboration with the Karuk and Hoopa Valley Tribes, Yurok Fisheries also recently conducted lamprey telemetry tagging studies to assess life history characteristics. Other studies have attempted to assess the presence of eulachon (Thaleichthys pacificus) in the Klamath River, with little success. Future eulachon studies will likely include the use of environmental DNA to assess the species' presence longitudinally in the river.

Pulikla Tribe of Yurok People

The Pulikla Tribe of Yurok People is located at the top of the Klamath River estuary. Members retain an unbroken tradition of fishing for salmon on the Klamath River. They do not have a formal fisheries department but actively participate in policy forums to promote fisheries restoration throughout the basin. The Tribe advocates for improved water management and water quality in the upper Klamath Basin because of the linkages to downstream fisheries health.

STATE AGENCIES

California Department of Fish & Wildlife

Chinook salmon, native trout, lamprey, sturgeon and other fish endemic to the Klamath Basin are regulated by California Department of Fish and Wildlife (CDFW) and the Oregon Department of Fish and Wildlife (ODFW).

In California, regulatory authority for all non-tribal in-river fisheries rests with the California Fish and Game Commission. The Commission is composed of five members appointed by the Governor and confirmed by the State Senate. The Commission sets hunting and sport fishing regulations including seasons, bag limits, methods and areas of take. Additionally, the Commission formulates general policies for the California Department of Fish and Wildlife (CDFW) and regulates aspects of commercial fishing. The Legislature has delegated to the Fish and Game Commission a variety of powers, some general in nature and some very specific. These powers are delegated within California Statutes that comprise the Fish and Game Code. Under the Commission, the CDFW serves to implement the State's policies, rules and regulations to manage and protect fisheries resources in waters of the State.

In-river fisheries management in the Klamath Basin is divided into two sets of regulatory management areas. The first management area includes habitats downstream of anadromous barriers, Iron Gate Dam on the Klamath River and Lewiston Dam on the Trinity River. The second management area focuses on habitats above the anadromous barriers.

Recreational fishing within the California portion of the Klamath Basin requires a California sport fishing license and other applicable report cards (steelhead and salmon report cards) (www.wildlife.ca.gov/Fishing/Inland). Fishery regulations above the dams are generally concordant with state-wide trout season bag and possession limit restrictions for stream fishing (reservoirs excluded). The Klamath River, above Iron Gate Dam, is traditionally open to angling between the last Saturday in April through November 15 (www.wildlife.ca.gov/Fishing/Inland).

Fishery regulations below Iron Gate Dam affect all recreational fishers (non-tribal members) in all areas including the Hoopa and Yurok Reservation lands. Most tributaries in the Lower Klamath River are closed to fishing year round, with the exception of Bogus Creek and the Salmon, Scott, and Shasta rivers

(www.wildlife.ca.gov/Fishing/Inland). These areas are restricted by time and area closures and "catch and release" regulations, with the exception that two hatchery-marked steelhead may be retained.

State regulatory changes are generally considered on a two-year cycle; however, because of the dynamic management within the Klamath Basin this regulatory cycle is performed annually. The annual cycle is required to incorporate prospective levels of adult fall Chinook salmon allocations into daily bag and possession limits or other restrictions for the recreational fishery which are commensurate with the expected level of harvestable adult fall Chinook. Regulations for other species (sturgeon, spring Chinook, steelhead, coho, etc.) are also updated annually in the Klamath Basin.

CDFW's Klamath-Trinity Program is dedicated to surveying and studying anadromous fishes within the current anadromous portions of the Klamath River and Trinity River basins. The program contains two projects: Klamath River Project (KRP) and Trinity River Project (TRP). The KRP encompasses the Klamath River from Iron Gate Dam downstream to the Pacific Ocean and includes the Salmon, Scott, and Shasta rivers, as well as Bogus Creek and a dozen other smaller tributaries. The TRP covers the Trinity River from Lewiston Dam (furthest upstream extent of anadromy) downstream to the confluence of the Klamath River. The goals of the KRP and TRP include assessing population abundance, age structure, hatchery composition, run timing, spawning distribution, fork length frequency, and sex ratios for salmonids, primarily of fall-run Chinook salmon.

Spring-run Chinook salmon are also monitored under the TRP. Monitoring efforts focus on producing annual run-size, angler harvest, and spawner escapement estimates for spring-run Chinook salmon within the Trinity River Basin (Kier et al. 2022). These efforts include evaluating both natural-origin and hatchery-origin (Trinity River Hatchery origin) fish. Spring-run chinook are also monitored on the Salmon River by the Salmon River Restoration Council and other partners. These include annual snorkel surveys in late July for spring-run Chinook salmon and summer steelhead (adults and half pounders) as well as spawner, carcass, and redd surveys for spring-run Chinook in early fall.

The CDFW established the Fisheries Restoration Grant Program (FRGP) in 1981 in response to rapidly declining populations of wild salmon and steelhead trout and deterioration fish habitat in the state (CDFW 2021b). The FRGP is primarily funded through the National Oceanic and Atmospheric Administration's Pacific Coastal Salmonid Recovery Fund. The program is a competitive grant program that invests millions of dollars to support projects that lead to process-based restoration, enhancement, or protection of anadromous salmonid habitat.

Wildlife Conservation Board (WCB) was created in 1947 within the California Department of Natural Resources then later placed with the CDFW. The WCB mission is to protect, restore, and enhance California's spectacular natural resources for wildlife and for the public's enjoyment in partnership with conservation groups, government agencies and the people of California (Wildlife Conservation Board 2021). The WCB provides competitive grant opportunities for primarily land acquisition, habitat restoration, and development of wildlife oriented public access facilities.

CDFW's Klamath River Project (KRP) has been conducting population monitoring in the Klamath River since 1978. The goals of the KRP include obtaining information on population abundance, hatchery composition, run timing, spawning distribution, fork length frequency, age composition, and sex ratios for salmonids (primarily Klamath River Fall Chinook (KRFC), but also coho and steelhead) in various tributaries to the Klamath River including the Salmon, Scott, and Shasta rivers, as well as Bogus Creek and 22 other smaller tributaries.

Oregon Department of Fish & Wildlife

Oregon also operates under a Commission system, with responsibility for fish and wildlife conservation planning and regulatory programs shared by many agencies, organizations and institutions (www.dfw.state.or.us/conservationstrategy/). Fish management in Oregon is directed under policy and statute (ORS 496.012 and OAR 635-007-0502). The Wildlife Policy states:

- Prevent serious depletion of any indigenous species.
- Provide the optimum recreational and aesthetic benefits for present and future generations of the citizens of this state.

Specific fish management in the Oregon section of the Klamath Basin is driven by the Klamath Basin Fish Management Plan (1997, OAR 635-500-3600, 635-500-3885, 635-500-3890). ODFW also prioritizes conservation and recovery of State Sensitive Native Fish species identified in the Oregon Conservation Strategy (ODFW 2006).

The Oregon Department of Fish and Wildlife (ODFW) conducts many fish restoration and monitoring projects in the Oregon portions of the Klamath Basin (ODFW 2016). These efforts are directed toward indigenous fishes, including ESA listed Lost river sucker, shortnose sucker, and bull trout, as well as the following unlisted fish populations: Jenny Creek sucker, Miller Lake lamprey, redband trout, Pit-Klamath brook lamprey, slender sculpin, Upper Klamath Lake lamprey, largescale sucker, smallscale sucker, summer run steelhead, and speckled dace. Monitoring focuses on assessing occupancy/distribution and abundance as well as population trends, age structure, size and life history where data are available (esp. redband trout) (ODFW 2016). ODFW deploys a wide range of monitoring methods depending on the fish species and population context. Examples include mark-resight, mark-recapture, PIT-tag capture-recapture, radio tag, area under the curve spawner surveys, redd counts, electrofishing, eDNA sampling, larval trawls, video weirs, hook and line sampling, snorkel surveys and scale analysis (ODFW 2016).

FEDERAL AGENCIES

NOAA Fisheries

The mission of NMFS is to recover and conserve marine and anadromous species protected under the Endangered Species Act (ESA) and the Marine Mammal Protection Act and other regulatory authorities. NMFS conducts ESA status reviews and makes ESA listing determinations, designates critical habitat, develops and implements ESA recovery plans, conducts ESA Section 7 consultations and coordinates programs that reduce impacts on protected resources.

NOAA Fisheries plans, implements, and funds Klamath Basin restoration projects including fish passage barrier modifications, sediment stabilization, and invasive species removal for the purposes of increasing access to habitat and improving river habitat for Federally listed species (NOAA Fisheries 2019c). Since the agency's involvement, over 65 acres of habitat have been restored and 30.6 miles of stream have been reopened for anadromous fish (NOAA Fisheries 2019c).

The Pacific Coastal Salmonid Recovery Fund established by Congress in 2000 is a restoration funding source administered by NOAA Fisheries through a competitive grant process that aims to reverse declines in Pacific salmon and steelhead. The program supports conservation projects in California, Oregon, Washington, Idaho, and Alaska (NOAA Fisheries 2020b). As of October 2019, NOAA Fisheries has awarded states and tribes over $1.4 billion (NOAA Fisheries 2020b). In addition, the NOAA Restoration Center has been allocated $891,000,000 nationwide for fiscal years 2022 through 2026 to restore marine, estuarine, coastal, and ecosystem habitat, and to restore fish passage by removing instream barriers as part of the Infrastructure Investment and Jobs Act of 2021.

NMFS Klamath River Coho Recovery Monitoring: NOAA's National Marine Fisheries Service developed a recovery plan for Klamath River coho salmon in 2007 and reports annually to Congress on implementation progress (NMFS 2015), including the status of research and monitoring activities. In 2014, NMFS expanded its activities in the basin to focus on environmental variation and fish response at different spatial scales and conservation of ESA-listed coho, steelhead and Chinook populations for tribal uses. Activities include fall Chinook stock assessments, evaluation of coho, steelhead/rainbow trout and Chinook population structures, genetic stock identification, evaluation of Klamath/Trinity Chinook salmon (Oncorhynchus tshawytscha) contributions to commercial fisheries, fish tracking studies to evaluate spatial responses of salmonids to stream temperatures, and genetic tagging and monitoring of fall and spring Chinook from the Trinity River Hatchery. Many of these activities are conducted in collaboration with other federal and state agencies, Tribes, local watershed groups and Humboldt State University.

