U.S. Fish & Wildlife Service

Revised Draft Recovery Plan for the Coterminous United States Population of Bull Trout

(Salvelinus confluentus)

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Revised Draft Recovery Plan

for the

Coterminous United States Population of

Bull Trout

(*Salvelinus confluentus*)

Pacific Region

U.S. Fish and Wildlife Service

Portland, Oregon

Approved: XXXXXXXXXXXXXXXXXXXXXXX

Regional Director, Pacific Region
U. S. Fish and Wildlife Service

Date: XXXXXXXXXXXXXXXXXXXXXXX

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Recovery plans delineate reasonable actions that are believed to be required to recover and protect listed species. We, the U.S. Fish and Wildlife Service, publish recovery plans, sometimes with the assistance of recovery teams, contractors, State agencies, Tribal agencies, and other affected and interested parties. Objectives will be attained and necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate other parties to undertake specific actions and may not represent the views nor the official positions or approval of any individuals or agencies involved in recovery plan formulation, other than our own. They represent our official position *only* after they have been signed by the Regional Director or Director as *approved*. Recovery plans are reviewed by the public and submitted for peer review before we adopt them as approved final documents. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

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Literature citation:

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An electronic copy of this recovery plan will also be made available at:

http://www.fws.gov/pacific/ecoservices/endangered/recovery/plans.html and

http://www.fws.gov/endangered/species/recovery-plans.html

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Acknowledgments

The U.S. Fish and Wildlife Service would like to gratefully acknowledge the contributions of the numerous individuals who have worked tirelessly towards the conservation and recovery of bull trout (see USFWS 2014 for a list of individuals).

Executive Summary

PREVIOUS FEDERAL ACTIONS

In November 1999, all populations of bull trout within the coterminous United States were listed as a threatened species pursuant to the Endangered Species Act of 1973, as amended (Act) (64 FR 58910; November 1, 1999). The 1999 final listing created one distinct population segment (DPS) of bull trout within the coterminous United States by adding bull trout in the Coastal-Puget Sound populations (Olympic Peninsula and Puget Sound regions) and Saint Mary-Belly River populations (east of the Continental divide in Montana) to the previous listings of three separate distinct population segments of bull trout in the Columbia River, Klamath River, and Jarbidge River basins (63 FR 31647, June 10, 1998; 64 FR 17110, April 8, 1999).

Between 2002 and 2004, three separate draft bull trout recovery plans were completed. In 2002, a draft recovery plan was completed that addressed bull trout populations within the Columbia, Saint Mary-Belly, and Klamath River basins (USFWS 2002b) and included individual chapters for 24 separate recovery units. In 2004, draft recovery plans were developed for the Coastal-Puget Sound drainages in western Washington, including two recovery unit chapters (USFWS 2004b), and for the Jarbidge River in Nevada (USFWS 2004c). None of these draft recovery plans were finalized, but they have served to identify recovery actions across the range of the species, and provide the framework for implementing numerous recovery actions by our partner agencies, local working groups, and others with an interest in bull trout conservation.

This revised draft recovery plan: (1) incorporates and builds upon all the new information found in numerous reports and studies regarding bull trout life history, ecology, etc., including a variety of implemented conservation actions, since the draft 2002 and 2004 recovery planning period; and (2) revises recovery criteria proposed in the 2002 and 2004 draft recovery plans to focus on effective management of threats to bull trout at the core area level, and de-emphasize achieving targeted point estimates of abundance of adult bull trout (demographics) in each core area.

STATUS OF THE SPECIES

Our most recent 5-year status review for bull trout was completed on April 8, 2008, and concluded that listing the species as “threatened” remained warranted range-wide in the coterminous United States. Based on this status review, in our most recent recovery report to Congress (USFWS 2012) we reported that bull trout were generally “stable” overall range-wide (species status neither improved nor declined during the reporting year), with some core area populations decreasing, some stable, and some increasing. Since the listing of bull trout, there has been very little change in the general distribution of bull trout in the coterminous United States, and we are not aware that any known, occupied bull trout core areas have been extirpated. Additionally, since the listing of bull trout, numerous conservation measures have been and continue to be implemented across its coterminous range. These measures are being undertaken by a wide variety of local and regional partnerships, including State fish and game agencies, State and Federal land management and water resource agencies, Tribal governments, power companies, watershed working groups, water users, ranchers, and landowners. In many cases these bull trout conservation measures incorporate or are closely interrelated with work being done for recovery of salmon and steelhead, which are limited by many of the same threats. The Service has compiled a comprehensive overview of conservation actions and successes since 1999 for bull trout in each recovery unit that is referenced in this revised draft recovery plan.

HABITAT REQUIREMENTS AND DISTRIBUTION

Of all the native salmonids in the Pacific Northwest of the United States, bull trout generally have the most specific habitat requirements, which are often referred to as the "four C's": Cold, Clean, Complex, and Connected habitat. This includes cold water temperatures (often less than 12 degrees Celsius), complex stream habitat including deep pools, overhanging banks and large woody debris, and connectivity between spawning and rearing areas and downstream foraging, migration, and overwintering habitats.

Within the coterminous United States, bull trout currently occur in the Columbia River and Snake River basins in Washington, Oregon, Montana, Idaho, and Nevada; Puget Sound and Olympic Peninsula watersheds in Washington; the Saint Mary basin in Montana; and the Klamath River basin of south-central Oregon. At the time of their coterminous United States listing in 1999, bull trout, although still widely distributed, were estimated to have been extirpated from approximately 60 percent of their historic range.

FACTORS AFFECTING THE SPECIES

Our listing rule that determined threatened status for the coterminous U.S. population of bull trout (USFWS 1999a) included a detailed evaluation of threats to bull trout at a landscape scale and a tabular analysis describing which threat factors acted on each individual subpopulation. However, the analysis was not quantitative and did not determine the threats that were deemed most significant in affecting bull trout at finer scale levels.

Based on our most recent status review (USFWS 2008a), historic habitat loss and fragmentation, interaction with nonnative species, and fish passage issues are widely regarded as the most significant threat factors affecting bull trout. The order of those threats and their potential synergistic effects vary greatly by core area and among local populations. In some parts of their extant range, bull trout experience few or no threats and harbor healthy populations throughout most or all available habitat; some bull trout core areas experience limited but major threats and have strong populations throughout most habitat; and some continue to experience severe and systemic threats and harbor relatively small populations that have been reduced to a limited portion of available habitat.

Additionally, climate change effects were not considered as a factor affecting bull trout at the time of listing in 1999. Since that time, several climate change assessments or studies have been published or are currently underway assessing the possible effects of climate change on bull trout. The results of these efforts will allow us to better understand how climate change may influence bull trout and help to identify suitable conservation actions ensure bull trout persist in the face of climate change.

STRATEGIC PLAN FOR RECOVERY

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 stable[1] in six recovery units; (2) effectively manage and ameliorate the primary threats[2] 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 revised draft recovery plan also includes a ***Threat Assessment Tool*** (Appendix E) that will be integral to evaluation of bull trout conservation status at the range wide and recovery unit scales. The analyses of threats will be based at the level of the component core areas. Preliminary core-area assessments can inform the process of recovery plan development by highlighting conservation actions that should be given locally higher priority, and aiding managers to forecast the results of assessing recovery criteria at the aggregated recovery unit level, thus allowing managers to target those core areas where conservation resources can be most efficiently directed. Furthermore, core area-level assessments will be useful to recovery criteria

[1] Demographically Stable: A ‘recovered’ bull trout population described in terms of size, age structure, and density. Implies that bull trout populations, at the local population, core area or recovery unit scale, interact with their surrounding environment so that their population scale status is stable or increasing based on measurements and calculations of population size, density, and age structure. (i.e. ecologically viable).

[2] Threat factors known or demonstrated (i.e. non-speculative) to impact or affect bull trout survival, growth, reproduction, distribution, migration etc., and their suitable cold water habitat.

evaluation and status assessments conducted as part of future 5-year reviews and five-factor threats analysis in any future delisting evaluation for a potential bull trout distinct population segment.

Although bull trout were believed to have undergone a significant reduction in their historical range prior to the time of their listing in 1999, bull trout continue to be found in suitable habitats and geographically widespread across numerous major river basins in five western states. While the purpose of the Act is to protect and recover threatened or endangered species and the ecosystems upon which they exist, the Act does not necessarily require a species, or in this case bull trout, to be recovered throughout its historic range or even to a majority of the currently suitable habitat. Instead, the Act requires that we recover threatened species such as bull trout such that they no longer are likely to become endangered within the foreseeable future throughout all or a significant part of their range.

In summary, ecologically viable populations of bull trout are necessary to produce stable core areas which in turn will result in viable recovery units. The recovery principles described in this revised draft recovery plan take into account the threats and physical or biological needs of bull trout throughout its range and focus on the range-wide recovery needs. This approach to achieving recovery should ensure adequate conservation of genetic diversity, life history features, and broad geographical representation (i.e., adequate spatial distribution) of bull trout populations in the six recovery units that comprise the coterminous population of bull trout.

RECOVERY GOALS, OBJECTIVES AND CRITERIA

The ultimate **goal** of this recovery strategy is to manage threats and ensure sufficient distribution and abundance to improve the status of bull trout throughout their extant range in the coterminous United States so that protection under the Endangered Species Act is no longer necessary. When this is achieved, we expect that:

- Bull trout will be geographically widespread across representative habitats and demographically stable in each recovery unit;
- The genetic diversity and diverse life history forms of bull trout will be conserved to the maximum extent possible; and
- Cold water habitats essential to bull trout will be conserved and connected.

Specifically, the revised draft recovery plan outlines actions necessary to:

- **Effectively manage and ameliorate primary threats.** We will focus on effectively managing and ameliorating the primary threats identified for each recovery unit at the core area scale such that bull trout will respond and persist well into the future.

- **Work cooperatively with partners to implement bull trout recovery actions.** This includes: acknowledging and building upon the numerous and ongoing conservation actions that have already been implemented throughout much of the range of bull trout since the time of listing, and utilizing existing and new information, including decision support tools (e.g., structured decision making (SDM), climate change considerations) in developing and prioritizing conservation actions in each recovery unit.

- **Adaptively manage the bull trout recovery program**. Because the effectiveness of many of the recovery actions described in this revised draft recovery plan, as well as future climate effects, are not completely understood, we will apply adaptive management principles to future monitoring, implementation, and other recovery actions for bull trout. Specific short-term recovery actions for bull trout in each of the six recovery units are described in the Implementation Framework (Part III).

Bull trout population status remains strong in some core areas. However, in developing this revised draft recovery plan, we acknowledge that despite our best conservation efforts, it is likely that some existing bull trout core areas will become extirpated due to various factors; including the effects of small populations and isolation (35 of 110 extant core areas comprise a single local population). Thus, our current approach to developing recovery criteria and necessary recovery actions for bull trout is intended to ensure adequate conservation of genetic diversity, life-history features, and broad geographical representation of bull trout populations while acknowledging some local extirpations are likely to occur. Specifically, we are proposing a recovery approach that: (1) focuses on the identification and effective management of known threat factors to bull trout; (2) acknowledges that some extant bull trout core area habitats will likely change (and may be lost) over time due to climate change effects; and (3) prioritizes and implements recovery actions in those areas where success is likely. Additionally, we are not intending that all currently occupied core areas identified in this revised draft recovery plan need to be recovered; however, we recognize that recovery at the recovery unit scale will require improvement in bull trout local populations relative to the time of listing and their habitats in some core areas, while other core areas will need to be 'maintained' into the foreseeable future.

The proposed recovery criteria represent our best assessment of the conditions that would most likely result in a determination that listing under the Act is no longer required. For bull trout, these conditions will be met when conservation actions have been implemented to ameliorate the primary threats in suitable habitats. If the primary threats have been effectively managed in each recovery unit, the long-term persistence of bull trout should be ensured. The Service may initiate an assessment of whether recovery has been achieved and delisting is warranted when the following has been accomplished in each recovery unit:

- For the Coastal, Mid-Columbia, Upper Snake and Columbia Headwaters Recovery Units: Primary threats are effectively managed in at least 75 percent of all core areas, representing 75 percent or more of bull trout local populations within each of these four recovery units (as identified in Appendix B and Table 2 in this revised draft recovery plan).

- For the Klamath and Saint Mary Recovery Units, all primary threats are effectively managed in all existing core areas, representing all existing local populations. In addition, because 9 of the 17 known local populations in the Klamath Recovery Unit have been extirpated and others are significantly imperiled and require active management, we believe that the geographic distribution of bull trout within this recovery unit needs to be substantially expanded before it can be considered to have met recovery goals. To achieve recovery, we seek to add seven additional local populations distributed among each of the three core areas (two in the Upper Klamath Lake core area, three in the Sycan core area, and two in the Upper Sprague core area) (see Appendix B and Table 2).

- In recovery units where shared foraging/migratory/overwintering (FMO) habitat outside core areas has been identified (Appendix G), connectivity and habitat in shared FMO areas should be maintained in a condition sufficient for regular bull trout use and successful dispersal among the connecting core areas for those core areas to meet the criterion.

If threats are effectively managed as described in Table 2 (i.e., 75 percent threshold in the Coastal, Mid-Columbia, Upper Snake, and Columbia Headwaters Recovery Units, and 100 percent for the Klamath and Saint Mary Recovery Units), we expect that bull trout will respond accordingly and reflect the biodiversity principles of resiliency, redundancy, and representation. Specifically, achieving the proposed recovery criteria in each recovery unit would result in geographically widespread and demographically stable local bull trout populations within the range of natural variation, with their essential cold water habitats connected to allow their diverse life history forms to persist into the foreseeable future; therefore the species would be brought to the point where the protections of the Act are no longer necessary.

It is important to note that the revised draft recovery plan identifies prioritized recovery actions we believe are necessary to address specific threat factors affecting bull trout in all existing 110 core areas within the 6 recovery units. Under the revised draft recovery plan, all bull trout core areas have potential to contribute to the conservation of the species. We developed the draft recovery criteria thresholds with the understanding that some bull trout local populations may be lost in the future. This loss could occur due to a variety of unforeseen factors, including the effects of small population size and isolated local populations, and the possible effects of future climate change. If recovery criteria are met in a recovery unit in the future, the Service may initiate an assessment of whether recovery has been achieved and if designation as a separate DPS and delisting is warranted.

RECOVERY ACTIONS

Recovery of bull trout will entail effectively managing threats to ensure the long-term persistence of populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat conditions and access to them that allow for the expression of various life-history forms within each of six recovery units. Specifically, recovery actions for bull trout generally fall into three categories (described below) that were previously, or will be, developed in cooperation with Federal, State, local, and other partners. The final recovery plan will include comprehensive Recovery Unit Implementation Plans (RUIPs) with an Implementation Schedule for each recovery unit that includes core area specific recovery actions. (An example template is included in Part III, Table 3).

1. Protect, restore, and maintain suitable habitat conditions for bull trout that promote diverse life history strategies and conserve genetic diversity.

2. Prevent and reduce negative effects of non-native fishes and other non-native taxa on bull trout.

3. Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.

NEXT STEPS: COMPLETING THE FINAL RECOVERY PLAN

While we have the statutory responsibility for developing and implementing this recovery plan for bull trout, recovery of bull trout across the coterminous United States will require the involvement of Federal, Tribal, State, private, and local interests. This revised draft recovery plan takes into account the expertise and contributions of numerous individuals and agencies since the 1999 listing of bull trout. The continued expertise and contributions of these, and additional agencies and interested parties, is needed to implement the recovery actions identified in this plan.

The final bull trout recovery plan will describe the principal actions needed to advance the recovery of bull trout in the six recovery units within the coterminous United States. The Service will work with interested and knowledgeable Federal, Tribal, State, private and other partners to develop individual Recovery Unit Implementation Plans (RUIPs) for each recovery unit that will provide site specific detail at the core area scale prior to completion of the final recovery plan. To enhance the effectiveness of this recovery plan, the RUIPs should be updated regularly (at least every 5 years) to reflect the lessons learned and refinements to the recovery strategy.

The final recovery plan will also include Implementation Schedules that outline core area specific recovery actions and estimated costs for bull trout recovery as set forth in the RUIP for each recovery unit. The RUIPs and associated implementation schedules for each of the six recovery units will be made available for public review and comment prior to being incorporated into the final recovery plan. An implementation schedule is a *guide* for meeting the recovery goals, objectives, and criteria discussed in Parts I and II of this plan. The implementation schedules indicate the listing factor being addressed by each action, action descriptions, responsible parties and lastly, estimated costs. The initiation and completion of recovery actions for bull trout is subject to the availability of funds, as well as other constraints affecting the parties involved.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. Background

A. Overview

Bull trout (*Salvelinus confluentus*) are members of the char subgroup of the family Salmonidae and are native to waters of western North America (Figure 1). In the United States, bull trout range widely through the Columbia River and Snake River basins, extending east to headwater streams in Idaho and Montana (including the Saint Mary headwaters east of the continental divide), into Canada and southeast Alaska, and to the Puget Sound and Olympic Peninsula watersheds of western Washington and the Klamath River basin of south-central Oregon. Historically bull trout also occurred in the Sacramento River basin in California. In general, the current distribution of bull trout is fragmented and localized within the boundaries of its historic range.

Figure 1. Mature bull trout. Photograph by Joel Sartore with Wade Fredenberg, National Geographic stock, used with permission.

In June 1998, two distinct population segments (DPS) of bull trout in the Columbia River and Klamath River basins were listed as threatened (63 FR 31647, June 10, 1998). The Jarbidge River distinct population segment of bull trout was emergency listed as endangered (63 FR 42737; August 11, 1998) and was later listed as threatened (64 FR 17110; April 8, 1999). Subsequently, in November 1999, all populations of bull trout within the coterminous United States were listed as a threatened species pursuant to the Endangered Species Act of 1973, as amended (Act) (64 FR 58910; November 1, 1999). This final listing defined one DPS by adding bull trout in the Coastal-Puget Sound populations (Olympic Peninsula and Puget Sound regions) and Saint Mary-Belly River populations (east of the Continental divide in Montana) to the previous listings. Based on the 2008 5-year status review (USFWS 2008a), bull trout have a recovery priority number of 9C on a scale of 1 (highest) to 18 (lowest (USFWS 1983), indicating that (1) this population is a distinct population segment of a species; (2) the coterminous United States population is subject to a moderate degree of threat(s); (3) the recovery potential is high; and (4) the degree of potential conflict with construction or other development projects during recovery is high.

Between 2002 and 2004, three separate draft bull trout recovery plans were completed. In 2002, a draft recovery plan that addressed bull trout populations within the Columbia, Saint Mary-Belly, and Klamath River basins (USFWS 2002b) was completed and included individual chapters for 24 separate recovery units. In 2004, draft recovery plans were developed for the Coastal-Puget Sound drainages in western Washington, including two recovery unit chapters (USFWS 2004b), and for the Jarbidge River in Nevada (USFWS 2004c). None of these draft recovery plans were finalized, but they have served to identify recovery actions across the range of the species and to provide a framework for implementing numerous recovery actions by our partner agencies, local working groups, and others with an interest in bull trout conservation.

In this revised draft recovery plan, we (1) incorporate and build upon all the new information found in numerous reports and studies regarding bull trout life history, ecology, etc., including a variety of implemented conservation actions, since the 2002 and 2004 draft recovery plans; and (2) have revised recovery criteria proposed in the 2002 and 2004 draft recovery plans to focus on effective management of threats to bull trout at the core area level and de-emphasize achieving targeted point estimates of abundance of adult bull trout (demographics) in each core area.

B. Status of the Species

In 1999, when we listed all bull trout in the coterminous United States as one distinct population segment we found that "…sufficient evidence exists in each of the population segments that demonstrate they are threatened by a variety of past and ongoing threats" that were generally consistent across the bull trout's range. Since the time of the listings of bull trout in 1998 and 1999 (USFWS 1998a, 1998b, 1999a, 1999b), a great deal of new information has been collected on the status of bull trout, factors affecting the species, and ongoing conservation actions implemented throughout its coterminous U.S. range.

1. New Information

New information used in developing this revised draft recovery plan is found in a variety of documents, including several Service documents: draft recovery plans (USFWS 2004b, 2004c), proposed and final critical habitat rules (USFWS 2002a, 2004a; 2005a, 2010a), USFWS Science Team Report (Whitesel *et al.* 2004), Bull Trout Core Area Templates (USFWS 2005b, 2009), the Bull Trout Core Area Conservation Status Assessment (USFWS 2005c), the revised Designation of Critical Habitat for Bull Trout (USFWS 2010a), and the 5-year Review (USFWS 2008a). In addition, new information is described in documents compiled by the five States (Montana, Idaho, Nevada, Washington, and Oregon) in which bull trout are found (Gamblin and Snyder 2005; Hagener 2005; Hanson 2005; Haskins 2005; IDFG 2005a; 2005b). A bull trout conservation strategy has recently been published for U.S. Forest Service lands in western Montana (USFS 2013). Other new information includes research on the larger role of climate change in affecting the status of bull trout throughout their range (Rieman *et al*. 2007; Porter and Nelitz 2009; Isaak *et al*. 2010, 2011; Wenger *et al*. 2011).

At the time of the listings, the assessment of the status of bull trout and its threats was reported by subpopulation. The Service identified 187 subpopulations range-wide in the Columbia, Klamath, Jarbidge, Saint Mary-Belly, and Coastal-Puget Sound DPSs. During the recovery planning process beginning in 2002, new information on fish movement supported refining the delineation of the 187 subpopulations into 121 bull trout core areas. In the last few years, we requested additional information regarding the status of bull trout for the purpose of designating critical habitat and refining the delineation of core areas, resulting in further refinement of our classification to comprise 110 currently occupied bull trout core areas, as well as 6 historically occupied core areas and 2 research needs areas, totaling 118 (see Appendix F. Comparison of Current and Former Core Areas and Recovery Unit Classifications). During this period we also distinguished two types of core areas for conservation purposes: complex core areas and simple core areas. Complex core areas are core areas that contain multiple local populations; they are typically situated in a larger patch of habitat, often occupied by bull trout of both the migratory life history form and the resident form, and include a diverse pattern of connected spawning and rearing (SR) habitats and foraging, migratory, and overwintering (FMO) habitats. Simple core areas are core areas that contain a single local population; typically they are situated in a smaller patch of habitat that may not include FMO stream habitat (e.g., an isolated headwater lake with a single SR stream) and sometimes include only the resident life history form or a very simple migratory pattern.

To update the most recent information on bull trout status and their threats, we developed the Core Area Templates (USFWS 2005b, 2005c) with the most recent update being completed in 2009 (USFWS 2009). These documents represent a compilation, core area by core area, of new information since listing on population status, threats, habitat, regulatory mechanisms, and conservation efforts. This new information was used in the bull trout core area conservation status assessment model to rank the conservation status of each of the 110 occupied core areas.

2. Life History and Ecology

Bull trout express both resident and migratory life history strategies (Rieman and McIntyre 1993). Resident forms of bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. Migratory bull trout spawn in tributary streams, where juvenile fish rear for 1 to 4 years before migrating to either a lake (adfluvial form) (Downs *et al*. 2006), river (fluvial form) (Fraley and Shepard 1989), or in certain coastal areas, to saltwater (amphidromous/anadromous) (Cavender 1978, McPhail and Baxter 1996; Washington Department of Fish and Wildlife. *et al.* 1997; Goetz *et al*. 2004; Brenkman and Corbett 2005; Jeanes and Morello 2006; Brenkman *et al*. 2007). Resident and migratory forms may be found together, and either form may give rise to offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993, Brenkman *et al*. 2007, Homel *et al.* 2008).

The size and age of bull trout at maturity depends upon habitat capacity and subsequent life history strategy. Resident fish tend to be smaller than migratory fish at maturity and produce fewer eggs (Fraley and Shepard 1989, Al-Chokhachy and Budy 2008). Bull trout normally reach sexual maturity in 4 to 7 years (Johnston *et al*. 2007); they frequently live for 10 years and occasionally for 20 years or more (McPhail and Baxter 1996, Al-Chokhachy and Budy 2008).

Of native salmonids in the Pacific Northwest of the United States, bull trout have the most specific habitat requirements (Rieman and McIntyre 1993), which are often referred to as the “four C’s”: Cold, Clean, Complex, and Connected habitat. These requirements include cold water temperatures compared to other salmonids (often less than 12 degrees Celsius); the cleanest stream substrates; complex stream habitat including deep pools, overhanging banks and large woody debris; and connectivity between spawning and rearing areas and downstream foraging, migration, and overwintering habitats.

Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997, Shellberg 2002, Al-Chokhachy *et al*. 2010).

Migratory corridors link seasonal habitats for all bull trout life histories. For example, in Montana and northern Idaho, migratory bull trout make extensive migrations in the Flathead River system (Fraley and Shepard 1989). Resident bull trout in tributaries of the Bitterroot River move downstream to overwinter in tributary pools (Jakober 1995). Migratory (allacustrine) bull trout in the Pend Oreille River drainage make complex post-spawning migrations (Dupont *et al*. 2007). The ability to migrate is important to the persistence of bull trout as it allows them to seasonally or temporally occupy habitat that may be advantageous on an intermittent basis (Rieman and McIntyre 1993; M. Gilpin, *in litt.* 1997; Rieman *et al*. 1997, Dunham and Rieman 1999, Muhlfeld and Marotz 2005). In essence, bull trout aggregations can function as complex metapopulations (see Whitesel *et al*. 2004). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed, or stray, to non-natal streams. Local populations that are extirpated by catastrophic events may also become re-established by bull trout migrants.

Bull trout depend on cold streams, although individual fish can be found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman *et al*. 1997; Ripley *et al*. 2005; Rieman *et al*. 2006). Water temperature above 15 degrees Celsius (59 degrees Fahrenheit) is believed to especially limit juvenile bull trout distribution, which may partially explain the patchy distribution within a watershed (Fraley and Shepard 1989; Rieman and McIntyre 1995; McMahon *et al*. 2007). Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992; Rieman and McIntyre 1993; Rieman *et al*. 1997; Baxter and McPhail 1999, Baxter *et al*. 1999). Goetz (1989) suggested optimum water temperatures for juvenile rearing of about 7 to 8 degrees Celsius (44 to 46 degrees Fahrenheit) and optimum water temperatures for egg incubation of 2 to 4 degrees Celsius (35 to 39 degrees Fahrenheit).

Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989) and water temperatures of 5 to 9 degrees Celsius (41 to 48 degrees Fahrenheit) in late summer to early fall (Goetz 1989). Land use and water use may also influence spawning behavior and distribution (Starcevich *et al*. 2010). In the Swan River, Montana, abundance of bull trout redds (spawning areas) was positively correlated with the extent of bounded alluvial valley reaches, which are likely areas of groundwater to surface water exchange (Baxter and McPhail, 1999). Survival of bull trout embryos planted in stream areas of groundwater upwelling used by bull trout for spawning were significantly higher than embryos planted in areas of surface water recharge not used by bull trout for spawning (Baxter and McPhail 1999). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August to November during periods of decreasing water temperatures. Water temperatures during spawning vary, but generally range from 4 to 10 degrees Celsius (39 to 51 degrees Fahrenheit) (Howell *et al*. 2010). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989; Pratt 1992; Rieman and McIntyre 1993). Migratory bull trout frequently begin spawning migrations as early as April and have been known to move upstream as far as 250 kilometers (155 miles) to spawning grounds in Montana (Fraley and Shepard 1989; Swanberg 1997). In Idaho, bull trout moved 109 kilometers (67.5 miles) from Arrowrock Reservoir to spawning areas in the headwaters of the Boise River (Flatter 1998). In the Blackfoot River, Montana, bull trout began spring migrations to spawning areas in response to increasing temperatures (Swanberg 1997). Depending on water temperature, egg incubation is normally 100 to 145 days (Pratt 1992), and after hatching, young fry remain in the substrate. Time from egg deposition to emergence of fry may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992).

Bull trout are opportunistic feeders, with food habits primarily a function of size and life history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish (Goetz 1989; Donald and Alger 1993). Adult migratory bull trout feed primarily on a wide variety of resident and anadromous fish species (Fraley and Shepard 1989; Brown 1992; Donald and Alger 1993; Guy *et al*. 2011). In coastal areas of western Washington, bull trout feed on forage fish species such as Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) in nearshore marine areas and the ocean (WDFW *et al.* 1997, Goetz *et al*. 2004).

3. Distribution

At the time of their coterminous United States listing in 1999, bull trout were still widely distributed although they had been extirpated from approximately 60 percent of their historic range (Quigley and Arbelbide 1997). For example, although bull trout still existed in most river basins where they were found historically, they had been likely extirpated in the McCloud River basin, California; the upper Deschutes, North and South Fork Santiam, and Clackamas River basins, Oregon; the White Salmon, lower Nisqually, Satsop, Lake Chelan, Okanagan, Sanpoil, and Kettle River basins, Washington; and locally in numerous tributaries and in salt water, lake, and mainstem river environments in other areas. These declines resulted largely from habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, and the introduction and subsequent proliferation of nonnative fish species.

Since 1999, there has been very little change in the general distribution of bull trout in the coterminous United States and we are not aware that any known, occupied bull trout core areas have been extirpated. Advancements in radio telemetry and hydroacoustic technology have been used to better understand bull trout movement patterns. Tracking movements of individual fish has greatly informed the proper application of fish passage technology, furthered the identification of metapopulation dynamics, contributed to verification of genetic patterns, and aided in assessment of movement timing and limiting factors. This technology has contributed to the identification of previously undocumented migrations of anadromous bull trout in near-shore waters of Washington State (Brenkman and Corbett 2005), of fluvial bull trout of the

Columbia River region of central Washington (USFWS 2001), and in the Snake River in Idaho (Chandler *et al.* 2001).

4. Population Abundance and Trend

We completed a 5-year status review of bull trout on April 8, 2008 (USFWS 2008a), and found that listing the species as "threatened" remained warranted range-wide in the coterminous United States. We evaluated the status of the 121 core areas recognized at that time (see Appendix F for crosswalk with current classification); of those, 23 exhibited population trends that were declining from slightly to severely, 18 were stable, 14 were increasing, and 66 were unknown. We also found that 75 core areas had substantial or moderate, imminent threats, with the remainder being less threatened (substantial or moderate, imminent threats not necessarily equivalent to 'primary threats' as defined in this document). We concluded that the "foreseeable future" for evaluating actions affecting bull trout and their recovery was from 4 to 10 generations, or roughly 28 to 70 years. Based on the 2008 5-year status review, we reported in our most recent recovery report to Congress (USFWS 2012) that bull trout were "stable" overall range-wide (species status neither improved nor declined during the reporting year), with some core area populations decreasing, some stable, and some increasing.

Subsequent to completion of the 2008 5-year review, we worked with State, Federal and Tribal agency biologists to update bull trout status information for each of 118 core areas (currently occupied or historic) that were identified in February, 2009, with updated information in Service "core area template" files, or documents for each core area capturing 2009 status and threats information. From these data we and our partners developed a relative ranking of all bull trout core areas range-wide, using criteria in the updated NatureServe status assessment tool (Faber-Langendoen *et al*. 2009). This tool consists of a spreadsheet that generates conservation status rank scores for species or other biodiversity elements based on various user inputs of status and threats. We used nine factors to score bull trout status and threats: (1) linear distance of occupancy; (2) number of occurrences, or local populations; (3) adult population size; (4) environmental specificity; (5) intrinsic vulnerability [4 and 5 were the same for the species across all areas scored]; (6) short-term trend; (7) long-term trend; (8) threat scope; and (9) threat severity. Thus, each core area rank score can be compared to other core areas to gain a relative understanding of the status of that core area, with lower scores representing core areas that are less robust and more vulnerable to extirpation.

The status assessment scores for all bull trout core areas range from 0.36 to 3.83 (Figure 2) (USFWS, *in litt.* 2012). The most robust, least threatened core areas include Hungry Horse Reservoir and Lake Koocanusa in Montana (Columbia Headwaters Recovery Unit) and the Middle Fork Salmon River and South Fork Salmon River in Idaho (Upper Snake Recovery Unit). The least robust, most threatened core areas include the North Fork Payette River and Weiser River in Idaho (Upper Snake Recovery Unit) and Asotin Creek in southeast Washington

(Mid-Columbia Recovery Unit). A majority of core areas with low status assessment scores include ‘simple’ core areas comprised of only a single local bull trout population. Nearly one-third (35 of 110) core areas considered in this revised draft recovery plan are ‘simple’ core areas. Bull trout in simple core areas likely contribute less to the overall viability of bull trout within a recovery unit, and these small, mostly isolated bull trout local populations are at an inherently higher risk of extirpation than core areas with multiple, well-connected local populations.

In preparation of this revised draft recovery plan, we also applied the NatureServe status assessment tool to evaluate the status of the six recovery units. The tool rated the Klamath Recovery Unit as the least robust, most vulnerable bull trout recovery unit and the Upper Snake Recovery Unit the most robust and least vulnerable recovery unit, with others suitably arrayed between (Figure 3). Further, this tool uses rank scores to categorize biological entities into one of six different categories to describe their degree of threat (Faber-Langendoen *et al.* 2009); for intraspecific groups such as recovery units ("T" ranks), these range from TX (Presumed Extinct) through T5 (Secure). The Klamath and Saint Mary Recovery Units are ranked as T2: “Imperiled- At high risk of extinction or elimination due to very restricted range, very few populations or occurrences, steep declines, or other factors.” The remaining recovery units except the Upper Snake Recovery Unit are ranked as T3: “Vulnerable- At moderate risk of extinction or elimination due to a restricted range, relatively few populations or occurrences, recent and widespread declines, or other factors.” The Upper Snake Recovery Unit is ranked as T4: “Apparently Secure- Uncommon but not rare; some cause for long-term concern due to declines or other factors.”