NMFS Pacific Coastal Salmon Recovery Fund (PCSRF) Database – Population Monitoring: After the development of project performance metrics in 2005 and 2010, the NMFS Pacific Coastal Salmon Recovery Fund (PCSRF) launched a project database and interactive web map (https://www.webapps.nwfsc.noaa.gov). This database catalogues PCSRF grant-funded restoration projects in the Klamath Basin from 2000 to 2016, two-hundred of which had population monitoring objectives (NMFS 2016b). Most fish population monitoring projects took place in the Mid Klamath River sub-basin. PCSRF-funded disease monitoring was concentrated in the Mid and Upper Klamath River sub-basins.

Fish disease monitoring is a relatively minor focus for PCSRF funded projects. In terms of frequency and spending, population monitoring peaked in the early 2000s, declined, then peaked again in the later 2010s. The peak in frequency from 2010-2015 was marked by an initial increase in spending then a decline – indicating that fewer funds were allocated across a greater number of projects over time. Spending ranged from about $700 to $765,000 per project (average $39,000).

Pacific Fishery Management Council

The Pacific Fishery Management Council manages fisheries for approximately 119 species of salmon, groundfish, coastal pelagic species (sardines, anchovies, and mackerel), and highly migratory species (tunas, sharks, and swordfish) on the West Coast of the United States. It is one of eight regional fishery management councils established by Congress in 1976. The Council has jurisdiction over the U.S. West Coast Exclusive Economic Zone (3-200 miles offshore).

The Council has 14 voting representatives from Oregon, Washington, California, and Idaho; many advisory bodies; and 15 staff members located in Portland, Oregon. Some Council members represent state or tribal fish and wildlife agencies, and some are private citizens who are knowledgeable about recreational or commercial fishing or marine conservation. Apart from state and tribal representatives, Council members are chosen by the governors of the four states within the Council region, in conjunction with the Secretary of Commerce.

Pacific States Marine Fisheries Commission

The Pacific States Marine Fisheries Commission (PSMFC) is an interstate agency that conserves, develops, and manages Pacific Ocean fishery resources. Its 6 member states include Alaska, California, Hawaii, Idaho, Oregon, and Washington. PSMFC works collaboratively with the fishing industry—including fishery managers, commercial and recreational fishermen, and seafood processors. It also teams up with government agencies involved with marine fisheries management, such as the National Oceanic and Atmospheric Administration (NOAA). Together they strive to make fishing resources sustainable for decades to come. PSMFC was established in 1947 by a compact—an agreement among states that was ratified by Congress. Each state in the compact is represented by 3 commissioners.

U. S. Bureau of Reclamation

The US Bureau of Reclamation (USBR) funds a significant amount of fish research and monitoring in the Klamath Basin. The agency provides funding to tribal natural resource departments, other federal agencies (i.e., FWS and USGS) and to universities. The Klamath Basin Area office has been engaged in endangered sucker monitoring for nearly two decades. Monitoring of juveniles at the A Canal Fish Evaluation Station (FES) is a Monitoring and Reporting requirement within the 2013 Biological Opinion (BiOp) and is highly likely to be a component of Reclamation's Proposed Action during the current reinitiated consultation. Some level of monitoring has taken place at the FES since the A Canal fish screen and pumped bypass were constructed in 2003, though the level of sampling protocol and level of effort have only been consistent since 2012. Monitoring takes place between mid-July and late September each year with a level of effort sufficient to capture the peak of juvenile sucker abundance and estimate the number of juvenile suckers that encounter the A Canal headworks and fish screen. During this effort Reclamation crews collect bypassed age-0 and age-1 suckers at the A Canal headworks and record length, weight and affliction data for all collected suckers. In many years, FES monitoring results in the largest collection of juvenile sucker data from Upper Klamath Lake and Reclamation has partnered with the USFWS CA-NV Fish Health Center, USGS, and Oregon State University to provide samples (fish health samples, hard parts for aging/growth etc.) for additional hypothesis testing. Currently, Reclamation is providing juvenile suckers greater than 80mm standard length to the USFWS for inclusion in the Sucker Assisted Rearing Program with the goal of rearing to a larger size and treating for external parasites before reintroduction into Upper Klamath Lake.

Between 2008 and 2011, Reclamation also monitored the adult sucker population in Lake Ewauna with the goal of better understanding its population structure and demographics. These efforts permitted a length-frequency analysis and estimates of abundance and survival. As a component of the 2013 BiOp, Reclamation continued to monitor the Lake Ewauana adult sucker population between 2014 and 2017 with the goal of transporting adult suckers to the Williamson River and augmenting adults spawning populations above Link River Dam. The monitoring primarily occurred during the spring months of March, April and May and Reclamation is currently coordinating with USGS to evaluate survival rates, movement, and the extent to which transported adult suckers have joined spawning populations above the lake. The forthcoming analysis from USGS may help inform potential future sucker capture and transport efforts from PaicifiCorp's Hydroelectric Reach.

The goal of the U.S. Bureau of Reclamation Klamath Coho Habitat Restoration Program is to support restoration activities that have a direct benefit to SONCC coho salmon and/or design, planning, or monitoring projects that can demonstrate direct benefits for coho salmon (National Fish and Wildlife Foundation [NFWF] 2021a). Since 2016, the program has funded 21 projects totaling $2.5 million (NFWF 2021a).

U. S. Fish & Wildlife Service

The Interior Department's U.S. Fish and Wildlife Service (USFWS) and the Commerce Department's National Marine Fisheries Service (NMFS) together administer the Endangered Species Act (Appendix G). The USFWS has primary responsibility for terrestrial and freshwater organisms, while the responsibilities of NMFS are mainly marine wildlife such as whales and anadromous fish such as salmon.

USFWS's mandate is to recover and restore endangered, threatened and imperiled species, fulfill its tribal trust and mitigation responsibilities, and conserve a wider range of fisheries and other aquatic resources. The agency also works to restore habitat across the landscape, prevent and control invasive species, assist Native American tribes and other partners in managing their fish and wildlife resources, advance fisheries and aquatic sciences and technologies, foster outdoor recreational opportunities, educate the public on the economic and ecological benefits of aquatic species and their habitats, and address new and emerging challenges such as climate change.

A substantial portion of the annual survey work is funded by the USFWS, originally as part of the Klamath River Basin Conservation Area Restoration Program, which was administered in 1986 under Public Law 99-552 (the Klamath Act). The intent of the Klamath Act was to restore anadromous fish, primarily salmon and steelhead, of the Klamath River Basin (USFWS 2008). The 1986 middle Klamath Cooperative Spawning Ground Surveys (SGS) were originally funded by the Klamath Act. The Klamath Act expired on October 1, 2006, and was not reauthorized by Congress. Since that time USFWS has continued to contribute funding to the survey effort using discretionary funding from their annual budget (CDFW 2017).

USFWS Restoration Grants are administered by the Pacific Southwest Region, Wildlife and Sport Fish Restoration Program to other entities, primarily state fish and wildlife agencies to conserve, protect and enhance fish, wildlife, their habitats, and the hunting, sport fishing and recreational boating opportunities they provide. The program administers ten primary grant programs which total approximately $91 million in grants annually within California, Nevada, and the Klamath Basin area. Grant programs and each program's requirements are highly diverse (USFWS 2020a).

The Klamath Basin Restoration Program is a partnership with USFWS to support Klamath Basin restoration projects to protect and benefit native resident and anadromous fish. The goal of the program is to address limiting factors facing anadromous fishes; support restoration actions to benefit resident fish populations of Lost River sucker, shortnose sucker, bull trout (Salvelinus *confluentus*), and redband trout (*O. mykiss*); and to undertake activities that will ultimately lead to successful reintroduction of anadromous fish to the upper Klamath Basin (NFWF 2021c).

The USFWS's National Fish Passage Program works with communities on a volunteer basis to remove or bypass barriers to fish passage and restore river ecosystems. Through the program the USFWS provides financial and technical assistance in planning, design, implementation, and monitoring of select fish passage projects (USFWS 2022). Over the past 23 years the program has worked with over 2,000 local communities, tribes, and private landowners; removed or bypassed over 3,400 barriers to fish passage; and reopened access to over 61,000 miles of stream habitat for fish and wildlife (USFWS 2022).

The USFWS's Coastal Program is one of the agencies' most effective resources for restoring and protecting fish and wildlife habitat on public and private lands (USFWS 2020b). Working with partners, the USFWS provides technical assistance for habitat conservation design and planning, and financial assistance for habitat restoration and protection projects (USFWS 2020b).

The Partners for Fish and Wildlife Program is the USFWS's habitat restoration cost-sharing program for conservation minded farmers, ranchers and other private landowners who wish to restore fish and wildlife habitat on their land (USFWS 2018). Since 1990, the Partners for Fish and Wildlife Program has restored and enhanced over 62,000 acres of wetlands and wildlife habitat in California for the benefit of ESA-listed species, migratory birds, and anadromous fishes (USFWS 2018).

U.S. Fish and Wildlife Service Salmonid, Speckled dace, Sucker and Lamprey Population Monitoring - The USFWS funds Tribal and agency research and monitoring for anadromous fish restoration in the Klamath River Basin. In 2013, the agency contributed more than $2.9 million to these efforts (NMFS 2015), which include both habitat and population monitoring. Non-anadromous species such as Lost River Sucker (*Deltistes luxatus*) and Speckled dace are also monitored.

USFWS and partners collect adult salmon escapement and stock assessment data, monitor juvenile fish abundance, size, growth and health (including Chinook, coho, steelhead and lamprey), conduct fish disease monitoring and assessment including for *C. shasta* and *P. minibicornis* in salmon and *I. multifiliis* in Speckled dace (Som and Hetrick 2017; Som et al. 2016a,b; Foott et al. 2016b), monitor fall Chinook spawner distribution, age

composition and escapement, and Lost River sucker (Deltistes luxatus) and shortnose sucker (*Chasmistes brevirostris*) fry survival and health in Upper Klamath Lake (Foott 2004; Stone et al. 2017).

USFWS has also conducted habitat, occupancy status and threats assessments for Pacific lamprey (*Lampetra tridentata*) in the Klamath basin as part of the North Coast Regional Implementation Plan for Measures to Conserve Pacific Lamprey (*Entosphenus tridentatus*) (Goodman and Reid 2015; Reid and Goodman 2016).