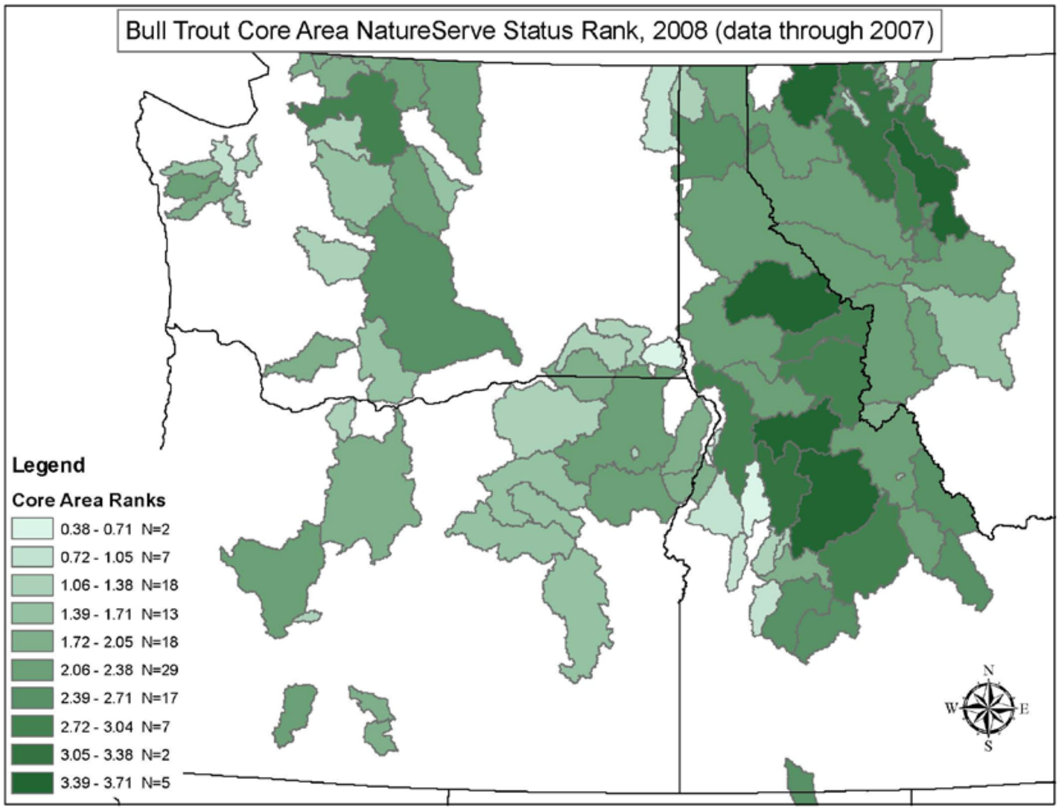


Figure 2. Map of 2008 NatureServe status assessment scores for each bull trout core area. Darker core areas indicate more robust demographic status (abundance, distribution, and trend) and/or fewer or less imminent or pervasive threats (Faber-Langendoen *et al*. 2009).

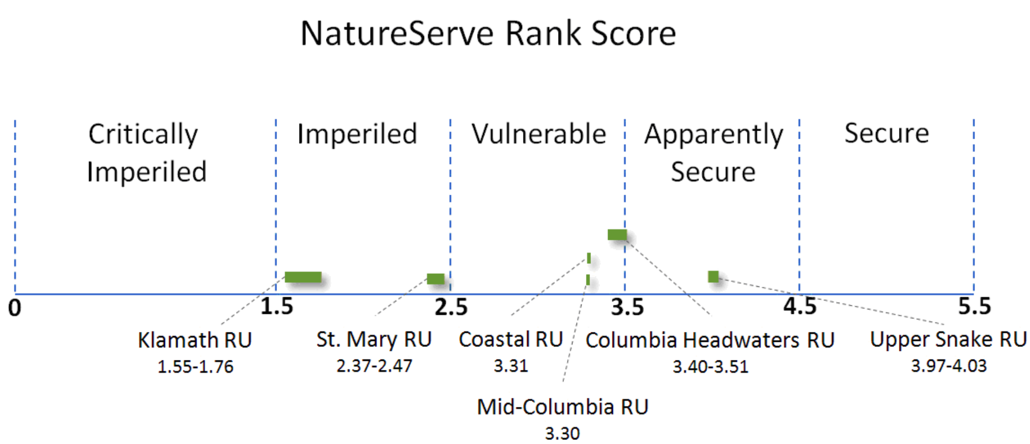


Figure 3. Distribution of 2008 NatureServe status assessment tool scores for each of the six bull trout recovery units (Faber-Langendoen *et al*. 2009). The Klamath Recovery Unit (RU) is the least robust, most vulnerable RU and the Upper Snake RU is the most robust and least vulnerable RU.

Status rank assessments may vary depending on individual biologists' judgment regarding population characteristics. Although our estimates of linear distance of occupancy and number of occurrences or local populations are relatively confident, estimating actual adult abundance, let alone population trends, can be exceedingly difficult due to a lack of adequate data across the range of bull trout. (However, because the tool assesses population size in broad categories [e.g., 10,000 to 100,000 individuals], relatively large changes in population size are required to change a core area or recovery unit score.) NatureServe threat levels are defined as "high", "moderate", "low", or "insignificant" in scope and severity, and assessing appropriate levels with respect to these definitions while integrating data on multiple threats also provides some scope for subjective judgment. Inputs to the NatureServe status assessment tool are sufficiently subjective and non-specific such that we do not rely on these calculations to set recovery criteria.

The NatureServe status assessment tool ranks the extent to which a biological entity is at risk, but by itself does not directly lead to a determination as to whether a species should be listed under the Endangered Species Act. We must ensure consideration of all the specific criteria in the Act to make such listing determinations. The authors of the NatureServe tool clarify (NatureServe 2011) that:

"[The Service] consider[s] NatureServe status ranks, and the documentation that supports them, as an input for making official determinations about a species' need for legal protection. However, NatureServe status assessment procedures have different criteria, evidence requirements, purposes, and taxonomic coverage than government lists of endangered and threatened species, and therefore these two types of lists should not be expected to coincide."

Thus, although NatureServe model inputs should generally correlate with status of the five listing factors identified by the Act, the model does not directly provide the analysis based on the five factors required for delisting. Nonetheless, we believe this method remains useful for describing and comparing the status of different core areas under a consistent framework, and identifying core areas that should be most responsive to effective threat management.

5. Habitat Use and Condition

New information that has become available on the complex migratory movements of fluvial, adfluvial, and anadromous life history forms (e.g., see USFWS 2002b; 2004a; 2004b, USFWS 2005b, 2005c) has increased our understanding of the extensive habitat use and connectivity requirements of the migratory life history form. Much of this new information has affirmed that the use of migratory corridors is critical to the survival of bull trout (e.g., see Bahr and Shrimpton 2004, Brenkman and Corbett 2005, Mogen and Kaeding 2005; 2007, Nelson *et al*. 2002, Neraas and Spruell 2001, Homel and Budy 2008, Monnot *et al* 2008). There is also updated information available to assess the level of core area fragmentation across the coterminous U.S. range, which significantly influences the persistence of these migratory forms of bull trout, though no conclusion can be reached whether or not habitat fragmentation has increased or decreased since the time of listing. Additionally, there is new information on where habitat degradation/loss and/or habitat improvements have occurred within individual core areas since the time of listing (e.g., see USFWS 2002b; 2004b; 2004c, USFWS 2005c, and USFWS 2005b, 2009).

6. Factors Affecting the Species

Supporting documentation for listing the coterminous U.S. population of bull trout as threatened (USFWS 1999a) included a detailed evaluation of threats to bull trout at a landscape scale and a tabular analysis describing which threat factors acted on each individual subpopulation. However, the analysis was not quantitative and did not determine the threats that were deemed most significant in affecting bull trout at finer scale levels.

Subsequently, the draft bull trout recovery plans for the Columbia River, Klamath River and Saint Mary-Belly populations (USFWS 2002a), and for the Coastal-Puget and Jarbidge populations (USFWS 2004b, 2004c), provide detailed information on threats at the recovery unit scale, similar to regional watersheds. Much of that threat information was incorporated from existing State bull trout management plans (e.g., Montana Bull Trout Restoration Team 2000; Batt 1996). A broad range of expert opinion both inside and outside the Service was utilized and incorporated in the threats analyses for the 2002 and 2004 draft recovery plans.

In the draft recovery plans (USFWS 2002a, 2004a, 2004b), as well as existing State restoration planning processes in Montana and Idaho (e.g., Montana Bull Trout Restoration Team 2000; Batt 1996); common categories were used to describe and evaluate human-caused threats to bull trout. Threat factors evaluated included dams, forest management practices, livestock grazing, agricultural practices, transportation networks, mining, residential development and urbanization, fisheries management activities, and any of a host of general practices as well as some natural events (e.g., fire or flood under certain circumstances) that may contribute to historical and current isolation and habitat fragmentation. These general threat categories to bull trout were also evaluated by an expert science panel convened by the Service in March 2005 as part of the 5-year review process (USFWS 2008a).

More recently, increasing concerns about management and recovery of bull trout prompted the Bull Trout Committee of the Western Division American Fisheries Society to independently survey professional opinion of 87 fishery scientists located throughout the Pacific Northwest in regard to bull trout status and future trends, limiting factors, effectiveness of restoration strategies and regulatory mechanisms, and information gaps limiting recovery. They used the same categories as above, though noting the difficulty of separating legacy impacts from current management practices and future threats – that is, separating causes from effects (e.g., forest management vs. production of sediment from forest roads). The survey (Al-

Chokhachy *et al*. 2008) concluded nonnative species, forest management practices, and fish passage issues were the top factors limiting bull trout populations at the range-wide level, both currently and historically. In addition, survey respondents identified corresponding restoration actions, especially nonnative species control, fish passage improvements, and habitat restoration as the highest ranking priorities for restoring healthy bull trout populations over the next 10 years. Many of the threat categories incorporate a suite of specific human land and water management activities that fall under their broader umbrella.

The threat analyses of Al-Chokhachy *et al*. (2008) were based on the collective body of information, compiled in a chronological sequence, dating back to the individual State plans and including the final listing rule and its documentation, the draft recovery plans, additional critical habitat analysis incorporated in proposed and final rules, and the most recent up-to-date core area template review. The collective record for this effort is voluminous, and exceeds several thousand pages. Habitat loss and fragmentation, and interaction with nonnative species are widely regarded as the most significant threats impacting bull trout (Al-Chokhachy *et al*. 2008). The order of those threats and their potential synergistic effects vary greatly by core area and among local populations. Some parts of the range of bull trout experience few or no threats and harbor healthy populations throughout most or all available habitat; some experience limited but major threats and have strong populations throughout most habitat; and some have major threats and weak populations that have been reduced to a limited portion of available habitat. Effective management of major threats is a conservation priority in parts or all of the six recovery units in this revised draft recovery plan, and bolstering weak populations is a priority primarily in those portions of those recovery units where demographic condition is weak (see Appendix B: List of Primary Threats and Factors Affecting Bull Trout).

Additionally, habitat restoration efforts and other potentially beneficial management activities are already occurring in most bull trout core areas, and these efforts were considered in the Bull Trout Core Area Conservation Status Assessment and core area templates (USFWS 2005b, 2005c, 2009).

The following discussion briefly summarizes our current understanding of the factors affecting the status of bull trout.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Many of the factors affecting bull trout fall into the category of destruction, modification, or curtailment of habitat and are described and characterized in a wide variety of documents, including various State plans (e.g., Montana Bull Trout Restoration Team 2000; Batt 1996), the previous draft recovery plans (USFWS 2002a, 2004a, 2004b), the critical habitat rules (USFWS 2004a; 2005a; 2010a), the original and updated Bull Trout Core Area Templates (USFWS 2005b, 2009), and the Bull Trout Core Area Conservation Status Assessment USFWS 2005c).

Most of these impacts (e.g., dewatering, sedimentation, thermal modification, water quality degradation) are human-caused and are a consequence of specific land and water management activities. Today, these types of impacts are frequently mitigated or moderated, especially on Federal lands and with a greater conservation emphasis in headwater areas where suitable bull trout spawning and rearing habitat occurs. It is the legacy effect of poor past land use management that continues to degrade bull trout habitat where habitat restoration has not yet occurred or has not been effective.

In our 2008 five year review (USFWS 2008a) we found that substantial or moderate and imminent threats to bull trout, primarily related to habitat impacts, existed in 75 of the 121 core areas recognized at the time (62 percent) and only 13 of 121 core areas (11 percent) were ranked as slightly threatened or unthreatened. Drought and wildfire impacts occur across the entire range (USFWS 2002b), and their potential magnitude, severity, and intensity remain high for bull trout across its range. Throughout much of the range of bull trout, wildfires will likely continue to increase in forests, prairie and arid land ecosystems in the coming decades (Littell *et al*. 2009). Mote *et al*. (2014) state that: "The combined impacts of increasing wildfire, insect outbreaks, and tree diseases are already causing widespread tree die-off and are virtually certain to cause additional forest mortality by the 2040s and long-term transformation of forest landscapes. Under higher (greenhouse gas) emissions scenarios, extensive conversion of subalpine forests to other forest types is projected by the 2080s."

Warmer and drier springs and summers, lower soil moisture and prolonged periods of elevated fire-danger all contribute to higher vulnerability to fire for forests and non-forests in the Northwest (Littell *et al*. 2009; Abatzoglou and Kolden 2013). Wetter winters are correlated with fire in non-forested habitats due to higher fuel availability in the summer in the form of grasses and shrubs, while fire in forested areas is highly associated with year-of-fire low precipitation (Littell *et al*. 2009; Abatzoglou and Kolden 2013). Also, snowpack losses and earlier snow melt at lower elevation forests (Mote *et al*. 2005; Pederson *et al*. 2013) are increasing fire risk in these areas (Abatzoglou and Kolden 2013). Wildfire frequency in western forests has increased fourfold during the period 1987-2003 as compared to 1970-1986, while the total area burned increased six-fold (Westerling *et al*. 2006). This study demonstrated that earlier snowmelt dates correspond to increased wildfire frequency. Trouet *et al*. (2006) confirm that these increases in area burned are tied to climate conditions despite forest suppression management practices such as thinning. Prolonged dry and hot periods are generally required for large fires (Gedalof *et al*. 2005) and future conditions will likely make these periods, and resultant wildfires, more likely.

In many areas where bull trout occur, management actions such as restoration of degraded habitat and improvement of fish passage have been implemented (USFWS 2013). However, it is too soon to measure significant results from those activities since it may take many years (generations) for bull trout populations to respond. The Bull Trout Core Area Templates (USFWS 2009) and the Bull Trout Core Area Conservation Status Assessment (USFWS 2008b) contain specific analysis of threats by core area.

Factor B. Overutilization for Commercial, Scientific, or Educational Purposes

At the time of listing in 1999, illegal harvest and ongoing incidental 'take' (hooking mortality) of bull trout by anglers catching and releasing fish or pursuing other species were identified as factors affecting the species in several areas (USFWS 1998a). Today, angling regulations have been adjusted in all States where bull trout occur to minimize angling impacts to bull trout, and legal, managed bull trout harvest is permitted in a handful of locations with relatively robust bull trout populations since the early and mid-1990s (USFWS 1998a). Current State fishing regulations have resolved most pre-listing concerns about the overutilization of bull trout by anglers. In some areas, bull trout numbers appear to have responded positively to those angling restrictions (USFWS 2005b).

In certain core areas, however, there is still concern over the vulnerability of large, migratory adult bull trout to the effects of illegal fishing, poaching, and incidental harvest from legal fisheries. Particularly in late summer, when these fish stage for spawning in small streams, they may be locally vulnerable to angling pressure. Enhanced enforcement of existing regulations, combined with angler education, is generally the best remedy to address this issue, and may include site-specific actions to control access and enforce take prohibitions. Thus, while at a range-wide scale we consider angling impacts to be a relatively minor threat, some significant localized impacts may remain that should be considered in core area management.

Overutilization for scientific purposes, including collecting, was not identified as a threat factor at the time of listing. For purposes of population monitoring, we authorize limited take of bull trout (usually nonlethal capture by net, trap, angling, or electrofishing; marking or PIT [passive integrated transponder] tagging; measurement and tissue sampling; and release) for scientific research through issuing Endangered Species Act section 10(a)(1)(A) recovery permits with appropriate special terms and conditions to minimize impacts to bull trout populations. We previously analyzed the effects of this take through a programmatic biological opinion on recovery permit issuance (USFWS 2000), and determined that scientific collecting does not jeopardize bull trout.

Factor C. Disease or Predation

Disease was considered only a minor threat in the original bull trout listing (USFWS 1998a, 1999a). Since the time of listing, whirling disease has become established in some drainages occupied by bull trout, primarily in western Montana and northern Idaho (USFWS 2005b). Whirling disease has been shown to dramatically impact salmonid communities and is known to disproportionately affect rainbow trout. Even though some wild bull trout populations are known to be infected with whirling disease in Montana (USFWS 2005b), direct effects of whirling disease on individual bull trout have not been documented.

Translocation of fishes between watersheds always has some potential to introduce fish pathogens, but there is little information on specific effects to bull trout. Some guidelines and agreements among fisheries managers have been developed for salmonids to reduce these risks and identify high- and low-risk transfers based on distance of transfer, species susceptibility, life stage, and pathogen findings (J. Evered *in litt*. 2014). Such information should be used as appropriate in design of future bull trout translocation efforts.

Invasive fish species of primary concern are those nonnative salmonids or other large predators that may prey upon and/or compete or hybridize with bull trout. Competition and hybridization effects are further discussed under Factor E, below. Frequently the same species can affect bull trout adversely both through competitive interactions with adult bull trout and predation on sub-adult fish. Results of interaction between invasive fishes and bull trout are not always clear, either spatially or temporally. Invasive fish species issues were identified in the original listing of bull trout (USFWS 1998a, 1999a), and the threat or recognition of such has grown significantly since that time (USFWS 2008a).

The 1998 bull trout listing rule (USFWS 1998a) stated that: "Negative effects of interactions with introduced non-native species may be the most pervasive threat to bull trout throughout the Columbia River basin." Over 75 percent of lakes containing adfluvial populations of bull trout also contain reproducing populations of brook trout, lake trout, brown trout, or some combination of the three species within their watershed (Fredenberg 2003). In the same analysis, nonnative fish species occurred in 86 percent of the managed and roaded watersheds where adfluvial populations of bull trout exist. Only three large natural lakes (over 200 acres) remain in the entire Columbia River Basin that still contain bull trout in their natural abundance and secure habitat in the absence of these other species.

Nonnative lake trout, brown trout, and northern pike have all been documented as predators on juvenile and sub-adult bull trout, and can be found in many bull trout core areas. In addition, walleye and smallmouth bass are continuing to spread in several large rivers and lakes occupied by bull trout. The complex species interactions that lead to bull trout decline are often not well understood, but there is widespread concern that predation on bull trout by piscivorous (fish eating) nonnative species may play an increasingly large role. At this time, one of the few management options available is direct predator removal through netting, trapping, or angler incentives (largely by State and Tribal managers). Due in part to the high costs and social constraints, application of these techniques has been limited and broader implementation remains problematic. Many of the predator species are also highly sought after sport fish species and may even be preferred by the public and promoted. The magnitude, severity, and intensity of this threat (Independent Scientific Advisory Board 2008) are significant in specific core areas (USFWS 2008b). As a consequence, threat factor C may be an increasingly important factor in bull trout declines and an increasingly larger obstacle to recovery.

Nonnative brook trout and lake trout are closely related to bull trout within the genus *Salvelinus*, and they along with other salmonid fish species that share common life history characteristics and preferences (e.g., fall spawning, piscivorous, affinity for cover) such as brown trout, have high potential to be competitors and sometimes predators. These species can threaten bull trout even in areas of otherwise secure habitat. Flathead Lake, Lake Pend Oreille, Priest and Upper Priest Lakes, Swan Lake, and many smaller bull trout core areas in the relatively secure lacustrine (lake) habitat of the Columbia Headwaters Recovery Unit in particular have experienced increased impacts of lake trout population expansion since the listing (Fredenberg 2002, Hansen *et al*. 2008, 2010; USFWS 2005a, 2008a, CSKT 2014). In addition, brook trout and rainbow trout have likely increased, and are projected to continue increasing, their range (an upward shift in elevation) due to climate change (Wenger *et al*. 2011, Isaak *et al*. 2010).

The long-term compatibility of brown trout and bull trout is not well understood. In some cases brown trout, which generally spawn later in the fall than bull trout, have been shown to superimpose their redds on bull trout redds, which may impact bull trout egg survival and hatching (Moran 2004). Brown trout are piscivorous at larger sizes and may prey upon juvenile bull trout in areas where they co-occur. The niche overlap between brown trout and bull trout is considerable and, as a result, brown trout may replace bull trout in certain circumstances. Along with factor “A” (the present or threatened destruction, modification, or curtailment of its habitat or range), the threat from nonnative species is considered the primary threat affecting bull trout in many core areas.

Factor D. Inadequacy of Existing Regulatory Mechanisms

Existing regulatory mechanisms were considered mostly inadequate to conserving bull trout in the original listing rule for bull trout (USFWS 1998a), and changes in those mechanisms have been taken into account in our analysis, as described below. Under the Act, Federal agencies consult with the Service on the effects of their management and operations on bull trout. Ongoing land management plans (primarily the Bureau of Land Management and the Forest Service) and facility operations (primarily U.S. Army Corps of Engineers, Bonneville Power Administration, Bureau of Reclamation, and power producers operating under Federal Energy Regulatory Commission permits) include provisions to minimize adverse effects to bull trout, where possible, and avoid jeopardizing the continued existence of the species.

Implementation of management measures by Federal agencies directly responsible for adhering to the requirements of the Act is likely to result in a progressive diminishment of some threats on Federal lands and at Federal facilities (e.g., effects of timber harvest, road building, grazing, and other land management actions conducted by the Forest Service and the Bureau of Land Management). Other threats are currently being assessed through monitoring and information gathering and potential reductions in the scope of their effects on bull trout have yet to occur (e.g., operations of the Federal Columbia River Power System conducted by the U.S. Army Corps of Engineers, the Bonneville Power Administration, and the Bureau of Reclamation). See Appendix C for a completed discussion on Interagency, Intergovernmental and State Consultation, Cooperation, and Protective Regulations.

State forest practice rules have been revised and updated in Washington and Oregon, at least partly in response to concern for the conservation of sensitive, threatened and endangered species, including bull trout. Oregon has adopted various amendments to its Forest Practices rules and Washington has developed an entire set of new regulations primarily in response to Federal listings of several salmonid species, including bull trout, in the late 1990s. The Nevada forest practices remain essentially unchanged since the listing of bull trout in 1998. In Idaho, the Snake River Basin Adjudication Idaho Forestry Program is currently in development (e.g., draft EIS with no firm date of completion) and would supplement the existing Idaho Forestry Program to address aquatic species protected by the Act. The objective of the supplemental forestry program is the protection of listed salmon and bull trout, within the Salmon/Clearwater River basins, and private landowners will be encouraged to participate. However, since the Program has not yet been approved or funded, the future effectiveness of the Snake River Basin Adjudication Idaho Forestry Program is undetermined. In other parts of Idaho where bull trout occur, forest practices remain essentially unchanged since the listing of bull trout. In 2011 Montana completed a multi-species habitat conservation plan (HCP) that also included bull trout. The Montana HCP includes best management practices that would minimize impacts to bull trout and its associated habitat (http://dnrc.mt.gov/HCP/links.asp).

In addition to consultation with other Federal agencies, the Service has engaged several private corporations and public agencies in the habitat conservation planning (HCP) process to provide for the conservation of bull trout. The development and implementation of HCPs has resulted in land management practices that generally exceed State regulatory requirements. As is the case with consultation with Federal agencies under the Act, the development and implementation of HCPs does not eliminate take or the adverse effects of legacy land management practices, but avoids jeopardy to bull trout by specifying actions that reduce threats and compensate for the effects of take. Habitat conservation plans addressing bull trout cover habitat across Montana, Oregon, Washington, Nevada, and Idaho. Additional HCPs are under active negotiation in several locations.

Factor E. Other Natural or Manmade Factors Affecting its Continued Existence

Competition and Hybridization: As discussed previously in Factor C, many of the same invasive predatory fish species that prey on smaller juvenile bull trout can also compete effectively with adult bull trout. Lake trout, brown trout, brook trout, and northern pike are large piscivorous species that overlap with bull trout in several core areas, and compete for the prey base of smaller forage fish. Direct competition for redd sites is also possible with brown and brook trout.

Brook trout are the only species known to commonly hybridize with bull trout throughout their range. There are numerous examples where bull trout hybridization with brook trout has been documented resulting in bull trout declines or even local extirpations (Leary *et al*. 1983, DeHaan and Godfrey 2009, Ardren *et al*. 2011). When bull trout hybridize with brook trout, the resulting hybrid offspring are often, but not always, sterile (Kanda *et al*. 2002, DeHaan *et al*. 2010), which leads to 'wasted' reproductive effort, and likely compete with remaining bull trout for food and space.

Climate Change: At the time of the listing in 1999, climate change effects were not considered as a factor affecting bull trout. Bull trout are vulnerable to the effects of warming climates, changing precipitation and hydrologic regimes, and are considered a useful indicator species of the effects climate change will have on the mountainous stream ecosystems where they reside. In addition to increased degradation of bull trout habitat and increased competition from non-native fish, as described above (see Factors A & C), climate change in the Pacific Northwest, as summarized by Mote *et al*. (2014) includes rising air temperature, changes in the timing of streamflow related to changing snowmelt, increases in extreme precipitation events, lower summer stream flows, and other changes. These impacts can affect bull trout habitat in a number of ways. Several climate change assessments or studies have been published (Rieman *et al.* 2007; Porter and Nelitz. 2009; Rieman and Isaak. 2010; Isaak *et al*. 2010, 2011; Wenger *et al*. 2011; Eby *et al.* 2014) or are currently underway (USGS 2011) assessing the possible effects of climate change on bull trout. The results of these efforts allow us to better understand how climate change may influence bull trout and help to identify suitable conservation actions to improve the status of bull trout throughout their range and ensure bull trout persist in the face of climate change. Issues include: the effects of rising air temperatures and lower summer flows on range contractions; changing stream temperatures, influenced by stream characteristics (e.g., amount of groundwater base flow contribution to the stream, stream geomorphology, etc.) affecting suitable bull trout spawning and rearing habitat; threats to redds and juvenile habitat from stream scouring caused by increased winter precipitation extreme events and increased rain in lower elevations (rather than snow); and lower summer flows inhibiting movement between populations and from spawning and rearing habitat to foraging habitat.

For example, a study of changing stream temperatures over a 13 year period in the Boise River basin estimated an 11 to 20 percent loss of suitable coldwater bull trout spawning and early juvenile rearing habitats (Isaak *et al*. 2010). These results suggest that a warming climate is already affecting suitable bull trout instream habitats. This is consistent with the conclusions of Rieman *et al*. (2007) and Wenger *et al*. (2011) that bull trout distribution is strongly influenced by climate, and predicted warming effects could result in substantial loss of suitable bull trout habitats over the next several decades. Wenger *et al.* (2011) also noted that bull trout already seem to inhabit the coldest available streams in study areas and in several watersheds bull trout do not have the potential to shift upstream with warming stream temperatures at lower elevations.

Sensitivity of stream temperature to changes in air temperature is complex and is influenced by geological and vegetational factors such as topography, groundwater recharge, glaciation history, and riparian vegetation (Isaak *et al*. 2010, Isaak and Rieman 2013). A new stream temperature data collection, modeling and mapping project, NorWeST, provides a much improved foundation for assessing bull trout cold water habitat (USFS 2014). Stream temperature data for the Northwest U.S. have been compiled from hundreds of biologists and hydrologists working for dozens of resource agencies and contains more than 45,000,000 hourly temperature recordings at more than 15,000 unique stream sites. These temperature data are being used with spatial statistical stream network models to develop an accurate and consistent set of climate scenarios for all streams.

Also, a range-wide vulnerability assessment for bull trout has been initiated (USGS 2011). The assessment will be completed in 2014 for a portion of the bull trout's range, models probability of presence using the NorWeST stream temperature data and models, and will map suitable habitat "patches" using fish presence, local threats, migratory connectivity, and climate sensitivity. The climate sensitivity parameters and data that will be linked to patches include flow variability (e.g., per cent high frequency of winter floods), thermal variability (per cent very cold), fire history (per cent severely burned relative to patch area), and snowpack (snow cover frequency). Other threats factors include composite indicators of human impacts, nonnative trout presence. Connectivity parameters include data among patches (stream/lake/sea distance to nearest occupied patch), migratory connectivity (distance to lake/sea), local barriers (culverts, diversions), and natural geomorphic features.

All these efforts to address climate change effects to bull trout have informed the development of the revised draft recovery plan. They suggest that effective long-term conservation and recovery of bull trout will require a decision framework to assess climate change effects to bull trout. In addition, conservation resources and funding to ensure that future conservation resources should be allocated to those areas with the coldest water temperatures that offer the greatest long-term benefit to sustain bull trout and their coldwater habitats.

7. Bull Trout Genetics and Population Structure

At the time we determined threatened status for all populations of bull trout in the coterminous United States (64 FR 58910), five potential distinct population segments (DPSs) were identified: (1) Klamath River, (2) Columbia River, (3) Coastal-Puget Sound, (4) Jarbidge River, and (5) Saint Mary-Belly River. The five DPSs were disjunct and geographically isolated from one another with no genetic interchange between them due to natural and man-made barriers, but were listed collectively since they included the entire distribution of bull trout in the coterminous United States.

Since listing, advances in techniques in genetics and increased bull trout genetic sampling have improved our understanding of the genetic structure and relationships among bull trout populations throughout the coterminous United States. This information, useful in the identification of appropriate units for conservation of bull trout as part of past and current bull trout recovery planning strategies continues to evolve and inform how we look at bull trout conservation needs. For example, Rieman and Allendorf (2001) examined available demographic information to evaluate effective population size for bull trout. They determined that most bull trout populations were at risk of reduced genetic variation due to small population size and recommended that recovery should include maintaining and improving connectivity and gene flow between populations. Spruell *et al.* (2003) described the genetic population structure of 65 bull trout populations from the northwestern United States, using 4 microsatellite loci. Their study concluded that genetic variation within populations was relatively low; variation between populations was relatively high; and the data supported the existence of at least three major genetically differentiated groups of bull trout, described as “Coastal,” “Snake,” and “Upper Columbia.” An earlier, broader scale analysis, which included western Canada (Taylor *et al.* 1999), reached similar conclusions. Whitesel *et al.* (2004) further analyzed the available scientific information associated with bull trout population structure and size to describe appropriate ‘groupings’ of bull trout and identify units of conservation. They concluded that for bull trout, “… a Conservation Unit should represent a complete and diverse environmental template that allows full expression of genotypic, phenotypic and spatial diversity among bull trout populations…” to “…help ensure resilience and persistence when environmental changes occur.”

More recently, Ardren *et al.* (2011) used newly developed and more variable genetic markers than previous studies and examined genetic variation among 75 representative bull trout populations sampled throughout the coterminous United States. They determined that 76 percent of the populations had an effective number of breeders less than 50 and indicated high divergence among populations caused by genetic drift and a high degree of natal fidelity. Their results suggested that bull trout conservation efforts should be focused at the core area level and affirm the hierarchical conservation strategy for bull trout as described in the recovery strategy narrative of this revised draft recovery plan.

8. Bull Trout Conservation Successes

Since the listing of bull trout, numerous conservation measures have been and continue to be implemented across its range in the coterminous U.S. These measures are being undertaken by a wide variety of local and regional partnerships, including State fish and game agencies, State and Federal land management and water resource agencies, Tribal governments, power companies, watershed working groups, water users, ranchers, and landowners. In many cases, these bull trout conservation measures incorporate or are closely interrelated with work being done for recovery of salmon and steelhead, which are limited by many of the same threats.

Since 1999, numerous conservation actions that contribute to bull trout recovery have been implemented across all six recovery units. These include removal of migration barriers (culvert removal or redesign at stream crossings, fish ladder construction, dam removal, etc.) to allow access to spawning or FMO habitat; screening of water diversions to prevent entrainment into unsuitable habitat in irrigation systems; habitat improvement (riparian re-vegetation or fencing, placement of coarse woody debris in streams) to improve spawning suitability, habitat complexity, and water temperature; instream flow enhancement to allow effective passage at appropriate seasonal times and prevent channel dewatering; and water quality improvement (decommissioning roads, implementing best management practices for grazing or logging, setting pesticide use guidelines) to minimize impacts from sedimentation, agricultural chemicals, or warm temperatures. At sites that are vulnerable to development, protection of land through fee title acquisition or conservation easements is important to prevent adverse impacts or allow conservation actions to be implemented. In several bull trout core areas, fisheries management to manage or suppress non-native species (particularly brown trout, brook trout, lake trout, and northern pike) is ongoing and may be important in addressing the effects from non-native fish competition, predation, or hybridization.

A more comprehensive overview of conservation successes since 1999 and described for each recovery unit is found in the <u>Summary of bull trout conservation successes and actions since 1999</u> (USFWS 2013).