U. S. Forest Service

Since 1992, the U.S. Forest Service has facilitated cooperative ground surveys of spawning fall Chinook in the Klamath National Forest, involving the Forest Service, California Department of Fish and Wildlife, Yurok Tribe, Karuk Tribe, Quartz Valley Indian Reservation, Salmon River Restoration Council, and local schools and volunteers. In addition to providing information to land managers regarding where the fish spawn (e.g., redd locations and density), these surveys are used to estimate the total in-river escapement of spawning fall Chinook salmon by the Klamath River Technical Team and the Pacific Fisheries Management Council, information that is used to determine harvest allocations for the subsequent year. Scale samples and otoliths are also taken from carcasses to help determine the age composition of the Klamath River fall Chinook run.

Since 2000 in the Salmon River watershed, spring Chinook salmon surveys have been conducted collaboratively by the Forest Service, Salmon River Restoration Council, California Department of Fish and Wildlife, Yurok Tribe, Karuk Tribe, and volunteers using redd count techniques. These surveys provide information to land managers and local resource councils regarding where the fish spawn. Additionally, the data assist in tracking trends in the usage of different sites under varying environmental and discharge conditions, and the mixing of spring-and fall-run Chinook stocks. Biological samples (scales and tissue) are passed to the California Department of Fish and Wildlife. Live spring Chinook in the Salmon River system are also enumerated during the annual Spring Chinook/Summer Steelhead Dive event. This is a long-term cooperative effort led by the Salmon River Restoration Council and Klamath National Forest. Participants include Federal, State, and Tribes, as well as volunteers.

The Klamath National Forest historically conducted annual juvenile presence/absence surveys for coho salmon in select Mid Klamath tributaries and in the Scott and Salmon River watersheds, and for steelhead in the Mid Klamath tributaries where they remain (Elk Creek, Clear Creek, Indian Creek, Dillon Creek, Grider Creek, Thompson Creek, and Independence Creek).

U.S. Geological Survey

Since 1995, USGS has implemented a long-term capture-recapture program to assess the status and dynamics of Lost River suckers and shortnose suckers. This record is likely the most detailed long-term dataset for any non-anadromous endangered fish in the US.

Fish from these two sucker populations were captured and tagged with passive integrated transponder (PIT) tags during their annual spawning migrations (Hewitt et al. 2014). Additionally, beginning in 2005, individuals that had been previously PIT-tagged were re-encountered on remote underwater antennas deployed throughout sucker spawning areas. Captures and remote encounters during spring 2012 were used to describe the spawning migrations in that year and also were incorporated into capture-recapture analyses of population dynamics.

In 2015, USGS began another monitoring program for juvenile suckers in Upper Klamath Lake and Clear Lake Reservoirs (Burdick et al. 2016). The goals of this program are to track annual variability in age-0 sucker production, juvenile sucker survival, growth, and condition. Results for the first year indicated that juvenile abundance and mortality are higher in Upper Klamath Lake than in Clear Lake Reservoir. Also, opercular deformities, skin

hemorrhages, black-spot causing parasites, and Lernaea spp. parasitism were observed in juveniles but only the latter was more prevalent in the Clear Lake Reservoir.

NON-GOVERNMENTAL ORGANIZATIONS

Klamath River Renewal Corporation (KRRC)

The KRRC, is a private, independent nonprofit 501(c)(3) organization created to take ownership of four PacifiCorp dams—JC Boyle, Copco No. 1 & No. 2, and Iron Gate—and then remove these dams, restore formerly inundated lands, and implement required mitigation measures in compliance with all applicable federal, state, and local regulations. The organization was formed by signatories of the amended Klamath Hydroelectric Settlement Agreement (KHSA) including the States of California and Oregon, local governments, Tribal nations, dam owner PacifiCorp, irrigators, and several conservation and fishing groups. This work is funded by PacifiCorp customer surcharges and California Proposition 1 water bond funds. https://klamathrenewal.org/

Mid-Klamath Watershed Council

The Mid-Klamath Watershed Council has participated in restoration projects in the Mid-Klamath subbasin since 2001. Population monitoring efforts include participation in fall carcass surveys along Klamath River Tributaries. MKWC also collaborates with the Karuk Tribe fisheries department to survey for spring Chinook, summer steelhead, winter steelhead, as well as green sturgeon, and participates in multi-agency fish kill monitoring efforts throughout the summer months (www.mkwc.org). Survey data are used to help determine population trends for Klamath River fish stocks, and to set harvest allocations for certain species.

PacifiCorp

The Klamath River Coho Enhancement Fund is a component of PacifiCorp's Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for SONCC Coho Salmon. It was developed to fund projects that will restore, enhance, and improve habitat, flows, and fish passage for SONCC coho salmon in the Klamath River and associated tributaries downstream of Iron Gate Dam (NFWF 2021b). Each year PacifiCorp provides $510,000 in grant funds to fund projects with direct benefits to SONCC coho salmon. The grant cycle began in 2009 and as of 2019, 51 grants have been selected totaling a combined value of $5.2 million (PacifiCorp 2020).

Salmon River Restoration Council (SRRC)

Since the early 1990's the Salmon River Restoration Council (SRRC), has been a lead coordinator with the USFS Klamath National Forest (KNF), Salmon/Scott Ranger District, of the Salmon River Cooperative Spring Chinook and Summer Steelhead Census Dive. This annual effort brings together volunteers and fisheries professionals to cooperative dive 100 miles of the Salmon River and main tributaries on 2-4 mile reaches during one day. This effort is the longest running live census of salmonids in the Klamath Basin and helps assess population status and trends for the critically imperiled spring-run Chinook population.

SRRC also coordinates annual spring-run and fall-run Chinook spawning and redd surveys, with volunteers (spring-run), the Karuk and Yurok Tribes, the KNF, and the California Department of Fish and Wildlife (CDFW). Collected data feeds into the Klamath River Spring and Fall Chinook Mega Tables maintained by CDFW, which tabulate and present spawning and harvest data and help set harvest guidelines for subsequent years. During these surveys, field technicians gather tissue, scale and otolith samples from carcasses. The samples have been used for many genetic and life history studies, including recent work by the UC Davis, Integrative Genetics and Genomics Group establishing the genetic uniqueness of Klamath River spring-run Chinook.

SRRC has also conducted occasional steelhead and coho spawning surveys, but hazardous winter conditions on the flashy river system and the volunteer nature of the work make this effort difficult and inconsistent. Regardless, SRRC was able to establish that a small population of coho salmon spawn annually in the Salmon River.

Since 2000, the SRRC has conducted periodic juvenile coho assessments. These include presence/absence surveys in collaboration with the Karuk Tribe on the Salmon River and key tributaries (also includes juvenile Chinook and Steelhead), population surveys under the Coastal Monitoring Plan Aquatic Survey Program, migration trap monitoring for the Karuk tribe at their out migration trap near the mouth of the Salmon River and at Big Bar on the Klamath River, and annual assessment of juvenile and adult fish passage throughout the Mid Klamath Basin and Salmon River tributaries with the Mid Klamath Watershed Council. SRRC and MKWC manually manipulate flow and create step pools to increase access to cold-water tributaries while also adding brush bundles at refugia sites to increase cover and habitat quality. This effort includes pre- and post-removal juvenile salmonid presence/absence surveys for the first 1000 feet and/or 10 pools.

Scott River Watershed Council (SRWC)

The SRWC is a local, non-profit organization established to promote and support education, restoration, and scientific planning and monitoring for natural resource issues in California's Scott Valley. The council was originally established in 1992 and became a nonprofit in 2011. Council staff are involved in a series of fisheries and water monitoring, habitat restoration and planning/coordination projects.

Siskiyou Resource Conservation District (SRCD)

The Siskiyou RCD is a Special District of Siskiyou County, California that was established in 1949. The SRCD works for the landowners of the Agricultural, Residential and Forest lands of the Salmon River and Scott River watersheds. The Salmon and Scott River's are major tributaries of the Klamath River located in Western Siskiyou County in far Northern California. The SRCD performs an extensive array of projects to protect the Natural Resources and rural lifestyle of the Scott River watershed. Projects include agricultural and diversion improvement, riparian protection and enhancement, water conservation, fisheries and wildlife habitat improvement, water quality monitoring, and biological monitoring.

Trout Unlimited

Trout Unlimited participates in fish and wildlife population monitoring led by partners, including Oregon Department of Fish and Wildlife fish sampling, U.S. Fish and Wildlife Service Oregon Spotted Frog sampling, and The Klamath Tribes focus monitoring. The organization is also partnered with Crater Lake National Park staff to document the abundance of bull trout in Sun Creek.

UNIVERSITIES

Oregon State University

Since 2006, the Bartholomew Lab in Oregon State University's Microbiology Department has conducted salmon disease monitoring and research funded by the US Bureau of Reclamation. This work tracks the spatial and temporal abundance of *C. shasta* in the Klamath Basin using sentinel fish exposures, river water sampling, and polychaete sampling (Bartholomew et al. 2017). Data is used to inform models that can better predict disease effects on salmonids under different temperature and flow conditions.

California Poly Humboldt

The University is involved in a variety of cooperative studies in the Klamath Basin.

APPENDIX B: RELATED PLANS

This section briefly summarizes a complex of related plans for the Klamath Basin which potential application to fish monitoring activities. Summaries are adapted from Appendix H of the IFRMP (2023).

KLAMATH BASIN INTEGRATED FISHERIES RESTORATION AND MONITORING PLAN (USFWS)

The Integrated Fisheries Restoration and Monitoring Plan (IFRMP) addresses the entirety of the Klamath basin and harmonizes priorities for ten native fish species (ESSA and Klamath Basin Working Groups 2023). This plan was intended to bring existing Klamath Basin restoration plans and planning efforts together and addresses key gaps using an adaptive management strategy. The IFRMP provides a unified framework for planning the restoration and recovery of native fishes from the Klamath headwaters to the Pacific Ocean while improving flows, water quality, habitat, and ecosystem processes. The IFRMP serves as a blueprint for potential restoration and monitoring actions in the Klamath Basin by identifying the highest priority watershed restoration actions and providing a general strategy to restore the basin. CDFW as well as ODFW assisted with development of the IFRMP and share a common understanding with the IFRMP in terms of recognizing the importance of restoring processes and habitat as critical to improving fish populations in the Klamath Basin.