9. Critical Habitat

We first designated critical habitat for bull trout on October 6, 2004 (USFWS 2004a), including 1,748 miles and 61,235 acres of bull trout habitat in the Columbia and Klamath River basins only. This designation was subsumed within the range-wide designation of critical habitat on September 26, 2005 (USFWS 2005a), including 3,828 miles and 143,218 acres of bull trout habitat. The 2005 designation was challenged in the U.S. District Court for the District of Oregon, in part because of concern over large exclusions of habitat that were made from the final rule compared to that which had been proposed. The Court granted the Service's request and directed the agency to complete a proposed revision by December 31, 2009, with a final designation to be delivered to the Federal Register by September 30, 2010. Final critical habitat was designated for bull trout and was published on October 18, 2010 (USFWS 2010a), including 19,729 miles and 488,252 acres of bull trout habitat.

We identified 32 critical habitat units (CHUs) in our 2010 bull trout critical habitat listing rule (USFWS 2010a), reflecting single core areas or groups of core areas that are in close proximity geographically and that are included in 6 recovery units (see Figure 5). These CHUs are specific to critical habitat designation and the interagency consultation procedures under section 7 of the Act. The CHUs are generally a level of organization at the major river basin scale that are intermediate in size and scope between recovery units and core areas in the hierarchical structure, and represent groupings of habitats that facilitate implementation of the rule, generally as aggregations of core areas within major river basins. .

In designating bull trout critical habitat, we considered the conservation relationship between critical habitat and recovery planning. Recovery plans formulate the recovery strategy for a species; however, unlike critical habitat, they are not regulatory documents, and there are no specific protections, prohibitions, or requirements afforded a species based solely on a recovery plan. While we expect that the 2010 critical habitat designation will contribute to the overall recovery strategy for bull trout described in this revised draft recovery plan, designated critical habitat, by itself, does not achieve recovery plan goals.

C. Previous Recovery Planning Efforts

Three separate draft bull trout recovery plans were completed between 2002 and 2004. The 2002 draft recovery plans addressed bull trout populations within the Columbia, Saint Mary-Belly, and Klamath River basins (USFWS 2002b). They included individual chapters for 24 separate recovery units. In 2004, draft recovery plans were developed for the Coastal-Puget Sound drainages in western Washington, including two recovery unit chapters (USFWS 2004b), and a single recovery unit chapter for the Jarbidge River in Nevada (USFWS 2004c). In total, the 2002 and 2004 draft recovery plans accounted for 27 separate recovery unit chapters. None of these draft recovery plans have been finalized, but they have served to identify recovery actions necessary to reduce threats to the species and to provide a framework for our partner agencies and local working groups to initiate these actions. While the lack of a final recovery plan has not hindered efforts to implement on-the-ground conservation throughout the coterminous United States, completing a final recovery plan will establish criteria for delisting bull trout at an appropriate recovery unit scale in the coterminous United States, and the overall context for prioritizing future recovery actions.

This current revised draft recovery plan represents an integration of new information collected since the 1999 listing regarding bull trout life history, distribution, demographics, conservation successes, etc., and update of all previous bull trout recovery planning efforts across the range of the single DPS currently listed under the Act, including all bull trout populations within the range of the species in the coterminous United States. This revised draft recovery plan supersedes and replaces previous draft recovery plans. The recovery unit structure has been reorganized in this current plan, combining the previous 27 recovery units into 6 newly defined recovery units: (1) Coastal Recovery Unit; (2) Klamath Recovery Unit; (3) Mid-Columbia Recovery Unit; (4) Upper Snake Recovery Unit; (5) Columbia Headwaters Recovery Unit; and (6) Saint Mary Recovery Unit. Additionally, recovery criteria proposed in the 2002 and 2004 draft recovery plans have been revised in the current draft to focus on effective management of threats to bull trout at the core area level, and a de-emphasis on achieving targeted point estimates of abundance of adult bull trout (demographics) in each core area.

The major changes between the earlier 2002 and 2004 draft bull trout recovery plans and the present revised draft recovery plan are summarized in Table 1.

Table 1. Major changes that occurred between issuance of the 2002 and 2004 Draft Recovery Plans and the 2014 Revised Draft Recovery Plan.

Parameter for Comparison	**2002 and 2004 Draft Plans**	**2014 Revised Draft Plan**
Recovery Units	27 recovery units	Now six (6) recovery units consistent with Distinct Population Segment (DPS) policy.
Reclassification	Single DPS (Coterminous U. S. population). Bull trout must be recovered range-wide to delist.	Potential for reclassifying into multiple DPSs in future. Could be delisted by recovery unit if recovery criteria are met in each recovery unit, and the recovery unit is designated as a DPS.

Parameter for Comparison	**2002 and 2004 Draft Plans**	**2014 Revised Draft Plan**
Status and Recovery Needs	Best available scientific and commercial information. Collaboration and use of ‘partner’ best professional judgment.	Considerable new information available since 2002 (see Status Overview section).
Recovery Criteria	Demographic targets, threat management, and possible passage restoration.	Effective management of threats by core area in each recovery unit (and population reintroductions in the Klamath River RU).
Core Areas/Local Populations	121 core areas > 600 local populations	110 currently occupied core areas > 600 local populations
Distribution	Core area and local population distribution described in draft recovery plan.	Mapped with Critical Habitat Rule published in 2010.
Recovery Standard	All recovery criteria must be achieved in each of 27 recovery units.	Effective management of threats assessed by core area rolled up to each of 6 recovery units.
Scope/Scale of Plan	Comprehensive	Reduced with details in appendices and living databases.
Threats	Comprehensive	Primary threats to be managed and prioritized.
Science Support	Existing scientific basis and understanding of bull trout life history, ecology and demographics.	Improved scientific basis and understanding of bull trout life history, ecology and demographics; factors affecting the species, including climate change.
Regulatory Framework	Existing State, Federal and Local Conservation Policies in place as of 1999.	Increased emphasis on new, updated or revised habitat conservation plans, water quality, State forest practices, etc.

II. Strategic Plan for Recovery

A. Overview

The primary recovery 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 stable; (2) manage and ameliorate the primary threats 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) work cooperatively with partners to develop and implement bull trout recovery actions in each of the six recovery units; and (4) to account for new information and future climate effects, apply adaptive management principles and focus on actions, and potentially locations that provide the greatest resiliency to climate-related threats.

Bull trout recovery will require building upon the numerous and ongoing conservation actions implemented on behalf of bull trout since their listing in 1999, improving our understanding of how various threat factors potentially affect the species, and using that information to work cooperatively with our partners to design, fund and implement effective conservation actions in areas that offer the greatest long-term benefit to sustain bull trout and where recovery can be achieved.

Although bull trout were believed to have undergone a significant reduction in their historical range prior to the time of their listing in 1999, bull trout continue to be found in suitable habitats and geographically widespread across numerous major river basins in five western states. The Act does not require a species, in this case bull trout, to be recovered throughout its historic range or even to a majority of the currently suitable habitat. Instead, the Act requires that we recover listed species such that they no longer meet the definitions of "threatened species" or "endangered species", i.e., are no longer in danger of extinction now or in the foreseeable future.

This revised draft recovery plan also includes a ***Threat Assessment Tool*** (Appendix E) that will be integral to evaluation of bull trout conservation status at the range wide and recovery unit scales will be based on analyses of threats at the level of the component core areas. Preliminary core-area assessments can inform the process of recovery plan development by highlighting conservation actions that should be given locally higher priority, and aiding managers to forecast the results of assessing recovery criteria at the aggregated recovery unit level, thus allowing managers to target those core areas where conservation resources can be most efficiently directed. Furthermore, core area-level assessments will be useful to recovery criteria evaluation and status assessments conducted as part of future 5-year reviews and five-factor threats analysis in any future delisting evaluation for a bull trout distinct population segment.

B. Recovery Strategy

As described in our recovery planning guidance (NMFS and USFWS 2010), the recovery strategy provides "a logical construct that identifies the assumptions and logic underlying the selection of one path over another to achieve the objectives and goal." Thus it constitutes the framework linking key facts and assumptions about the species' biology, threats, and environmental constraints with the recommended recovery actions. The major threats and constraints affecting bull trout (addressed in detail with specific citations above in sections I.B.2, *Life History and Ecology* and I.B.6, *Factors Affecting the Species*), need to be addressed with appropriate management actions as described below to allow survival and recovery of the species.

Bull trout have specific requirements for spawning and rearing habitat: appropriate spawning substrate (loose, clean gravel with minimal fine sediment); cold water (influenced by flow levels, groundwater infiltration, cold springs, riparian shading, solar radiation, valley geomorphology, air temperature, temperature of upstream tributaries, and other factors); excellent water quality (high dissolved oxygen concentrations and minimal contamination from chemicals and sediment); low gradient stream segments with stable channel structure; and presence of complex cover (woody debris, undercut banks, boulders, and pools). While bull trout expressing the resident life history will remain localized to watersheds with spawning and rearing habitat, the expression of migratory life history strategies (fluvial, adfluvial, anadromous, or amphidromous) is also dependent on the presence of appropriate foraging/migratory/overwintering habitat, suitable flow levels, and lack of barriers (physical or thermal) to connectivity. Metapopulation structure, genetic exchange, and recolonization of extirpated local populations are dependent on unrestricted movement of migratory individuals through downstream foraging/migratory/overwintering habitat. Appropriate timing and seasonality of streamflow is important for successful spawning (avoiding redd mortality from drying or flood scouring events), adult survival (e.g., preventing stranding in side channels), and to provide adequate flow for migratory movement past barriers. A suitable prey base is necessary for successful survival and reproduction: smaller bull trout such as juveniles and adult residents feed on a diverse array of zooplankton, aquatic insects, and small fish (and are themselves vulnerable to predation by larger predatory fish), while larger migratory adults feed on a variety of larger forage fish. Most of the threats to bull trout operate by impairing one or more of these biological requirements, which are also reflected in the primary constituent elements of bull trout critical habitat (USFWS 2010a). Below, we summarize the mechanisms by which these threats affect bull trout and the general recovery actions that are appropriate to effectively respond to these threats. Specific details and relative emphasis of these measures may vary among different regions; these differences are summarized by recovery unit in the Recovery Actions section below, and will be discussed in more detail in the Recovery Unit Implementation Plans.

When fine sediments enter streams at levels beyond natural background conditions, they can accumulate within spawning gravels and reduce survival of eggs and embryos by impairing their access to oxygenated water, as well as adversely affecting juveniles and adults by interfering with foraging, clogging gills, physically abrading tissues, and disrupting orientation and movement patterns. Accumulation of sediment can adversely alter stream structure by filling in pools and changing substrate composition. Sedimentation can result from wildfire; erosion or debris flows from unstable slopes; and a variety of management activities, including instream construction, excessive grazing, timber harvest, agricultural inputs, urban/residential land uses, road maintenance and construction, and mining. Therefore, minimizing this threat requires reduction of these activities or implementing best management practices to minimize erosion and release of sediment into streams. For example, sediment impacts from roads can be addressed by identifying sediment-producing areas; redirecting runoff to downslope areas away from stream channels; maintaining bridges, culverts, and crossings; or decommissioning surplus roads and removing culverts and bridges on closed roads. Mining impacts can be reduced by removing or stabilizing mine tailings and waste rock within stream channels and floodplains. Compatible grazing practices include fencing of riparian areas, rotation of grazing, and relocating salt and watering facilities away from sensitive riparian areas. Timber harvest and other upland management impacts should avoid buffer areas along riparian zones and retain forest cover on unstable slopes above spawning streams. Additional research on effectiveness of these practices and alternative methods may be useful to adaptively improve management of bull trout habitat.

Other impacts to water quality, including pH changes and heavy metal contamination from mines; runoff of pesticides, fecal coliform, or nutrients from agricultural activities or urban development; associated low dissolved oxygen concentrations; or oil from roads, can adversely affect bull trout. Fish exposed to contaminants such as heavy metals and pesticides can suffer direct mortality at high levels, or at lower levels can experience chronic sublethal impacts to performance, swimming ability, migratory behavior, reproductive success, and survival rates. Therefore, water quality in bull trout habitat should be maintained at high levels by implementing best management practices and enforcing water quality standards.

Bull trout have extremely low tolerance for warm water temperatures, especially in spawning and rearing habitat. Thermal tolerances are narrowest during egg incubation, when warm water reduces egg survival rates and size at hatching. In juvenile and adult bull trout, warm water has sublethal effects such as reducing feeding rate and growth rate, or at sufficiently high temperatures can directly cause mortality. Because water temperature is affected by riparian cover and inputs of cold water from groundwater and springs, management practices to promote cold water habitats include identifying geomorphic zones that act as sources of cold water and protecting riparian areas from timber harvest, wildfire, and livestock grazing impacts. Moreover, we expect the geographic distribution of cold water habitat to progressively diminish over the next 50 to 100 years as effects of climate change become more intense; as ambient air temperature increases, stream reaches with viable cold water sources will become increasingly valuable to bull trout and should be targeted early for protection and management. Adult bull trout, particularly the migratory life history forms, may use comparatively warm river and stream reaches seasonally, moving out of them during warm seasons when water temperatures increase; thus, their ability to adaptively respond to changing water temperatures depends on full connectivity for movement between headwater and mainstem habitats, as discussed further below.

Streams with complex structure, including deep pools, overhanging banks, riparian vegetation, and large woody debris, provide local sites of cool microclimate, pockets of slow water, and physical shelter, thus increasing bull trout spawning success and adult and juvenile survivorship. Removal of these structural components (e.g., stream channelization; grazing, forestry, or other impacts to riparian vegetation; reduction of woody debris in streams, either by direct removal from streams or by harvest of riparian trees that could supply woody debris in future; sediment accumulation reducing pool depth) will adversely affect bull trout populations. Therefore, implementing management practices that prevent these impacts or restore complex structural components to streams will benefit bull trout reproductive success and survivorship. Most management practices discussed above for sedimentation can help to mitigate impacts to structural complexity of streams; revegetation of riparian zones and other stream restoration actions can directly restore structural components and compensate for past impacts.

Connectivity between spawning and rearing habitat and downstream foraging/migratory/overwintering habitat sufficient for bull trout to move freely and with minimal risk is necessary for the expression of migratory life history patterns. In core areas where multiple local populations exist, interaction among local populations through movement of migratory individuals is critical to maintaining genetic diversity and recolonizing local populations that become extirpated. Thus, when connectivity with FMO habitat is impaired or blocked, bull trout populations tend to become restricted to isolated local populations of small resident fish, which may have low genetic diversity, are vulnerable to extirpation, and cannot be readily recolonized. Barriers to connectivity may consist of natural physical features such as waterfalls; river reaches that create mortality risks or prevent movement of adult fish because of entrainment, excessively warm water, or poor water quality; instream structures such as culverts or weirs; or dams. The severity of passage barriers is generally affected by the volume of streamflow, which can vary with seasonal precipitation, droughts, and dam operations so that passage is available only at certain times of year.

Thus, removing or minimizing the effects of connectivity barriers is important for restoring expression of migratory life history and movement among local populations within core areas. Core areas should be assessed for significant passage barriers that impair their connectivity. Depending on impacts and cost-effectiveness, restoration actions may include removal or improvement of culverts, modifying seasonal instream flows, or reconfiguring natural passage barriers. However, the potential for facilitating colonization by nonnative fishes should also be considered before implementing these projects.

Dams that were designed without fish passage facilities, or with fish passage capability inadequate for movement of bull trout, can impair or block connectivity. Some dams can block movement by causing seasonal dewatering of downstream reaches; or at the other extreme, high volumes of spill can also result in nitrogen supersaturation downstream, which can impair or kill bull trout by causing gas bubble disease. Seasonal flow regimes resulting from dam operations may differ substantially from the flow patterns needed for bull trout migration, for example by release of high flows in summer to supply agricultural uses. Therefore, in each core area where dam operations are a significant threat to recovery they should be reviewed to determine whether they are adversely affecting bull trout passage, and modified if necessary to minimize impacts. Where fish passage facilities are lacking or inadequate, it may be appropriate to construct improved facilities, or in some cases consider decommissioning the dam.

Water diversions at dams, ditches, small agricultural intakes, and hydropower facilities can entrain juvenile or adult bull trout, killing them or permanently removing them from access to spawning habitat. Therefore, to prevent this impact in core areas where it is a threat, water diversion structures or hydropower facilities within bull trout spawning or foraging/migratory/overwintering habitat should be prioritized by their level of impact and screens or other remedial actions that are adequate to exclude juvenile bull trout should be installed or implemented.

Lack of suitable habitat within foraging/migratory/overwintering habitat, including shared foraging/migratory/overwintering habitats in mainstem, estuarine, and near shore areas, can increase mortality of migratory individuals or discourage movement through these areas, resulting in reduced connectivity among local populations or core areas. Therefore, impaired foraging/migratory/overwintering areas should be identified within core areas and in shared foraging/migratory/overwintering habitats, and habitat improvement measures should be implemented where feasible. Recovery actions in mainstem river habitats may include flow and water temperature management, channel restoration, and improvement of structural habitat components. In estuarine and near shore habitats projects may include improving beach nourishment; removing or modifying structures such as riprap, dikes, and tide gates; contaminant remediation; or restoring eelgrass or kelp beds.

In watersheds where bull trout populations have been severely reduced or extirpated and connectivity impairment is likely to prevent natural recolonization, active reintroduction or supplementation of bull trout from appropriate source populations may help reestablish viable local populations to improve core area status. Such efforts may involve direct translocation from more vigorous populations or captive breeding of bull trout in controlled propagation facilities. Such translocation programs should consider appropriate precautions against introduction of fish pathogens to new watersheds.

Because bull trout depend on the availability of invertebrates and smaller fish as prey, they can be vulnerable to the introduction of other species with overlapping diets (lake trout, northern pike, brown trout, brook trout, and bass) that can compete effectively for these resources and reduce the prey base. Insufficient availability of food or behavioral exclusion from foraging habitat due to competition can result in decreased growth and survival of bull trout. Brown trout and brook trout may also compete directly for spawning and rearing areas, damaging bull trout redds and reducing incubation success. Introduction of nonnative fishes can also interact with changes in habitat, so that other species that are better adapted to warmer water temperatures might competitively exclude bull trout as water temperatures increase. Moreover, larger predatory species (particularly lake trout, northern pike, and brown trout) can prey directly on smaller bull trout individuals. Once established, nonnative fish populations can often colonize connected watersheds and can be difficult to eradicate.

Therefore, minimizing or eliminating these adverse effects from past introductions and preventing new introductions into bull trout habitat is important to recovery of bull trout, and is a critical issue in certain recovery units. Because nonnative species issues vary greatly among core areas depending on ecosystem characteristics and the particular species involved, competitive and predatory interactions within watersheds should be reviewed and the feasibility of eradication or suppression (for example through targeted experimental removal or liberal harvest regulations) should be assessed. Where these measures will benefit bull trout and are cost-effective and feasible, nonnative fish species should be actively controlled. Ongoing public and private fish stocking programs should be reviewed and modified if necessary to avoid any additional introductions of nonnatives; moreover, the potential for illegal introductions should be addressed with a combination of public education and enforcement policies. Removal of barriers within streams, while usually beneficial for migratory movement of bull trout, should also be evaluated with respect to the potential for facilitating colonization by nonnative fishes.

Introduced brook trout can also hybridize with bull trout. Hybrid individuals do not contribute to perpetuation of bull trout populations; they are usually sterile and if not, their offspring are of mixed genetic composition and could result in introgression of brook trout genetics into the population. Thus, hybridization represents wasted reproductive effort for bull trout, and should be avoided in order to maintain ecologically viable and genetically pure bull trout populations. Many of the same measures discussed above for competitive and predatory interactions with nonnative fishes are appropriate for addressing hybridization; however, genetic studies of bull trout populations that coexist with brook trout can also be useful to evaluate the extent of hybridization and identify introgressed individuals.

We currently consider disease a minor threat to bull trout. Whirling disease has potential to affect bull trout either directly or indirectly through its impacts on prey species or competitors. Therefore, research into its effects on fish communities and potential management remedies may be important in core areas where this is an issue.

Impacts to bull trout through fishing include killing by legal harvest (in a few watersheds where allowed by State fishing regulations at the time of listing) or illegal poaching; harassment and inadvertent injury or hooking mortality, for individuals incidentally caught and released by recreational anglers targeting other species; and bycatch in nets. Where bull trout populations are healthy and angling pressure is relatively low they may be able to sustain a moderate level of harvest or bycatch mortality, so it may be reasonable to establish recreational fisheries under State management authority in core areas that are proven to have fully met recovery targets. However, excessive harvest has potential to depress population levels and slow or reverse progress toward recovery, so existing regulations should be enforced and the development of State or Tribal fish management plans should be done conservatively based on watershed-specific fisheries research on bull trout population status and potential for overharvest.

Climate change is an independent threat to bull trout that exacerbates many of the other threats discussed above, and that we expect to increase in severity over coming decades. Stream temperature modeling indicates that increasing air temperatures and other changes to hydrology and other factors, modified by local habitat conditions, will tend to result in increased water temperatures, reducing the amount of stream habitat with suitable cold water conditions to scattered refugia protected by groundwater inputs or other factors. Warm dry conditions are also likely to increase the frequency and extent of forest fires, which in addition to their acute effects on streams can increase sedimentation and cause longer-term warming of water by eliminating riparian shading. Projected lower instream flows and warmer water in foraging/migratory/overwintering habitats will exacerbate the lack of connectivity within and between bull trout core areas. Moreover, we expect increased water temperatures to alter competitive interactions between bull trout and other fish species that are better adapted to warm conditions, resulting in increased risk of bull trout habitat being colonized by fishes that will outcompete and/or prey upon them. Climatic warming will change seasonality of streamflow, as increased spring runoff from rain-on-snow events causes flooding and scouring of spawning gravels, while glacial retreat and reduction of summer snowpack reduces cold water flows during summer months. Sea level rise will result in the loss of, and changes to, near shore and estuarine habitat. Although addressing the root causes of greenhouse gas emissions and climate change is not within our jurisdiction, management planning should account for these increased threats and proactively protect those habitats that are expected to best maintain cold water conditions suitable for bull trout.

Adequate responses to all of these threats will require cooperative work from a wide variety of partners, including Federal and State land and water management agencies, regulatory agencies, State fish and game departments, Tribes, and user groups. Enforcement of fisheries regulations and habitat protection standards by State, Federal, and tribal agencies is critical for protecting bull trout and their habitat. In a number of core areas local working groups are already implementing a wide variety of these recovery actions for bull trout, and they will continue to be a crucial resource for working toward recovery.

C. Recovery Units

Our bull trout recovery strategy is founded on a hierarchical approach (Figure 4) to geographic classification. Bull trout are listed as a single DPS within the five-state area of the coterminous United States. This single DPS is subdivided into six biologically-based recovery units, as described below. Recovery units are population units that have been "…documented as necessary to both the survival and recovery of the species in a final recovery plan" (NMFS and USFWS 2010). A viable recovery unit should demonstrate that the three primary principles of biodiversity have been met: representation (conserving the breadth of the genetic makeup of the species to conserve its adaptive capabilities); resiliency (ensuring that each population is sufficiently large to withstand stochastic events); and redundancy (ensuring a sufficient number of populations to provide a margin of safety for the species to withstand catastrophic events). Therefore, each recovery unit is "*individually necessary* to conserve [biological features that are] necessary for long-term sustainability of the *entire listed entity*", and thus "recovery criteria for the listed entity should address each identified recovery unit, and every recovery unit must be recovered, before the species can be delisted" (NMFS and USFWS 2010).

A distinct population segment (DPS) differs from a recovery unit in that it is an individual listed entity, designated through a rule-making process pursuant to Section 4 of the Act, and can be listed or delisted independently of other populations of the same species. Our 1996 DPS policy (USFWS 1996) defines the elements we consider when deciding whether to list a DPS under the Act: 1) discreteness of the population segment in relation to the remainder of

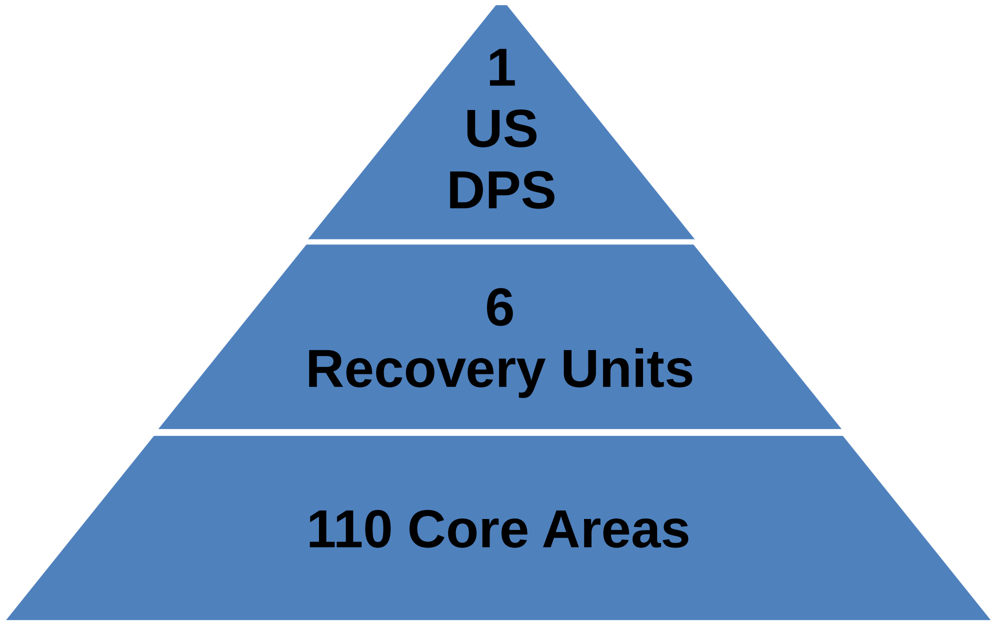


Figure 4. Hierarchical relationship of bull trout geographic classification units.

the species to which it belongs; 2) the significance of the population segment to the species to which it belongs; and 3) the population segment's conservation status in relation to the Act's standards for listing. It is possible for a recovery unit to also meet these criteria and qualify as a DPS, but because DPSs can only be designated through a rule-making process, a recovery plan cannot designate a DPS or treat a recovery unit as one (NMFS and USFWS 2010).

Upon completion of our 2008 5-year review, we determined that bull trout should still be listed as threatened and that the Service should “develop a number of recovery units for bull trout (perhaps 5 to 10 for management purposes) that contain assemblages of core areas that retain genetic and ecological integrity, and allow potential future options to pursue regulatory relief/delisting on a recovery unit basis.” We then conferred with State and Federal partners to determine the best course of action and determined that there was a desire from partners to complete a final recovery plan to ensure that recovery actions could continue to be implemented.

Each of the six recovery units are further organized into multiple bull trout core areas, which are mapped as non-overlapping watershed-based polygons, and each core area includes one or more local populations. Within the coterminous United States we currently recognize 110 occupied core areas, which comprise 600 or more local populations. In addition, there are six core areas where bull trout historically occurred but are now extirpated, and two “research needs areas” where bull trout were known to occur historically, but their current presence and historical use of the area are uncertain. The core areas are designated based on the best available information, and since the publication of the 2002 and 2004 draft recovery plans some core areas have been modified, split, or combined as more specific distribution, migratory patterns, and genetic information have been gathered. Core areas are functionally similar to bull trout metapopulations, in that bull trout within a core area are much more likely to interact, both spatially and temporally, than are bull trout from separate core areas. While bull trout are not listed in Canada, some core areas are heavily dependent on upstream or downstream SR or FMO habitat in Canada (e.g., Saint Mary River, Kootenai River, and Skagit River).

Each occupied core area is composed of often patchily distributed occupied areas of bull trout habitat which include one or more local populations. Core areas can be further described as complex or simple core areas. Complex core areas are core areas that contain multiple local bull trout populations; typically they are situated in a larger patch of habitat, sometimes occupied by bull trout of both the migratory life history form and the resident form, which includes a diverse pattern of connected SR habitats and FMO habitats. Simple core areas are those that contain one bull trout local population. Simple core areas are almost always small in scope, with a population size that is necessarily restricted by the size of the habitat. Typically, simple core areas are ecologically if not physically isolated from other core areas by natural, not anthropogenic factors (e.g., natural barriers, thermal gradients, or large spatial separation from other core areas) that have been operable for thousands of years. However, simple core areas may represent extremes of the range or habitat and may contain unique genetic or life history adaptations worthy of preservation. If additional local populations are discovered or are colonized within simple core areas, it could be reclassified as a complex core area. The relative importance of any core area will need to be assessed with regards to the specific recovery unit that the core area resides in. If a core area contains a unique phenotype or genotype the relative importance of that core area should be assessed in terms of resiliency, redundancy, and representation compared to all core areas (simple or complex) in a specific recovery unit.

In the bull trout critical habitat rule (USFWS 2010a) we also identified a number of marine or mainstem riverine habitat areas outside of bull trout core areas that provide primary constituent elements of critical habitat. These areas do not include SR habitat, but provide FMO habitat that is typically shared by bull trout originating from multiple core areas. These shared FMO areas, listed in Appendix G, thus support the viability of bull trout populations by contributing to successful overwintering survival and dispersal among core areas.

Since the early 2000s, new data and reanalysis have suggested that the coterminous U.S. listed entity would be more appropriately divided into 6 recovery units, rather than the 5 DPSs identified in the original listing rules or the 27 recovery units identified in the 2002 and 2004 draft recovery plans. We worked with a number of State, Federal, and Tribal partners in 2008 and 2009 to evaluate alternatives for organizing core areas into possible recovery units that would also be consistent with the “discreteness” and “significance” criteria in the DPS policy. Ten alternatives were evaluated that explored from 2 to 69 potential recovery units, based on mitochondrial and microsatellite DNA analysis, and on biogeographical considerations, including geological establishment of major watersheds, isolation of portions of watersheds above major waterfalls, co-occurrence with other fish species, and occurrence in different ecological zones (Ardren *et al*. 2011). The six recovery units identified in this plan (Figure 5) reflect this most recent information and analysis, and were first described in the 2010 proposed critical habitat rule (USFWS 2010a). They include: (1) Coastal Recovery Unit; (2) Klamath Recovery Unit; (3) Mid-Columbia Recovery Unit; (4) Upper Snake Recovery Unit; (5) Columbia Headwaters Recovery Unit; and (6) Saint Mary Recovery Unit (Figure 5).

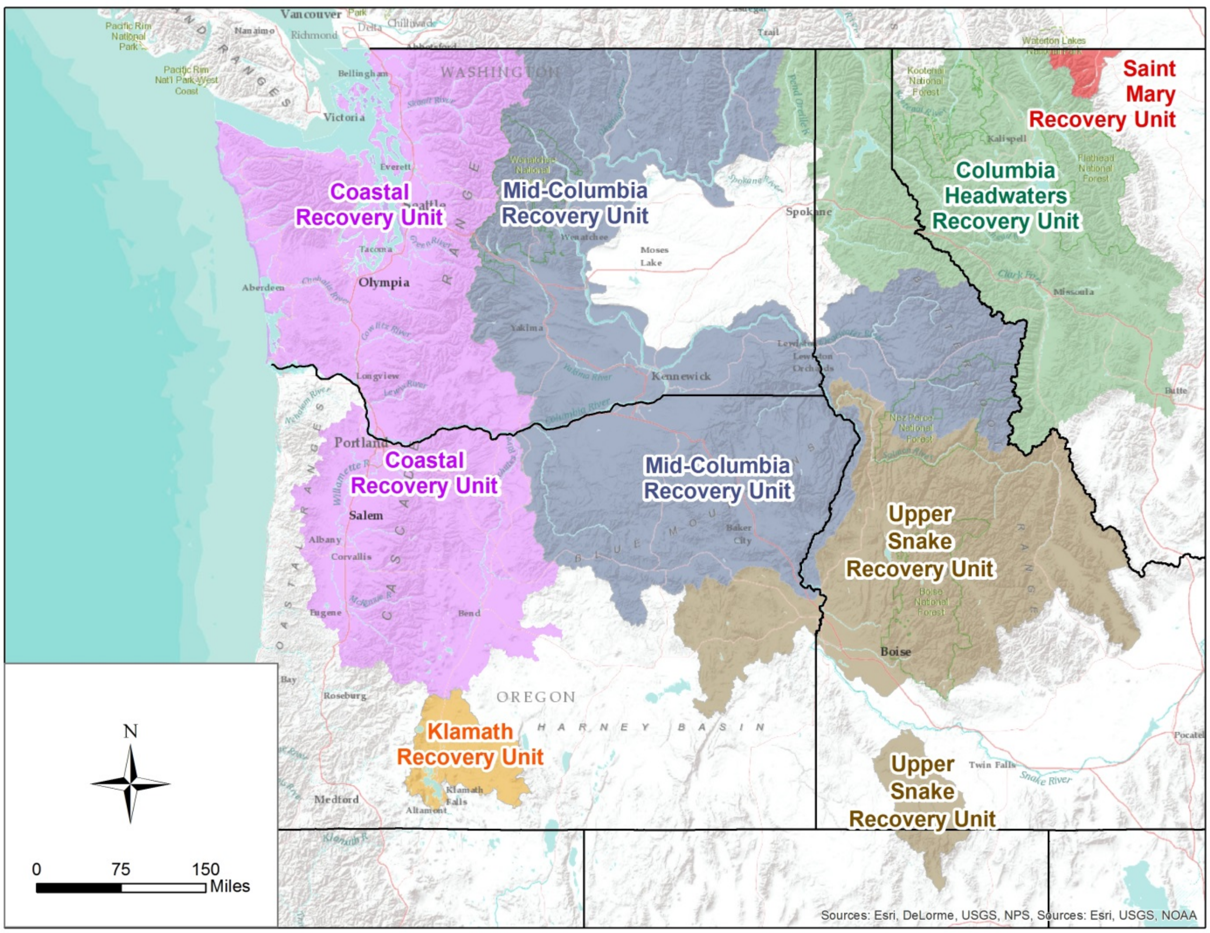


Figure 5. Locations of the six bull trout recovery units in the coterminous United States.