This plan was completed in 2023 following a multi-year, collaborative planning process funded by the U. S. Fish and Wildlife Service (USFWS) and administered by the Pacific States Marine Fisheries Commission (PSMFC). The IFRMP was intended to provide a unifying framework and tools to inform federal agencies (and other interested parties) on the highest priority basin-scale functional watershed restoration actions to help reverse the declines of multiple native Klamath Basin fish populations (ESSA Technologies Ltd. & Klamath Basin Working Groups 2023). The work was completed in five phases between 2016 and 2023 with the first phase focused on completion of a detailed information synthesis report (ESSA 2017).

The IFRMP identifies:

- Key basin-wide restoration goals and objectives.
- Core performance indicators of watershed function.
- Priority restoration project concepts (146 across 12 subbasins) which are meant to be implemented over many years).
- Strategies for closing gaps in basin-wide monitoring for important indicators of fish and watershed status.
- Cost estimates for proposed restoration and monitoring activities.
- Recommendations for ongoing plan implementation and adaptively updating restoration

Elements of the IFRMP are generally organized by a biophysical hierarchy for major tiers of watershed function. The plan identifies restoration goals based on statements of broad outcomes to be achieved and objectives based on specific and measurable tasks required to make the goals achievable.

The IFRMP also identifies core performance indicators (CPIs) that allow for monitoring and tracking progress for each objective as well as whole-basin goals. CPIs were developed through literature review of common watershed status indicators and further refined though review, preference surveys, and follow-up webinar discussions with IFRMP participants across Sub-basin Working Groups. CPIs are a subset of potential indicators that can be reliably tracked given constraints on time and funding. Monitoring of CPIs occurs alongside other types of monitoring occurring in the basin to track project implementation and effectiveness.

Monitoring gaps were identified based on a review of existing information and a series of ranking exercises by IFRMP participants. Individual recommendations for monitoring to address gaps were ranked into five tiers (Tier 1 – Tier 5) of priority based on the discussions during working groups and expert judgement. Tier 1 monitoring

activities are considered the most important for near-term implementation and provide the most comprehensive understanding of basin-wide status and trends.

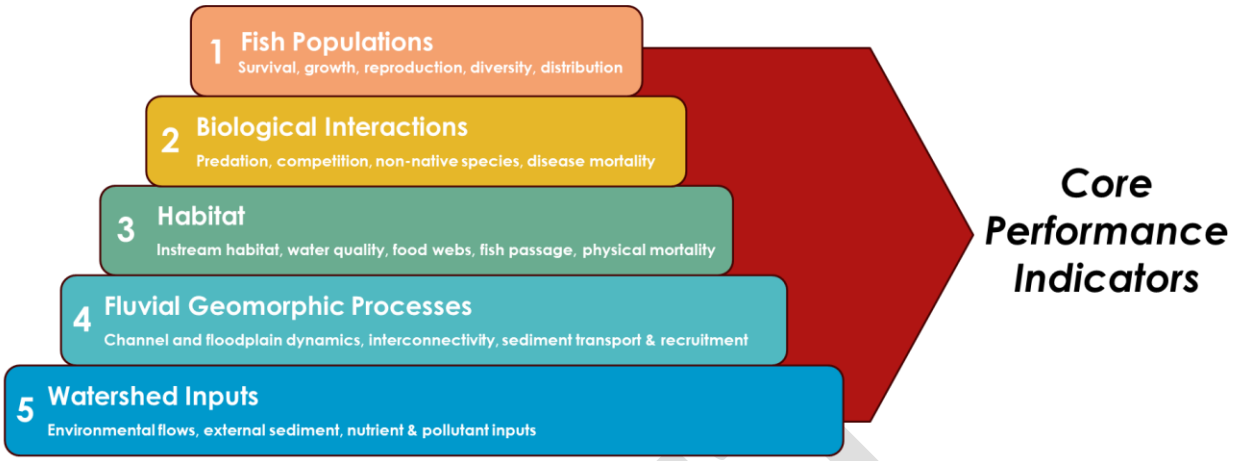

Figure 16. IFRMP Process-based watershed function hierarchy.

Table 15. Key IFRMP monitoring priorities.

Watershed Process Tier	CPI	Description
Watershed Inputs	5.2.1 Seasonal Instream Flow	Expand existing network of real-time streamflow gaging stations
	5.2.2 Nutrient Loads	Establish network of automated water samplers
	5.2.3 Fine Sediment Loads and Turbidity	Expand/maintain network of continuous real-time sondes (top priority sites)
Fluvial Geomorphic Processes	5.3.2 Geomorphic Flushing / Scouring Flows	Characterize flushing flows with gage data and transport measurement calibrations
	5.3.4 Channel Complexity	Assess basin-wide planform complexity from aerial imagery
	5.3.5 Sediment Transport	Map substrate sizes with remote sensing (bathymetric LiDAR, air photos)
Habitat	5.4.1 Water Temperature	Expand/maintain network of continuous real-time sondes (top priority sites)
	5.4.2 Water Chemistry (DO, pH, conductivity)	Expand/maintain network of continuous real-time sondes (top priority sites)
	5.4.3 Turbidity	Expand/maintain network of continuous real-time sondes (top priority sites)
	5.4.4 Thermal Refugia	Identify and map thermal refugia across the basin with airborne thermal infrared remote sensing
	5.4.5 Nutrients	Establish network of automated water samplers
	5.4.6 Nuisance phytoplankton and associated algal toxins	Expand/maintain existing monitoring network for evaluating levels of nuisance phytoplankton/algal toxins with indirect measures
	5.4.7 Stream Habitat Condition (Physical)	Assess basin-wide planform complexity from aerial imagery
	5.4.8 Riparian Condition	Assess riparian vegetation with aerial NDVI
Biological Interactions	5.5.1 Disease	Expand existing monitoring network for *Ceratonova shasta* and *Parvicapsula minibornis*
	5.5.1 Disease	Expand existing monitoring network for *Ichthyopthierius multifiliis* (Ich) and *Flavobacterium columnarae* (Columnaris)
	5.5.2 Invasive aquatic species	Establish eDNA sampling network for monitoring invasives
Fish Populations	5.6.1 Focal Species Population Indicators	Establish eDNA sampling network for monitoring distribution of focal fish species
	5.6.1 Focal Species Population Indicators	Fill existing or upcoming gaps on life-cycle monitoring

Table 16. Klamath IFRMP goals, objectives and core performance indicators (IFRMP 2023).

Goal	Objectives	CPIs
Fish Populations (FP) **1. Achieve naturally self-sustaining native fish populations.**	FP1: Maintain or increase spatial distributions	• Focal species presence/absence • % of historical habitat occupied
	FP2: Increase juvenile production	• Presence of spawning • Presence of rearing • Productivity
	FP3: Increase juvenile survival and recruitment to spawning populations	• Recruitment
	FP4: Increase overall population abundance and productivity, particularly in areas of high existing abundance or potential future abundance or in special or unique populations	• Abundance
	FP5: Maintain or increase life history and genetic diversities	• Life history diversity • Age structure/demographics • Genetic diversity
Biological Interactions (BI) **3. Reduce biotic interactions that could have negative effects on native fish pops.**	BI1: Do not generate adverse competitive or genetic consequences for native fish when carrying out conservation-oriented hatchery supplementation as needed **[Outside scope of IFRMP, included here for completeness]**	NA
	BI2: Minimize disease-related mortality by reducing vectors and factors known to lead to fish disease outbreaks	• Prevalence of disease pathogens • Prevalence of disease-related mortality
	BI3: Reduce impacts of non-native plant and animal species on native fish	• Presence of invasive aquatic species
Habitat (H) **4. Improve freshwater habitat access and suitability for fish and the quality and quantity of habitat used by all freshwater life stages**	H1: Restore fish passage and re-establish channel and other habitat connectivity, particularly in high-value habitats (e.g., thermal refugia)	• See FP 1
	H2: Improve water temperatures and other local water quality conditions and processes for fish growth and survival	• Thermal refugia • Water temperature • Water chemistry • Turbidity • Nutrients
		• Chlorophyll-a • Nuisance phytoplankton & cyanotoxins
	H3: Enhance, maintain community and food web diversity supporting native fish	• None brought forward as priority to support
	H4: Reduce fish mor tality due to entrainment, scour, stranding	• None brought forward as priority to support
	H5: Enhance and maintain estuary, mainstem, tributary, lake and wetland habitats for all freshwater life stages and life histories of resident and anadromous fish	• Riparian condition • Stream habitat condition (physical)
Fluvial Geomorphic Processes (FG) **5. Create and maintain spatially connected and diverse channel and floodplain morphologies**	FG1: Increase and maintain coarse sediment recruitment and transport	• Sediment transport
	FG2: Increase channel and floodplain dynamics and interconnectivity	• Geomorphic flushing flows • Channel complexity • Floodplain connectivity
	FG3: Promote and expand establishment of diverse riparian and wetland vegetation that contributes to complex channel and floodplain morphologies	• Large wood recruitment and retention
Watershed Inputs (WI) **6. Improve water quality, quantity, and ecological flow regimes**	WI1: Improve instream ecological flow regimes year-round for the Klamath River mainstem and tributary streams	• Instream flows
	WI2: Reduce anthropogenic fine sediment inputs while maintaining natural and beneficial fine sediment inputs	• Fine sediment loads
	WI3: Reduce external nutrient and pollutant inputs that contribute to bio-stimulatory conditions	• Nutrient loads

KLAMATH HYDROELECTRIC SETTLEMENT AGREEMENT

The four mainstem hydroelectric dams: Iron Gate, Copco 1, Copco 2, and J.C. Boyle, were previously owned and operated by PacifiCorp through a Federal Energy Regulatory Commission (FERC) license. On February 28, 2006, PacifiCorp's 50-year FERC license (FERC Project No. 2082-062) to operate the dams expired. PacifiCorp initially pursued relicensing the four hydroelectric facilities for another 50 years and under the Federal Power Act, NOAA Fisheries and USFWS required prescriptions for fishways and recommended certain fishery protection, mitigation, and enhancement measures for relicensing. In addition, relicensing required compliance with Section 401 of the Clean Water Act (CWA) to improve degraded water quality created by the reservoirs (DOI and NOAA Fisheries 2013). For PacifiCorp these conditions put into question the economic viability of the dams and identified potential risks to their ratepayers. Therefore, PacifiCorp opted to become a signatory of the 2010 Klamath Hydroelectric Settlement Agreement (KHSA) and subsequent 2016 amended KHSA.

The amended KHSA provided a process for the decommissioning and removal of the four dams with the intent of restoring Klamath Basin natural resources, including anadromous fish passage, fisheries, and water quality. It is a multi-party agreement to resolve disputes regarding the FERC relicensing proceedings by establishing a process for potential dam removal and operation of the dams until that time (KHSA 2016).

Update to address KRRC, Definite Decommissioning Plan, Interim Measures, etc.

KLAMATH BASIN WATER QUALITY MONITORING PLAN

The plan was produced as a coordination effort by members of the Klamath Basin Monitoring Program (KBMP) and updated in 2015 (KBMP 2016). This plan was intended to serve as a foundation continued collaboration within the Klamath Basin, by: 1) recommending water quality investigations to answer questions for resource managers, 2) providing for data management, data sharing and data communications to resource managers and other water quality investigators, and 3) providing for consistent sampling methods and quality assurance protocols to assure the comparability of data among the various agencies, watershed groups and tribal governments conducting work within the Klamath Basin. The plan is currently under review to identify priorities to sustain essential legacy monitoring, while identifying short-term research needs and emerging gaps in the long-term water quality monitoring network.

STATE REINTRODUCTION PLANS

Klamath River Anadromous Fishery Reintroduction and Restoration Monitoring Plan

This plan, published by the California Natural Resources Agency and Department of Fish and Wildlife, provides a blueprint to guide the reintroduction and monitoring of anadromous fishes in the newly undammed Klamath River (CNRA & CDFW 2024). The plan was prepared in collaboration with Native American Tribes, the State of Oregon and federal partners, including NOAA Fisheries and the U.S. Fish and Wildlife Service. The plan's principal goal is to reestablish viable, wild, self-sustaining populations for species conservation, ecological benefits and to enhance Tribal, commercial and recreational fisheries. The primary strategy is to allow natural recolonization of Chinook salmon, coho salmon, steelhead and Pacific lamprey into newly accessible spawning and rearing habitat. The plan identifies a detailed and phased monitoring program for fish abundance, productivity, spatial structure, diversity and health employing foot, boat-based, sonar, snorkel and aerial surveys, sampling weirs, juvenile emigration traps, electrofishing, telemetry and PIT tagging.

Implementation Plan for the Reintroduction of Anadromous Fish into the Oregon Portion of the Upper Klamath Basin

This plan, developed by the Oregon Department of Fish and Wildlife and the Klamath Tribes (ODFW & TKT 2021), identifies species-specific approaches to guide the reintroduction of historically present anadromous fishes following dam removal including a volitional approach for Fall-run Chinook, Coho Salmon, steelhead trout, and Pacific Lamprey, and active reintroduction of hatchery-reared spring-run Chinook Salmon. The plan identifies a monitoring strategy to assess fish passage, adult escapement, juvenile productivity, and spatial distribution within each sub-basin and related monitoring facilities and activities, including the use of PIT and telemetry tags, spawner/carcass surveys, snorkel and electrofishing surveys, video weirs, adult weir traps, downstream juvenile traps and sonar systems.

SPECIES RECOVERY PLANS

Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon

The SONCC Coho Salmon ESU recovery plan (NMFS 2016) was developed to provide a roadmap for conservation partners to recovery of this species. The Plan was 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. The Plan also provides recovery targets to work toward, as well as criteria by which progress toward recovery will be tracked.

Revised Recovery Plan for the Lost River sucker and Shortnose sucker

A recovery plan was published in 1993 and revised in 2012 (USFWS 2012). The goal of the recovery program is to arrest the decline and enhance Lost River sucker and shortnose sucker populations so that Endangered Species Act protection is no longer necessary. Demographic-based objectives include increasing larval production, individual survival and recruitment to spawning populations, and therefore abundance in spawning populations. The objectives of restoring spawning and nursery habitat, expanding reproduction, reducing the negative impacts from water quality on all life stages, clarifying the effects of other species on all life stages, reducing entrainment, and establishing auxiliary populations comprise the threats-based objectives.

Recovery Plan for the Coterminous United States Population of Bull Trout

Bull Trout in the Klamath Basin are addressed by an ESA Recovery Plan published by the USFWS (2015). The primary strategy for recovery of bull trout in the coterminous United States is to: (1) conserve bull trout so that they are geographically widespread across representative habitats and demographically stable1 in six recovery units; (2) effectively manage and ameliorate the primary threats2 in each of six recovery units at the core area scale such that bull trout are not likely to become endangered in the foreseeable future; (3) build upon the numerous and ongoing conservation actions implemented on behalf of bull trout since their listing in 1999, and improve our understanding of how various threat factors potentially affect the species; (4) use that information to work cooperatively with our partners to design, fund, prioritize, and implement effective conservation actions in those areas that offer the greatest long-term benefit to sustain bull trout and where recovery can be achieved; and (5) apply adaptive management principles to implementing the bull trout recovery program to account for new information. The plan identifies a suite of recovery criteria and related actions.

REGIONAL RESTORATION PLANS

Lower Klamath River Restoration Plan

This plan seeks to restore aquatic habitat conditions within Lower Klamath River tributaries to a level that supports viable, self- sustaining populations of native salmonids (YTFP and YTWRP 2000). These goals will be accomplished through treatment of road networks and upslope sediment sources, improvement of instream and riparian habitats, and through interaction with public and private landowners to implement improved long-term land management practices in the sub-basin. The plan addresses monitoring to assess the effectiveness of implemented restoration projects and to monitor any physical and/or biological changes resulting from anthropogenic activities.

Mid Klamath River Recovery Plan

This plan (Soto et al. 2008), overseen by The US Fish and Wildlife Service (Yreka Office), aims to identify and recommend actions that will improve conditions for the sub-basin's anadromous fish, both through restoration of aquatic and terrestrial environments and protection of unimpaired environments. The plan outlines both passive and active restoration actions that address the most important physical and biological processes for healthy anadromous fish runs. It is designed to target the eight sub-watersheds within the Mid Klamath sub-basin: The Volcanic Outer Region, Checkerboard, Red Butte, Grider Elk, Siskiyou, Western Marble Mountain, Orleans, and Red Cap. It considers cumulative watershed impacts, upland management, wilderness protection opportunities, physical and biological monitoring, public engagement, and identification of planning needs and information gaps. Further, it summarizes key issues, priorities, opportunities, and current or proposed restoration actions within each of the sub-watersheds.

Upper Klamath Basin Watershed Action Plan

This plan prioritized restoration actions necessary to address specific impairments to riverine, wetland, riparian and floodplain process and function at multiple scales within the Upper Klamath Lake, Williamson, and Sprague sub-basins in order to achieve water quality goals and improve conditions for resident and anadromous fish species (UKBWAPT 2021). The plan was prepared by U.S. Fish and Wildlife Service, Trout Unlimited, Klamath Watershed Partnership, The Klamath Tribes, Oregon Department of Environmental Quality, The Nature Conservancy, and the North Coast Regional Water Quality Control Board of California. This plan identifies a conceptual monitoring framework and data gaps at the project and watershed scales. The plan included a monitoring framework intended to inform both project and watershed scale analyses, and based on ongoing Klamath Tribes and USFS aquatics programs.

Klamath Reservoir Reach Restoration Prioritization Plan

NOAA Fisheries, in partnership with Trout Unlimited and PSMFC, developed the Klamath Reservoir Reach Restoration Prioritization Plan (O'Keefe et al. 2022) which assessed baseline habitat conditions and diversion structures in the Klamath River and tributaries from Link River Dam downstream to Iron Gate Dam (excluding the reservoir footprints). The plan identified specific locations where anadromous fish habitats could be improved and prioritized restoration based on specific criteria. The scope included identifying cold-water refugia, unscreened water diversions, baseline habitat conditions and restoration opportunities. This effort resulted in the identification and prioritization of 82 habitat restoration projects, 91 potential diversion screening projects, and 38 potential flow restoration projects. The plan was intended for use by federal and state agencies, Tribes, and basin partners to prioritize restoration actions including reintroduction of anadromous fish post dam removal. No monitoring elements were described in this plan because they are described in detail in the IFRMP, the California

Department of Fish and Wildlife Klamath Monitoring Framework and the Oregon Department of Fish and Wildlife/Klamath Tribes Reintroduction Plan.

Trinity River Restoration Program

This program is intended to mitigate impacts of the Trinity River Division of the Central Valley Project on anadromous fish populations in the Trinity River by successfully implementing the 2000 Trinity River Record of Decision and achieving Congressionally mandated restoration goals. The long-term goals of the Program are to: 1) restore the form and function of the Trinity River; 2) restore and sustain natural production of anadromous fish populations in the Trinity River to pre-dam levels; and 3) to facilitate full participation by dependent Tribal, commercial, and sport fisheries through enhanced harvest opportunities.

The TRRP Record of Decision described six components of restoration: (1) flow management out of Lewiston Dam; (2) sediment management, including gravel augmentation to offset losses behind the dams; (3) channel rehabilitation in the mainstem Trinity above the North Fork, through direct manipulation; (4) watershed rehabilitation, to reduce fine sediment inputs and improve connectivity; (5) infrastructure improvements, including bridge retrofits and moving houses in the floodplain; and (6) adaptive management, to monitor the effects of the restoration actions and guide future restoration. Restoration actions are intended to restore fluvial-geomorphic processes, increase habitat for juveniles and adults, increase juvenile salmon production, and ultimately create harvest opportunities for the following species: fall-run Chinook salmon, spring-run Chinook salmon, coho salmon, steelhead, Pacific lamprey, and green sturgeon. There has been extensive monitoring and research activity through the TRRP.

A 2022 science plan was intended to provide guidance on how the Trinity River Restoration Program (TRRP or Program) should conduct science to reduce critical management uncertainties and support the successful implementation of the Program strategies to achieve Program goals. The long-term goals of the Program are to: 1) restore the form and function of the Trinity River; 2) restore and sustain natural production of anadromous fish populations in the Trinity River to pre-dam levels; and 3) to facilitate full participation by dependent tribal, commercial, and sport fisheries through enhanced harvest opportunities. The TRRP strategy for accomplishing these goals is to restore the processes that produce a healthy alluvial river through a combination of five management actions mandated by the 2000 Trinity River Record of Decision (ROD): flow management; habitat rehabilitation; sediment management, watershed rehabilitation, and infrastructure improvements.