A brief description of the six recovery units (Figures 6 to 11) identified in this recovery strategy is provided below; see Appendix D for a more complete description of each recovery unit. Each recovery unit comprises several neighboring core areas that share similar bull trout genetic, geographic (hydrographic), and/or habitat characteristics. Conserving bull trout at the core area level allows for the maintenance of broad representation of genetic diversity. Neighboring core areas will benefit from potential source populations in the event of local extirpations and provides a broad array of options among neighboring core areas to contribute recovery under uncertain future environmental change.

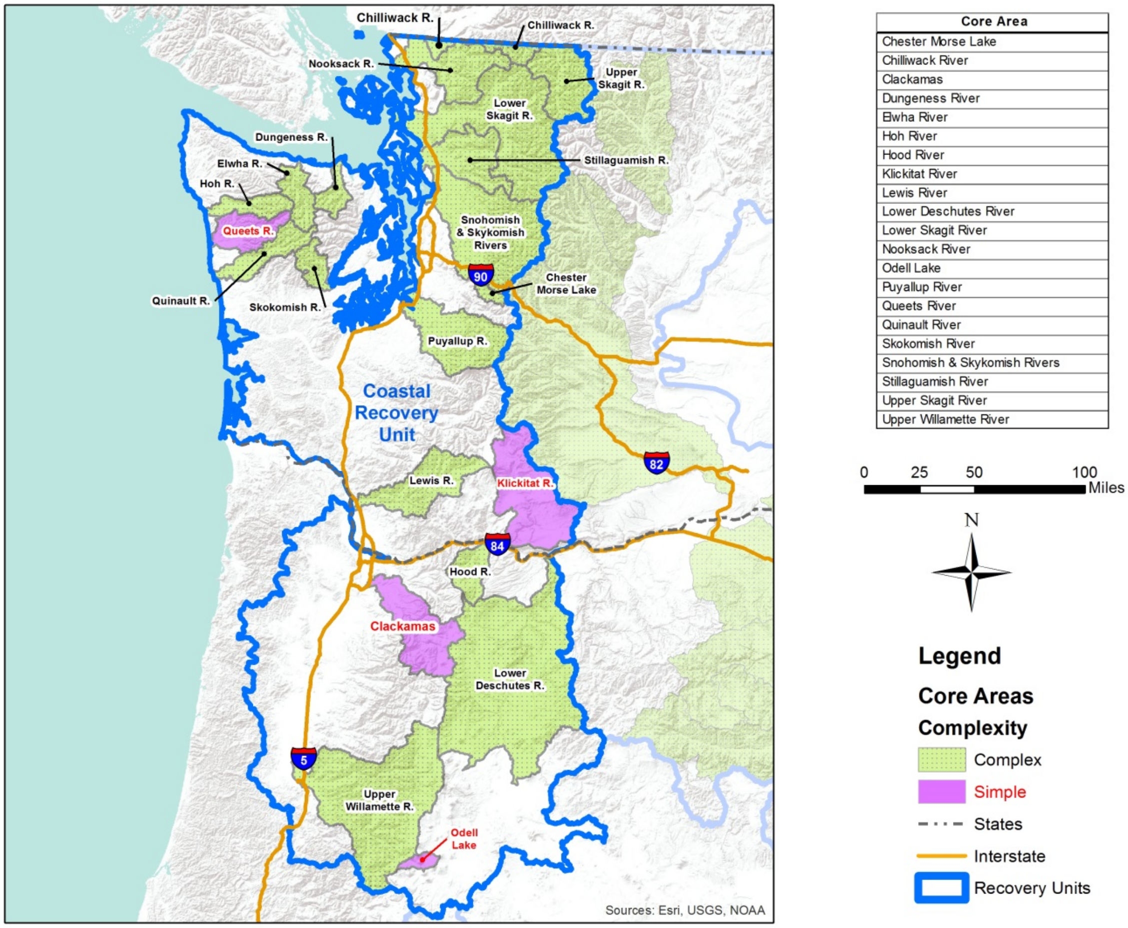


Figure 6. Map of the Coastal Recovery Unit.

The Coastal Recovery Unit is located within western Oregon and Washington. Major drainages include the Olympic Peninsula, Puget Sound, and Lower Columbia River basins, Upper Willamette River, Hood River, Lower Deschutes River, Odell Lake, and the Lower Mainstem Columbia River. In the Coastal Recovery Unit, we have designated 21 existing bull trout core areas (including the Clackamas River core area where bull trout had been extirpated and were reintroduced in 2011) and identified 4 historically occupied core areas that could be reestablished. Core areas within the recovery unit are distributed among three geographic regions: Puget Sound (includes one core area that is actually part of the lower Fraser River system), Olympic Peninsula, and Lower Columbia River. The only core areas currently supporting anadromous local populations of bull trout are located within the Puget Sound and Olympic Peninsula geographic regions.

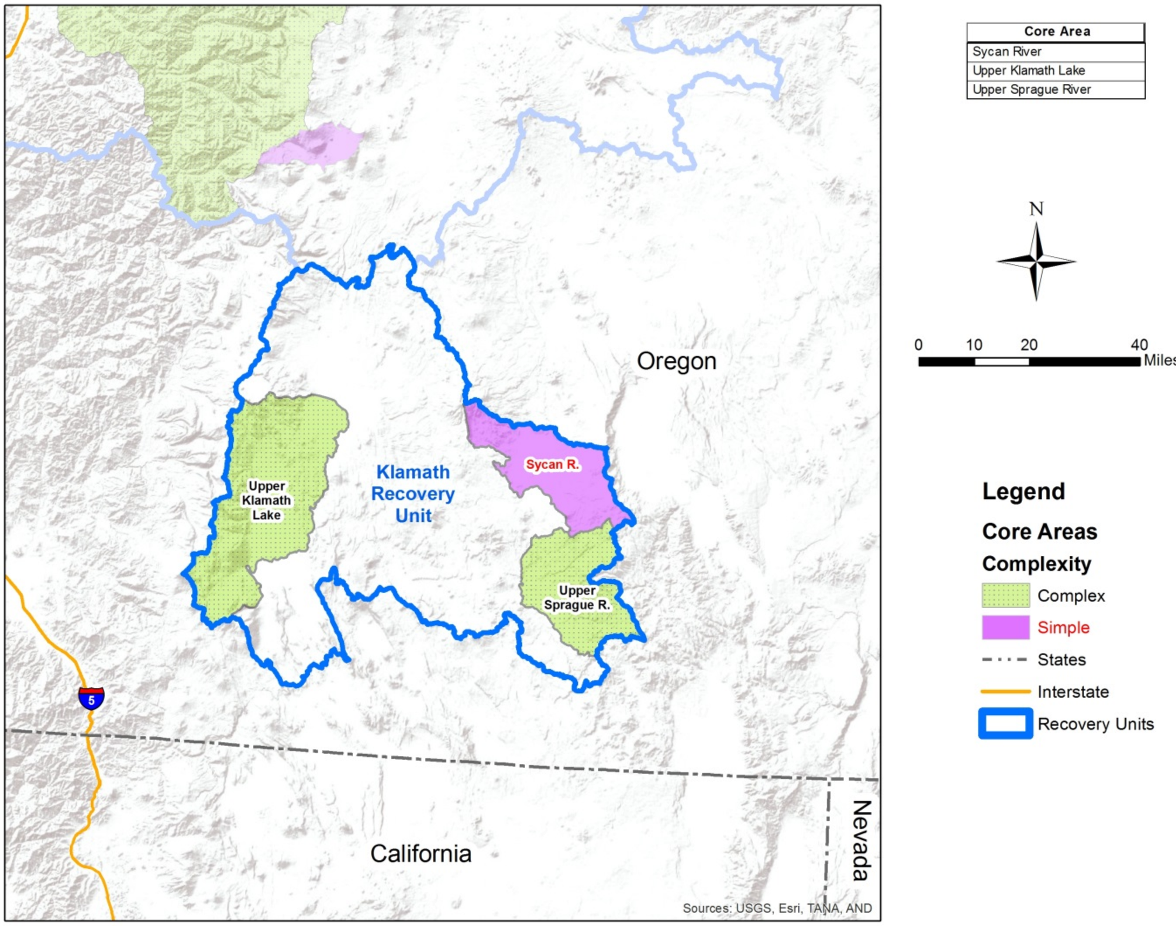


Figure 7. Map of the Klamath Recovery Unit.

The Klamath Recovery Unit is located in southern Oregon and comprises three bull trout core areas, all within the Klamath River drainage. The Upper Klamath Lake core area is comprised of the northern portion of the lake and its immediate major and minor tributaries. The Sycan River core area is comprised of Sycan Marsh and its tributaries and the Sycan River and its tributaries. The Upper Sprague River core area is comprised of drainages of the North Fork and South Fork of the Sprague River.

Eight local populations presently occur in the Klamath Recovery Unit. In addition to these eight, nine other local populations previously existed (i.e., Annie Creek, Cherry Creek, Sevenmile Creek, Fort Creek, Calahan Creek, Coyote Creek, Sycan River, North Fork Sprague River, and South Fork Sprague River; Arant 1911, Light *et al*. 1996, Buchanan *et al*. 1997, Service 2002a). This recovery unit is the most significantly imperiled, having experienced considerable extirpation and geographic contraction of local populations and declining demographic condition, and natural re-colonization is constrained by dispersal barriers and presence of nonnative brook trout.

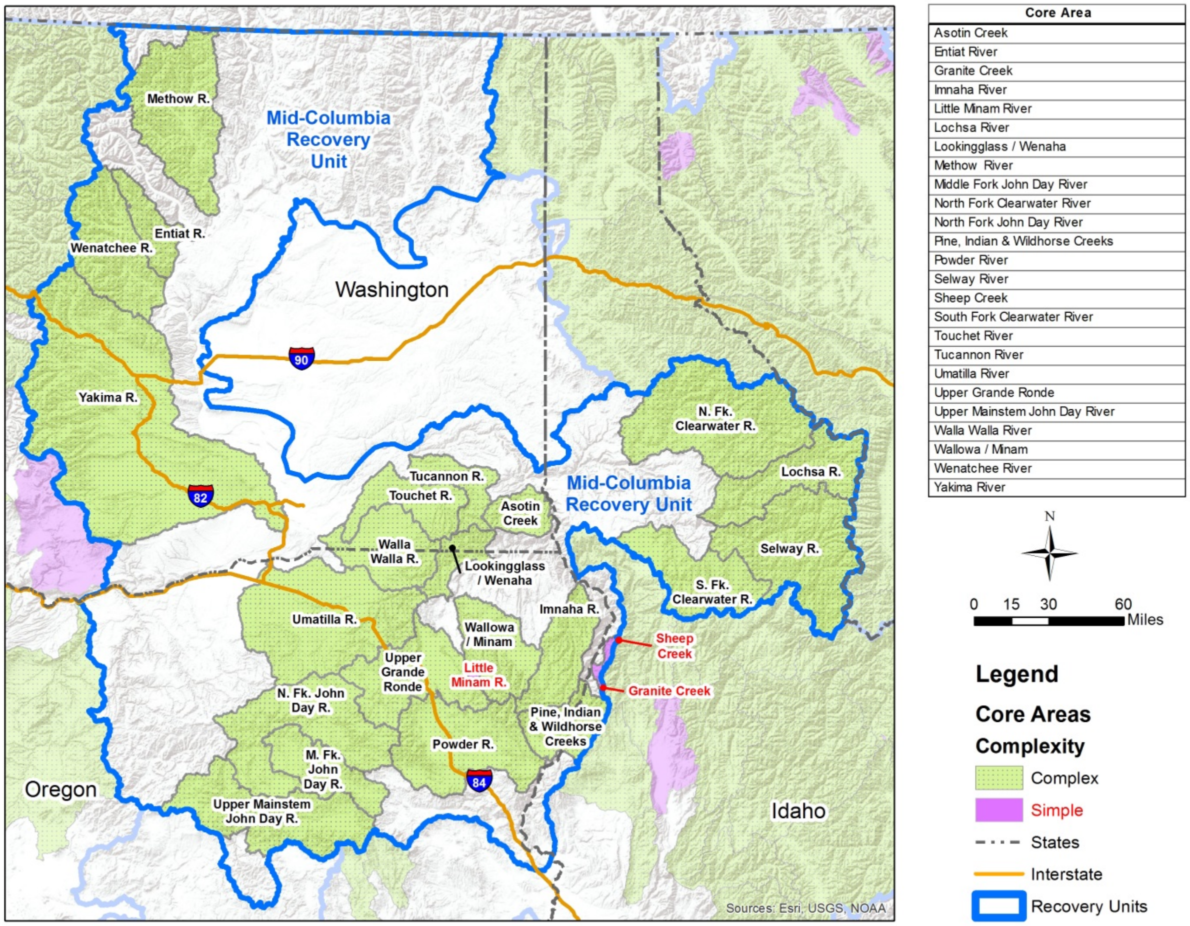


Figure 8. Map of the Mid-Columbia Recovery Unit.

The Mid-Columbia Recovery Unit is located within eastern Washington, eastern Oregon, and portions of Idaho. Major drainages include the Yakima River, John Day River, Umatilla River, Walla Walla River, Grande Ronde River, Imnaha River, Powder River, Clearwater River, and small drainages along the Snake River and Columbia River. The Mid-Columbia Recovery Unit includes 25 occupied core areas in 4 geographic regions: 1) the Lower Mid-Columbia (5 core areas in the John Day, Umatilla, and Walla Walla basins); 2) the Upper Mid-Columbia (4 core areas from the Yakima basin north to the Canadian border); 3) the Lower Snake (13 core areas in the Clearwater, Tucannon, Asotin, Grande Ronde, and Imnaha basins along with Granite and Sheep Creeks); and 4) the Mid-Snake (2 core areas in the Powder basin and Pine, Indian and Wildhorse Creeks). There are also two historically occupied core areas (Eagle Creek and Chelan River) and two Research Needs Areas (Burnt River and Eastern Washington) in this recovery unit.

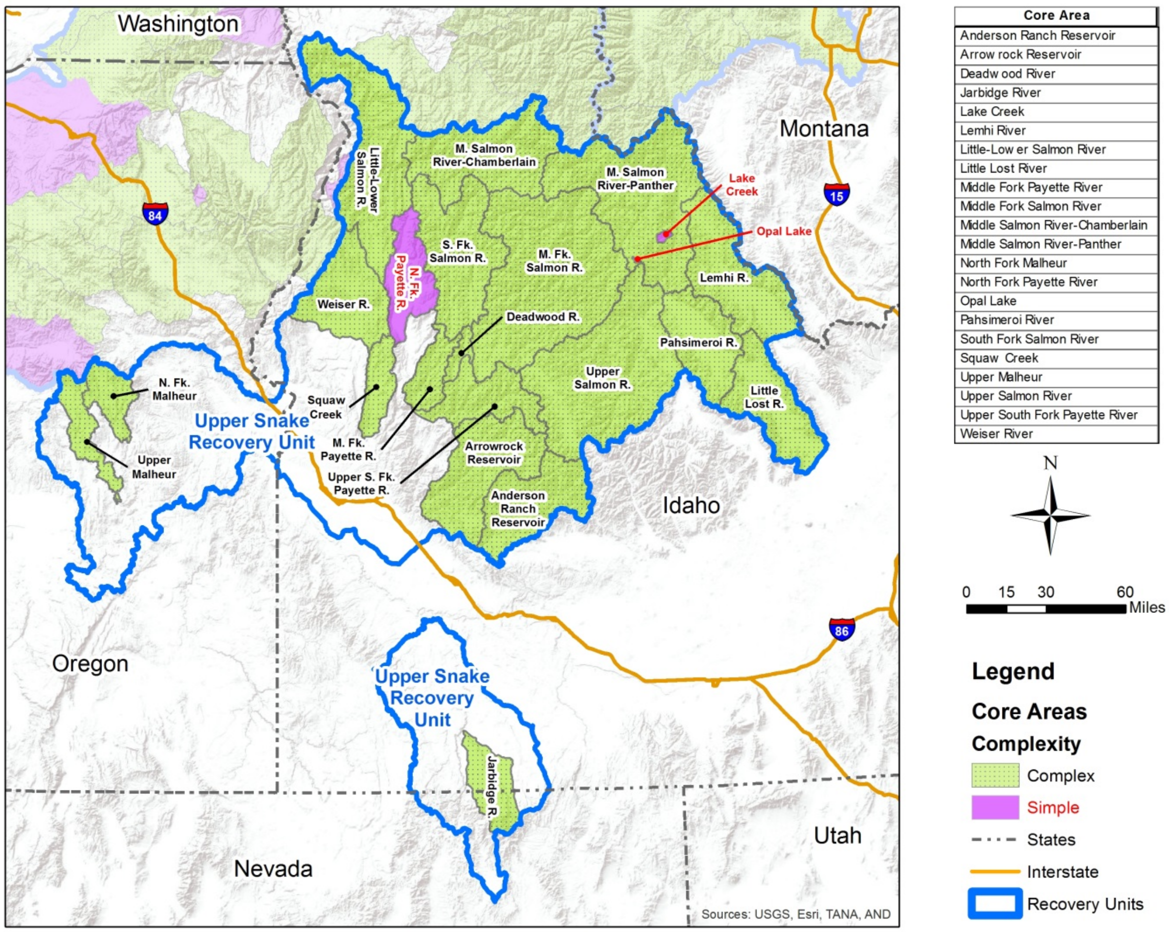


Figure 9. Map of the Upper Snake Recovery Unit.