Shasta Watershed Stewardship Plan

This plan, overseen by The Shasta Valley Resource Conservation District (SVRCD) and in collaboration with the North Coast Regional Water Quality Control Board (NCRWQCB), is a non-regulatory report that outlined key actions to improve water quality and habitats for sensitive species (SVRCD et al. 2018). It provided a watershed-scale, adaptive management-focused, stewardship framework to support its goals. It also highlighted current monitoring endeavors and observed water quality trends throughout the sub-basin. It was intended that the report will be continuously updated, based on information from the many stakeholders involved in undertaking the actions outlined within, and as a result of its adaptive management approach. This plan included a Shasta River Watershed Water Quality Monitoring Plan identifying implementation monitoring, effectiveness monitoring, validation monitoring, and compliance monitoring.

Scott River Strategic Action Plan

This plan is intended to improve the effectiveness of natural resource management and enhancement by both assessing watershed condition and by providing a basis for setting priorities for future restoration and management actions in the Scott River sub-basin (SRWC 2005). Major restoration concerns within the watershed

addressed by the SAP focus on improving water quality and habitat conditions for threatened Coho, Chinook, and Steelhead (anadromous salmonids). Restoration opportunities considered under the SAP include bank stabilization, fish passage and screening of diversions, riparian fencing and replanting, alternative stock water systems, tailwater return systems, and road reconditioning. This plan identifies long-term trend and project effectiveness monitoring.

Salmon River Restoration Strategy

This plan was developed by the Salmon River Restoration Council (SRRC) and the Klamath National Forest to collaboratively restore and protect aquatic habitats used by native fish communities in high-priority drainages of the Salmon River watershed (Elder et al. 2002). Because the Salmon River contains some of the most pristine waters in the Lower Klamath, the strategy focused on protection and prevention, primarily targeting the reduction of upslope hazards to aquatic habitats. The SRRS has five overarching goals: 1) assess current watershed conditions and needs, 2) determine the extent of restoration needed to meet target conditions, 3) target high-priority geographic areas to derive the greatest benefit, 4) focus on highest priority restoration needs, and 5) promote education and collaboration. The plan was intended to meet anadromous fish recovery goals through the use of multi-year restoration objectives and priority watershed conditions. Monitoring is focused mainly on stream temperatures and flow.

APPENDIX C - INDEX OF KLAMATH BASIN FISH MONITORING ACTIVITIES

Subject		Task		Activity						Species								Monitoring Question							
O No.	Description	T No.	Description	A No.	Type	Life stage	Season	Location	Lead	Spr Chk	Fall Chk	Coho	O. mykiss	Suckers	Bull trout	Redband	Lamprey	Grn Sturg	Eulachon	Satus	ESA	Fishery	Dams	Passage	Water	Hatcheries	Habitat	Other
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.1	Monitor Fall Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.1.1	Spawning Surveys	Ad	Fall	Klamath mainstem	USFWS		1									1		1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.1	Monitor Fall Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.1.2	Spawning Surveys	Ad	Fall	Salmon R	CDFW		1									1		1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.1	Monitor Fall Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.1.3	Spawning Surveys	Ad	Fall	Scott/Shasta/Bogus	CDFW		1									1		1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.1	Monitor Fall Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.1.4	Spawning Surveys	Ad	Fall	Klamath lower tribs other	YT		1									1		1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.1	Monitor Fall Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.1.5	Spawning Surveys	Ad	Fall	Klamath middle tribs other	CDFW		1									1		1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.1	Monitor Fall Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.1.6	Weir/Video	Ad	Fall	Scott/Shasta/Bogus	CDFW		1									1		1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.2	Monitor Coho adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.2.1	Spawning Surveys	Ad	L Fall	Klamath mainstem	USFWS			1								1	1	1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.2	Monitor Coho adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.2.2	Spawning Surveys	Ad	L Fall	Salmon R	CDFW			1								1	1	1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.2	Monitor Coho adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.2.3	Spawning Surveys	Ad	L Fall	Scott/Shasta/Bogus	CDFW			1								1	1	1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.2	Monitor Coho adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.2.4	Spawning Surveys	Ad	L Fall	Klamath lower tribs	YT			1								1	1	1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.2	Monitor Coho adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.2.5	Weir/Video	Ad	L Fall	Scott/Shasta/Bogus	CDFW			1								1	1	1				1		
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.3	Monitor Spring Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.3.1	Snorkel Surveys	Ad	Sum	Salmon R	SRRC	1										1		1						
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.3	Monitor Spring Chinook adult abundance, distribution & attributes in the Lower-Mid Klamath Basin	1.3.2	Spawning Surveys	Ad	Sum	Klamath lower tribs other	YT	1										1		1						
1	Lower-Mid Klamath Salmon & Steelhead Adults	1.4	Monitor Steelhead/O. mykiss adult abundance, distribution & attributes in the Lower-Mid Klamath B	1.4.1	Snorkel Surveys	Ad	Sum	Klamath lower tribs	YT				1							1		1						
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.1	Monitor juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath mainstem	2.1.1	Outmigrant trap	Juv	Spr	Klamath L mainstem Weitchepec	YT	1	1	1	1				1			1	1			1			
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.1	Monitor juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath mainstem	2.1.2	Outmigrant trap	Juv	Spr	Klamath L mainstem Kinsman/Big Bi	KT	1	1	1	1				1			1	1			1			
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.1	Monitor juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath mainstem	2.1.3	Outmigrant trap	Juv	Spr	Klamath L mainstem IS/Bogus	USFWS	1	1	1	1				1			1	1	1		1			
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.1	Monitor juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath mainstem	2.1.4	Acoustic telemetry	Juv	Spr	Klamath L	KT/YT		1	1								1	1						
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.2	Monitor juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath tributaries	2.2.1	Outmigrant trap	Juv	Spr	Scott/Shasta/Bogus	CDFW	1	1	1	1				1			1	1			1		1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.2	Monitor juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath tributaries	2.2.2	Outmigrant trap	Juv	Spr	Salmon R	KT	1	1	1	1				1			1	1					1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.2	Monitor juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath tributaries	2.2.3	Outmigrant trap	Juv	Spr	Klamath L tribs	YT		1	1	1				1			1	1					1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.3	Monitor juvenile salmonid distribution & attributes in Lower-Mid Klamath tributaries	2.3.1	Snorkel survey	Juv	Sum	Klamath L tribs	YT			1								1	1					1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.3	Monitor juvenile salmonid distribution & attributes in Lower-Mid Klamath tributaries	2.3.2	PIT tagging & arrays	Juv	Sum	Klamath L tribs	YT			1								1	1		1			1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.3	Monitor juvenile salmonid distribution & attributes in Lower-Mid Klamath tributaries	2.3.3	Snorkel survey	Juv	Sum	Klamath mid tribs	KT			1								1	1					1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.3	Monitor juvenile salmonid distribution & attributes in Lower-Mid Klamath tributaries	2.3.4	Juvenile collection	Juv	Sum	Klamath mid tribs	YT			1								1	1					1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.3	Monitor juvenile salmonid distribution & attributes in Lower-Mid Klamath tributaries	2.3.5	PIT tagging & arrays	Juv	Sum	Klamath mid tribs	KT			1								1	1		1			1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.3	Monitor juvenile salmonid distribution & attributes in Lower-Mid Klamath tributaries	2.3.6	Snorkel survey	**All**	Sum	Salmon, Scott & Shasta R	SHARED	1		1	1							1	1					1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.3	Monitor juvenile salmonid distribution & attributes in Lower-Mid Klamath tributaries	2.3.7	Juvenile collection	Juv	Sum	Salmon, Scott & Shasta R	SHARED	1		1	1							1	1					1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.3	Monitor juvenile salmonid distribution & attributes in Lower-Mid Klamath tributaries	2.3.8	PIT tagging & arrays	Juv	Sum	Salmon, Scott & Shasta R	RWC/CDF	1		1	1							1	1		1			1	
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.4	Monitor & evaluate juvenile salmonid health in the Lower-Mid Klamath Basin	2.4.1	Disease monitoring	Juv	Spr	Klamath L	OSU		1	1								1	1			1	1		
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.4	Monitor & evaluate juvenile salmonid health in the Lower-Mid Klamath Basin	2.4.2	Disease analysis	Juv	Spr	Klamath L	OSU		1	1								1	1			1			
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.5	Evaluate juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath Basin	2.5.1	S3 Model analysis	Juv	Spr	Klamath L	USGS		1									1				1			
2	Lower-Mid Klamath Salmon & Steelhead Juveniles	2.5	Evaluate juvenile salmonid migration, numbers & attributes in the Lower-Mid Klamath Basin	2.5.2	S3 Model analysis	Juv	Spr	Klamath L	USGS			1								1	1			1			
3	Trinity Salmon & Steelhead Adults	3.1	Monitor Fall Chinook adult abundance, distribution & attributes in the Trinity Basin	3.1.1	Weir/Trap	Ad	Fall	Trinity mainstem	CDFW		1									1		1			1	1		
3	Trinity Salmon & Steelhead Adults	3.1	Monitor Fall Chinook adult abundance, distribution & attributes in the Trinity Basin	3.1.2	Spawning Surveys	Ad	Fall	Trinity mainstem lower	USFWS		1									1		1			1	1	1	
3	Trinity Salmon & Steelhead Adults	3.1	Monitor Fall Chinook adult abundance, distribution & attributes in the Trinity Basin	3.1.3	Spawning Surveys	Ad	Fall	Trinity mainstem middle	USFWS		1									1		1			1	1	1	
3	Trinity Salmon & Steelhead Adults	3.2	Monitor Coho adult abundance, distribution & attributes in the Trinity Basin	3.2.1	Weir/Trap	Ad	L Fall	Trinity mainstem	CDFW			1								1	1	1			1	1		
3	Trinity Salmon & Steelhead Adults	3.2	Monitor Coho adult abundance, distribution & attributes in the Trinity Basin	3.2.2	Spawning Surveys	Ad	L Fall	Trinity tributaries	YT			1								1	1	1				1		
3	Trinity Salmon & Steelhead Adults	3.3	Monitor Spring Chinook adult abundance, distribution & attributes in the Trinity Basin	3.3.1	Weir/Trap	Ad	Sum	Trinity mainstem	CDFW	1										1		1			1	1	1	
3	Trinity Salmon & Steelhead Adults	3.3	Monitor Spring Chinook adult abundance, distribution & attributes in the Trinity Basin	3.3.2	Spawning Surveys	Ad	Sum	Trinity South Fork	CDFW	1										1		1				1		
3	Trinity Salmon & Steelhead Adults	3.3	Monitor Spring Chinook adult abundance, distribution & attributes in the Trinity Basin	3.3.3	Spawning Surveys	Ad	Sum	Trinity tributaries	CDFW	1										1		1				1		
3	Trinity Salmon & Steelhead Adults	3.4	Monitor Steelhead/O. mykiss adult abundance, distribution & attributes in the Trinity Basin	3.4.1	Snorkel Surveys	Ad	Sum	Trinity tributaries	USFWS				1							1		1				1		
4	Trinity Salmon & Steelhead Juveniles	4.1	Monitor juvenile salmonid migration, numbers & attributes in the Trinity mainstem	4.1.1	Outmigrant trap	Juv	Spr	Trinity mainstem Willlow Cr	USFWS	1	1	1	1				1			1	1			1			
4	Trinity Salmon & Steelhead Juveniles	4.1	Monitor juvenile salmonid migration, numbers & attributes in the Trinity mainstem	4.1.2	Outmigrant trap	Juv	Spr	Trinity mainstem Pear Tree	HVT	1	1	1	1				1			1	1			1			
4	Trinity Salmon & Steelhead Juveniles	4.2	Monitor juvenile salmonid migration, distribution, numbers & attributes in the Trinity tributaries	4.2.1	Outmigrant trap	Juv	Spr	Trinity L tribs	HVT		1	1	1				1			1	1						1	
4	Trinity Salmon & Steelhead Juveniles	4.3	Monitor juvenile salmonid migration, distribution, numbers & attributes in the Trinity tributaries	4.2.2	Snorkel survey	Juv	Sum	Trinity U tribs	YT	1		1	1							1	1						1	
4	Trinity Salmon & Steelhead Juveniles	4.4	Evaluate juvenile salmonid migration, numbers & attributes in the Trinity Basin	4.3.1	S3 Model analysis	Juv	Spr	Trinity mainstem	USGS		1									1				1			
5	Upper Klamath Salmon & Steelhead	5.1	Monitor anadromous adult abundance, distribution & attributes in the dam removal reach mainstem	5.1.1	Sonar	Ad	Fall-Win	Klamath U mainstem	CAL TRT		1	1	1							1	1	1	1					
5	Upper Klamath Salmon & Steelhead	5.1	Monitor anadromous adult abundance, distribution & attributes in the dam removal reach mainstem	5.1.2	Netting	Ad	Fall-Win	Klamath U mainstem	CAL TRT		1	1	1							1	1	1	1					
5	Upper Klamath Salmon & Steelhead	5.1	Monitor anadromous adult abundance, distribution & attributes in the dam removal reach mainstem	5.1.3	Spawning Surveys	Ad	Fall-Win	Klamath U mainstem	USFWS		1	1	1					1		1	1	1	1			1		
5	Upper Klamath Salmon & Steelhead	5.1	Monitor anadromous adult abundance, distribution & attributes in the dam removal reach mainstem	5.1.4	Weir/Video	Ad	Fall-Win	Klamath U mainstem OR	ODFW		1	1	1					1		1	1	1	1			1		
5	Upper Klamath Salmon & Steelhead	5.1	Monitor anadromous adult abundance, distribution & attributes in the dam removal reach mainstem	5.1.5	Telemetry	Ad	Fall	Klamath U	CAL TRT		1	1	1							1	1	1	1					
5	Upper Klamath Salmon & Steelhead	5.2	Monitor anadromous adult abundance, distribution & attributes in the dam removal reach tributaries	5.2.1	Spawning Surveys	Ad	Fall-Win	Klamath U tribs CA	CDFW		1	1	1					1		1	1	1	1			1		
5	Upper Klamath Salmon & Steelhead	5.2	Monitor anadromous adult abundance, distribution & attributes in the dam removal reach tributaries	5.2.2	Spawning Surveys	Ad	Fall-Win	Klamath U tribs OR	ODFW		1	1	1					1		1	1	1	1			1		
5	Upper Klamath Salmon & Steelhead	5.2	Monitor anadromous adult abundance, distribution & attributes in the dam removal reach tributaries	5.2.3	Weir/Video	Ad	Fall-Win	Klamath U tribs CA	CDFW		1	1	1					1		1	1	1	1			1		
5	Upper Klamath Salmon & Steelhead	5.2	Monitor anadromous adult abundance, distribution & attributes in the dam removal reach tributaries	5.2.4	Weir/Video	Ad	Fall-Win	Klamath U tribs OR	ODFW		1	1	1					1		1	1	1	1			1		
5	Upper Klamath Salmon & Steelhead	5.3	Monitor juvenile salmonid migration, numbers & attributes in dam removal reach	5.3.1	Outmigrant trap	Juv	Spr	Klamath U mainstem OR	ODFW		1	1	1					1		1	1		1	1			
5	Upper Klamath Salmon & Steelhead	5.3	Monitor juvenile salmonid migration, numbers & attributes in dam removal reach	5.3.2	Outmigrant trap	Juv	Spr	Klamath U tribs CA	CDFW		1	1	1					1		1	1		1	1			
5	Upper Klamath Salmon & Steelhead	5.3	Monitor juvenile salmonid migration, numbers & attributes in dam removal reach	5.3.3	Outmigrant trap	Juv	Spr	Klamath U tribs OR	ODFW		1	1	1					1		1	1		1	1			
5	Upper Klamath Salmon & Steelhead	5.4	Monitor juvenile salmonid distribution & attributes in dam removal reach tributaries	5.4.1	Snorkel/Sampling	Juv	Sum	Klamath U tribs CA	CDFW		1	1	1							1	1		1				
5	Upper Klamath Salmon & Steelhead	5.4	Monitor juvenile salmonid distribution & attributes in dam removal reach tributaries	5.4.2	Snorkel/Sampling	Juv	Sum	Klamath U tribs OR	ODFW		1	1	1							1	1		1				
5	Upper Klamath Salmon & Steelhead	5.4	Monitor juvenile salmonid distribution & attributes in dam removal reach tributaries	5.4.3	PIT tagging & arrays	Juv	Sum	Klamath U tribs CA	CDFW			1	1							1	1		1				
5	Upper Klamath Salmon & Steelhead	5.4	Monitor juvenile salmonid distribution & attributes in dam removal reach tributaries	5.4.4	PIT tagging & arrays	Juv	Sum	Klamath U tribs OR	ODFW			1	1							1	1		1				

6	Klamath Headwaters Salmon & Steelhead	6.1	Monitor anadromous adult runs to and through upper Klamath Dams	6.1.1	Ladder count	Ad	Sum-Win	Keno Dam		1	1	1	1				1			1	1		1	1				
6	Klamath Headwaters Salmon & Steelhead	6.1	Monitor anadromous adult runs to and through upper Klamath Dams	6.1.2	Ladder count	Ad	Sum-Win	Link River Dam		1	1	1	1				1			1	1		1	1				
6	Klamath Headwaters Salmon & Steelhead	6.1	Monitor anadromous adult runs to and through upper Klamath Dams	6.1.3	Telemetry	Ad	Sum-Win	Keno/Link River Dams		1	1	1	1								1		1	1				
6	Klamath Headwaters Salmon & Steelhead	6.2	Monitor anadromous salmonids at upper Klamath Dams	6.1.4	PIT tag arrays	All	Sum-Win	Keno Dam		1	1	1	1								1		1	1				
6	Klamath Headwaters Salmon & Steelhead	6.2	Monitor anadromous salmonids at upper Klamath Dams	6.1.5	PIT tag arrays	All	Sum-Win	Link River Dam		1	1	1	1								1		1	1				
6	Klamath Headwaters Salmon & Steelhead	6.3	Monitor anadromous adult abundance, distribution & attributes in Klamath Basin headwaters	6.2.1	Spawning Surveys	Ad	Fall-L Fall	Klamath headwaters	ODFW		1	1	1								1		1					
6	Klamath Headwaters Salmon & Steelhead	6.3	Monitor anadromous adult abundance, distribution & attributes in Klamath Basin headwaters	6.2.2	Spawning Surveys	Ad	Fall-L Fall	Klamath headwaters	ODFW	1	1	1	1								1		1					
6	Klamath Headwaters Salmon & Steelhead	6.3	Monitor anadromous adult abundance, distribution & attributes in Klamath Basin headwaters	6.2.3	Weir/Video	Ad	Fall-L Fall	Klamath headwaters		1	1	1	1				1				1		1					
6	Klamath Headwaters Salmon & Steelhead	6.3	Monitor anadromous adult abundance, distribution & attributes in Klamath Basin headwaters	6.2.4	Telemetry	Ad	Fall-L Fall	Klamath headwaters	USGS		1	1	1								1		1					
6	Klamath Headwaters Salmon & Steelhead	6.4	Monitor juvenile salmonid migration, anundance, distribution & attributes in Klamath Basin headwa	6.3.1	Outmigrant trap	Juv	Spr	Klamath headwaters		1	1	1	1								1		1					
6	Klamath Headwaters Salmon & Steelhead	6.5	Monitor juvenile salmonid migration, anundance, distribution & attributes in Klamath Basin headwa	6.3.2	PIT tagging	Juv	Spr	Klamath headwaters	?	1													1					
6	Klamath Headwaters Salmon & Steelhead	6.5	Monitor juvenile salmonid migration, anundance, distribution & attributes in Klamath Basin headwa	6.3.3	PIT tagging	Juv	Spr	Klamath headwaters		1	1	1	1								1		1					
6	Klamath Headwaters Salmon & Steelhead	6.5	Monitor juvenile salmonid migration, anundance, distribution & attributes in Klamath Basin headwa	6.3.4	PIT tag arrays	Juv	Annual	Klamath headwaters		1													1					
6	Klamath Headwaters Salmon & Steelhead	6.5	Monitor juvenile salmonid migration, anundance, distribution & attributes in Klamath Basin headwa	6.3.5	PIT tag arrays	Juv	Annual	Klamath headwaters		1													1					
6	Klamath Headwaters Salmon & Steelhead	6.5	Monitor juvenile salmonid migration, anundance, distribution & attributes in Klamath Basin headwa	6.3.6	PIT tag arrays	Juv	Annual	Klamath Lake		1													1					
7	Salmon & Steelhead Fisheries	7.1	Monitor and evaluate fall season fisheries for Klamath Fall Chinook & Coho	7.1.1	Harvest survey	Ad	Fall	Yurok fishery	YT		1	1									1	1				1		
7	Salmon & Steelhead Fisheries	7.1	Monitor and evaluate fall season fisheries for Klamath Fall Chinook & Coho	7.1.2	Harvest survey	Ad	Fall	Hoopa fishery	HVT		1	1									1	1				1		
7	Salmon & Steelhead Fisheries	7.1	Monitor and evaluate fall season fisheries for Klamath Fall Chinook & Coho	7.1.3	Harvest survey	Ad	Fall	Other tribal fishery			1	1									1	1				1		
7	Salmon & Steelhead Fisheries	7.1	Monitor and evaluate fall season fisheries for Klamath Fall Chinook & Coho	7.1.4	Harvest survey	Ad	Fall	Non-tribal fishery	CDFW		1	1									1	1				1		
7	Salmon & Steelhead Fisheries	7.3	Monitor and evaluate fall season fisheries for Klamath Fall Chinook & Coho	7.1.5	Fishery assessment	Ad	Fall	Basinwide	CDFW		1									1		1				1		
7	Salmon & Steelhead Fisheries	7.3	Monitor and evaluate fall season fisheries for Klamath Fall Chinook & Coho	7.1.6	Fishery assessment	Ad	Fall	Basinwide	CDFW			1								1	1	1				1		
7	Salmon & Steelhead Fisheries	7.2	Monitor and evaluate spring season fisheries for Klamath Spring Chinook	7.2.1	Harvest survey	Ad	Spr	Yurok fishery	YT	1												1				1		
7	Salmon & Steelhead Fisheries	7.2	Monitor and evaluate spring season fisheries for Klamath Spring Chinook	7.2.2	Harvest survey	Ad	Spr	Hoopa fishery	HVT	1												1				1		
7	Salmon & Steelhead Fisheries	7.2	Monitor and evaluate spring season fisheries for Klamath Spring Chinook	7.2.3	Harvest survey	Ad	Spr	Non-tribal fishery	CDFW	1												1				1		
7	Salmon & Steelhead Fisheries	7.3	Monitor and evaluate spring season fisheries for Klamath Spring Chinook	7.2.4	Fishery assessment	Ad	Spr	Basinwide	CDFW	1												1				1		
8	Salmon & Steelhead Hatcheries	8.1	Monitor Fall Creek hatchery production & returns	8.1.1	Hatchery releases	Juv	Spr	Fall Creek Hatchery	CDFW		1	1									1					1		
8	Salmon & Steelhead Hatcheries	8.1	Monitor Fall Creek hatchery production & returns	8.1.2	Hatchery marks/tags	Juv	Spr	Fall Creek Hatchery	CDFW		1	1								1	1	1				1		
8	Salmon & Steelhead Hatcheries	8.1	Monitor Fall Creek hatchery production & returns	8.1.3	Hatchery processes	Juv	Spr	Fall Creek Hatchery	CDFW		1	1									1					1		
8	Salmon & Steelhead Hatcheries	8.1	Monitor Fall Creek hatchery production & returns	8.1.4	Hatchery collection	Ad	Sum-Win	Fall Creek Hatchery	CDFW		1	1								1	1	1				1		
8	Salmon & Steelhead Hatcheries	8.1	Monitor Fall Creek hatchery production & returns	8.1.5	Hatchery composition	Ad	Sum-Win	Fall Creek Hatchery	CDFW		1	1									1	1				1		
8	Salmon & Steelhead Hatcheries	8.1	Monitor Fall Creek hatchery production & returns	8.1.6	Hatchery-origin spawners	Ad	Sum-Win	Fall Creek Hatchery	CDFW		1	1									1	1				1		
8	Salmon & Steelhead Hatcheries	8.1	Monitor Fall Creek hatchery production & returns	8.1.7	Hatchery return	Ad	Sum-Win	Fall Creek Hatchery	CDFW		1	1									1	1				1		
8	Salmon & Steelhead Hatcheries	8.2	Monitor Trinity River hatchery production & returns	8.2.1	Hatchery releases	Juv	Spr	Trinity Hatchery	CDFW	1	1	1	1								1				1	1		
8	Salmon & Steelhead Hatcheries	8.2	Monitor Trinity River hatchery production & returns	8.2.2	Hatchery marks/tags	Juv	Spr	Trinity Hatchery	CDFW	1	1	1	1							1	1	1			1	1		
8	Salmon & Steelhead Hatcheries	8.2	Monitor Trinity River hatchery production & returns	8.2.3	Hatchery processes	Juv	Spr	Trinity Hatchery	CDFW	1	1	1	1								1				1	1		
8	Salmon & Steelhead Hatcheries	8.2	Monitor Trinity River hatchery production & returns	8.2.4	Hatchery collection	Ad	Sum-Win	Trinity Hatchery	CDFW	1	1	1	1							1	1	1			1	1		
8	Salmon & Steelhead Hatcheries	8.2	Monitor Trinity River hatchery production & returns	8.2.5	Hatchery composition	Ad	Sum-Win	Trinity Hatchery	CDFW	1	1	1	1								1	1			1	1		
8	Salmon & Steelhead Hatcheries	8.2	Monitor Trinity River hatchery production & returns	8.2.6	Hatchery-origin spawners	Ad	Sum-Win	Trinity Hatchery	CDFW	1	1	1	1								1	1			1	1		
8	Salmon & Steelhead Hatcheries	8.2	Monitor Trinity River hatchery production & returns	8.2.7	Hatchery return	Ad	Sum-Win	Trinity Hatchery	CDFW	1	1	1	1							1	1	1			1	1		
9	Lost River & Shortnose Suckers	9.1	Monitor Lost River & Shortnose Sucker stock status in the upper Klamath Basin	9.1.1	Trammel net	Ad		Klamath Lake	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.1	Monitor Lost River & Shortnose Sucker stock status in the upper Klamath Basin	9.1.2	Trap net	Juv		Klamath Lake	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.1	Monitor Lost River & Shortnose Sucker stock status in the upper Klamath Basin	9.1.3	PIT tag arrays	All		Klamath Lake & tribs	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.1	Monitor Lost River & Shortnose Sucker stock status in the upper Klamath Basin	9.1.4	Weir	Ad		Williamson R	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.1	Monitor Lost River & Shortnose Sucker stock status in the upper Klamath Basin	9.1.5	Population sampling	All		Clear Lake	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.1	Monitor Lost River & Shortnose Sucker stock status in the upper Klamath Basin	9.1.6	Population sampling	All		Klamath headwaters other	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.1	Monitor Lost River & Shortnose Sucker stock status in the upper Klamath Basin	9.1.7	Stock status update	All		Klamath headwaters	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.1	Monitor Lost River & Shortnose Sucker stock status in the upper Klamath Basin	9.1.8	Telemetry (acoustic/radio??)	All		Klamath headwaters	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.2	Monitor Lost River & Shortnose Sucker recruitment factors	9.2.1	Ecological limitatons	Juv		Klamath headwaters	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.2	Monitor Lost River & Shortnose Sucker recruitment factors	9.2.2	Environmental limitations	Juv		Klamath headwaters	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.2	Monitor Lost River & Shortnose Sucker recruitment factors	9.2.3	Waterbird predation	Juv		Klamath headwaters	USGS					1						1	1							
9	Lost River & Shortnose Suckers	9.3	Monitor Lost River & Shortnose Sucker hatchery supplementation effectiveness	9.3.1	Hatchery-assisted rearing	Juv		Klamath headwaters	USFWS					1						1	1							
9	Lost River & Shortnose Suckers	9.3	Monitor Lost River & Shortnose Sucker hatchery supplementation effectiveness	9.3.2	Post release assessment	Juv		Klamath headwaters	USFWS					1						1	1							
9	Lost River & Shortnose Suckers	9.3	Monitor Lost River & Shortnose Sucker hatchery supplementation effectiveness	9.3.3	In-hatchery evaluations	Juv		Klamath headwaters	USFWS					1						1	1							
10	Other Focal Species	10.1	Monitor Bull Trout status & restoration effectiveness	10.1.1	Population sampling	All		Klamath headwaters	ODFW						1					1	1							
10	Other Focal Species	10.1	Monitor Bull Trout status & restoration effectiveness	10.1.2	Assessment modeling	All		Klamath headwaters	ODFW						1					1	1							
10	Other Focal Species	10.1	Monitor Bull Trout status & restoration effectiveness	10.1.3	Restoration evaluations	All		Klamath headwaters	ODFW						1					1	1							
10	Other Focal Species	10.2	Monitor Redband Trout status & restoration effectiveness	10.2.1	Population sampling	All		Klamath headwaters	ODFW							1				1								
10	Other Focal Species	10.2	Monitor Redband Trout status & restoration effectiveness	10.2.2	Restoration evaluations	All		Klamath headwaters	ODFW							1				1								
10	Other Focal Species	10.3	Monitor Lamprey status	10.3.1	Status assessment	All		Klamath									1			1								
10	Other Focal Species	10.4	Monitor Green Sturgeon status	10.3.2	Status assessment	All		Klamath mainstem										1		1								
10	Other Focal Species	10.5	Monitor Eulachon status	10.3.3	Status assessment	All		Klamath lower											1	1	1							
11	Coordination & Data Management	11.1	Facilitate cooperative information sharing and coordination	11.1.1	Work group	--	--	Basinwide	PSMFC	1	1	1	1															1
11	Coordination & Data Management	11.1	Facilitate cooperative information sharing and coordination	11.1.2	Annual workshops	--	--	Basinwide	PSMFC	1	1	1	1															1
11	Coordination & Data Management	11.2	Facilitate access to fish monitoring data	11.2.1	PIT Tag database	--	--	Basinwide	PSMFC	1	1	1	1															1
11	Coordination & Data Management	11.2	Facilitate access to fish monitoring data	11.2.2	PIT Tag data entry	--	--	Basinwide	PSMFC	1	1	1	1															1