The Upper Snake Recovery Unit occurs within central Idaho, northern Nevada, and eastern Oregon. Major drainages include: the Salmon River, Malheur River, Jarbidge River, Little Lost River, Boise River, Payette River, and the Weiser River. The Upper Snake Recovery Unit contains 22 bull trout core areas found in 7 geographic regions: Boise River, Jarbidge River, Little Lost River, Malheur River, Payette River, Salmon River and Weiser River. The only core areas currently supporting adfluvial populations of bull trout are located in the Upper Salmon River, Deadwood River, Anderson Ranch, Arrowrock, Opal Lake, and Lake Creek core areas. All remaining core areas contain resident populations and most have fluvial populations.

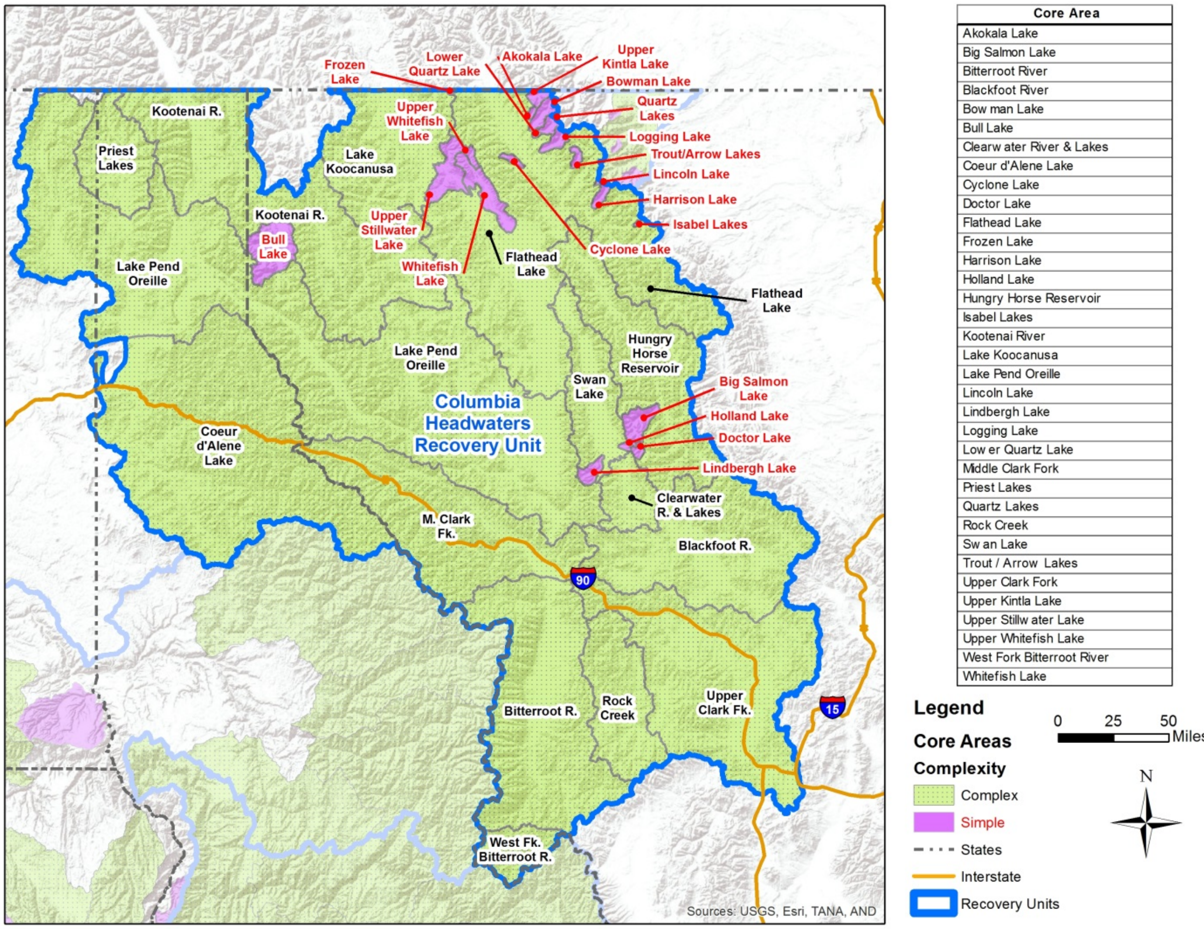
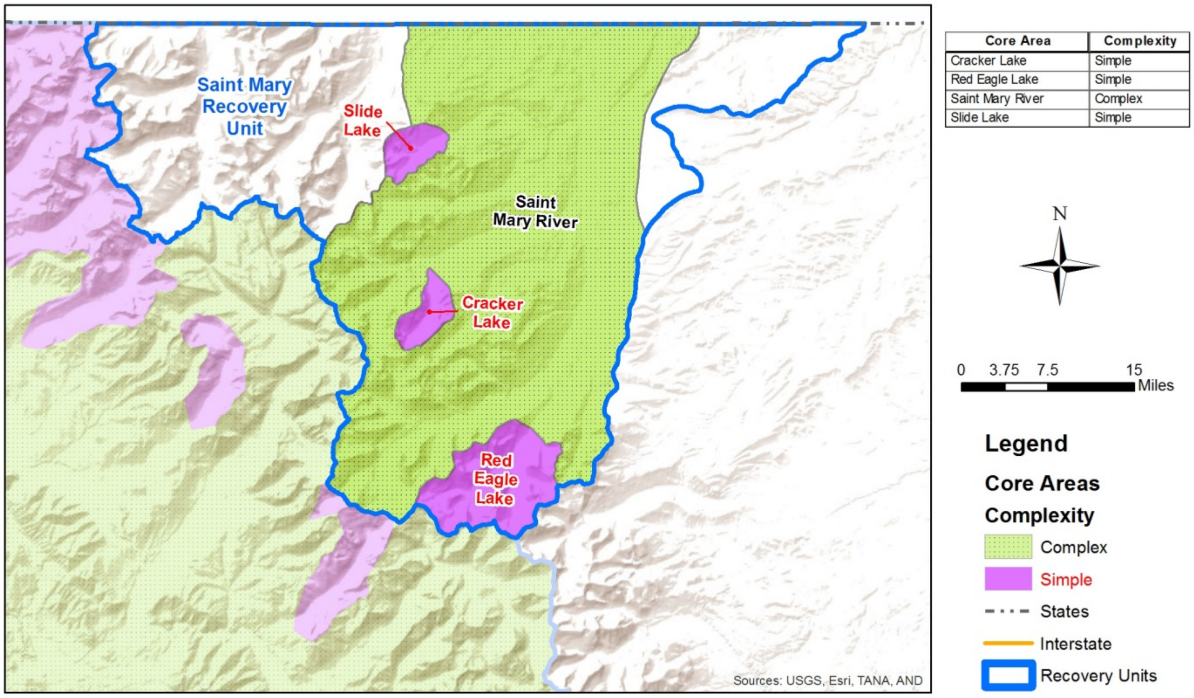


Figure 10. Map of the Columbia Headwaters Recovery Unit.

The Columbia Headwater Recovery Unit occurs within western Montana, northern Idaho, and a portion of northeastern Washington. Major drainages include the Coeur d’Alene Lake Basin, Kootenai River Basin, and the Clark Fork River Basin. In this revised draft recovery plan, we have slightly reorganized the 2002 structure for the Columbia Headwaters Recovery Unit based on latest available science and fish passage improvements that have rejoined previously fragmented habitats. There are 35 bull trout core areas that occur in 4 geographic regions: Clark Fork River, Flathead Lake, Coeur d’Alene Lake, and Kootenai River. Fifteen of the 35 core areas are referred to as “complex” core areas as they represent larger interconnected habitats, each containing multiple spawning streams considered to host separate and largely genetically identifiable local populations. The other 20 “simple” core areas are represented primarily by isolated headwater lakes (most are in Glacier National Park) with single local populations.



Core Area	Complexity
Cracker Lake	Simple
Red Eagle Lake	Simple
Saint Mary River	Complex
Slide Lake	Simple

Figure 11. Map of the Saint Mary Recovery Unit.

The Saint Mary Recovery Unit, which is located in Montana but is heavily linked to downstream resources in southern Alberta, Canada, comprises four core areas; only one (Saint Mary) is a complex core area with multiple (four) local populations. The remaining three core areas (Slide Lake, Cracker Lake, and Red Eagle Lake) are simple core areas that occur upstream of seasonal or permanent barriers comprised of genetically isolated single local populations in Glacier National Park.

D. Recovery Goals, Objectives, and Criteria

The ultimate **goal** of this recovery strategy is to manage threats and ensure sufficient distribution and abundance to improve the status of bull trout throughout their extant range in the coterminous United States so that protection under the Endangered Species Act is no longer necessary. When this is achieved, we expect that:

- Bull trout will be geographically widespread across representative habitats and demographically stable;
- The genetic diversity and diverse life history forms of bull trout will be generally conserved; and
- Cold water habitats essential to bull trout will be conserved and connected.

Specifically, the revised draft recovery plan outlines actions needed to:

- **Effectively manage and ameliorate primary threats.** We will focus on effectively managing and ameliorating the primary threats identified for each recovery unit at the core area scale such that bull trout will respond and persist well into the future.

- **Work cooperatively with partners to develop and implement bull trout recovery actions.** This includes: acknowledging and building upon the numerous and ongoing conservation actions that have already been implemented throughout much of the range of bull trout since the time of listing, and utilizing existing and new information, including decision support tools (i.e., Structured Decision Making, climate change considerations) in developing and prioritizing conservation actions in each recovery unit that will be included in Recovery Unit Implementation Plans (RUIPs).

- **Adaptively manage the bull trout recovery program**. Because the effectiveness of many of the recovery actions described in this revised draft recovery plan, as well as current and future climate effects to all populations, are not completely understood, we will apply adaptive management principles to future monitoring, implementation and other recovery actions for bull trout. Specific short-term recovery actions for bull trout in each of the six recovery units are summarized in section II.H (Recovery Actions) below, and will be described in greater detail in the RUIPs and accompanying Implementation Schedules in the final recovery plan.

- **Focus recovery efforts on actions, and potentially within recovery units, which provide the greatest resiliency against difficult-to-manage threats such as climate change**. Emerging decision support tools such as the NorWeST regional stream temperature database, mapping and modeling provide information on prioritizing recovery investments.

It should be emphasized that although bull trout were believed to have undergone a significant reduction in their historical range prior to the time of their listing in 1999, bull trout continue to be found in suitable habitats and are geographically widespread across numerous major river basins in five western states. The Act does not require a species, in this case bull trout, to be recovered throughout its historic range or even to a majority of the currently suitable habitat. Instead, the Act requires that we recover listed species such that they no longer meet the definitions of “threatened species” or “endangered species”.

E. How Much Is Enough?

The goals, objectives and criteria stated above are intended to meet the purposes of the Act which include "to provide a means whereby the ecosystems upon which [species] depend may be conserved," and to bring species to the point where the protections of the Act are no longer necessary. The threshold of when protections are no longer necessary can vary depending on the degree of certainty of conservation sought over time; e.g., minimally viable species (least certain over shortest time) (Reed *et al.* 2003, Trail *et al.* 2007); ecologically viable species (moderately certain into foreseeable future) (Peery *et al.* 2003), or species with viability of evolutionary potential (most certain over longest time) (Lynch and Lande, 1998).

Our recovery planning guidance (NMFS and USFWS 2010) recommends that recovery criteria be SMART: Specific, Measurable, Achievable, Realistic, and Time-referenced. We seek to identify recovery criteria for bull trout that meet these practical directives and are based in a sound scientific rationale, reflecting biodiversity principles of resiliency (ecological quality and ability to persist), redundancy (maintaining multiple replicates of populations/habitats to insure against catastrophic loss), and representation (conserving the full range of natural variation) (Shaffer and Stein 2000, Tear *et al*. 2005). We have additionally identified seven principles of conservation specific to bull trout (USFWS 2010): (1) conserve the opportunity for diverse life-history expression; (2) conserve the opportunity for genetic diversity; (3) ensure bull trout are distributed across representative habitats; (4) ensure sufficient connectivity among populations; (5) ensure sufficient habitat to support population viability (e.g., abundance, trend indices); (6) address threats, including climate change; and (7) ensure sufficient redundancy in conserving population units. These recovery principles take into account the threats and physical or biological needs of the species throughout its range and focus on the range-wide recovery needs.

Bull trout population status remains strong in some core areas. However, we must also acknowledge that despite our best conservation efforts, it is likely that some existing bull trout core areas will become extirpated due to various factors, including the effects of small populations and isolation (i.e., 35 of 110 extant core areas are comprised of a single local population). Thus, our current approach to developing recovery criteria and necessary recovery actions for bull trout is intended to ensure adequate conservation of genetic diversity, life-history features, and broad geographical representation of bull trout populations while acknowledging some local extirpations are likely to occur. Specifically, we are proposing a recovery approach that: (1) focuses on the identification of and effective management of known threat factors to bull trout; (2) acknowledges that some extant bull trout core area habitats will likely change (and may be lost) over time due to climate change effects; and (3) prioritizes and implement recovery actions in those areas where success is likely.

F. Proposed Recovery Criteria

The proposed recovery criteria represent our best assessment of the conditions that would most likely result in a determination that listing under the Act is no longer required. For bull trout, these conditions will be met when conservation actions have been implemented to ameliorate the primary threats in suitable habitats. If the primary threats have been effectively managed in each recovery unit, the long-term persistence of bull trout should be ensured.

The Service may initiate an assessment of whether recovery has been achieved and delisting is warranted when the following has been accomplished in each recovery unit:

- For the Coastal, Mid-Columbia, Upper Snake, and Columbia Headwaters Recovery Units: Primary threats are effectively managed in at least 75 percent of all core areas, representing 75 percent or more of bull trout local populations within each of these four recovery units (as identified in Appendix B and Table 2).

- For the Klamath and Saint Mary Recovery Units: All primary threats are effectively managed in all existing core areas, representing all existing local populations. In addition, because 9 of the 17 known local populations in the Klamath Recovery Unit have been extirpated and others are significantly imperiled and require active management, we believe that the geographic distribution of bull trout within this recovery unit needs to be substantially expanded before it can be considered to have met recovery goals. To achieve recovery, we seek to add seven additional local populations distributed among the three core areas (two in the Upper Klamath Lake core area, three in the Sycan core area, and two in the Upper Sprague core area) (see Appendix B and Table 2).

- In recovery units where shared FMO habitat outside core areas has been identified (Appendix G), connectivity and habitat in shared FMO areas should be maintained in a condition sufficient for regular bull trout use and successful dispersal among the connecting core areas for those core areas to meet the criterion. Shared FMO areas that function sufficiently to meet the criterion should provide the primary constituent elements of critical habitat specific to migration habitat.

Table 2. Proposed Recovery (Delisting) Criteria: For each recovery unit, number of core areas (and local populations) where threats must be effectively managed; reaching this 'threshold' would initiate the delisting evaluation process.

Recovery Unit	Existing		Threshold	
	Total Number of Extant Core Areas	Total Number of Local Populations within Extant Core Areas	Minimum Number of Core Areas with Threats Effectively Managed	Minimum Number of Local Populations within Effectively Managed Core Areas
Coastal RU	21	85	**16**	**64**
Mid-Columbia RU	25	136	**19**	**102**
Upper Snake RU	22	208	**17**	**156**
Columbia Headwaters RU	35	161	**27**	**121**
Klamath RU*	3	8	**3***	**8***
Saint Mary RU	4	7	**4**	**7**

*Klamath RU threshold 100 percent of existing local populations, plus additional reintroductions.

Outcome: If threats are effectively managed as described in Table 2 above (i.e., 75 percent threshold in the Coastal, Mid-Columbia, Upper Snake, and Columbia Headwaters Recovery Units, and 100 percent for the Klamath and Saint Mary Recovery Units), we expect that bull trout will respond accordingly and reflect the biodiversity principles of resiliency, redundancy, and representation. Specifically, achieving the proposed recovery criteria in each recovery unit would result in geographically widespread and demographically stable local bull trout populations within the range of natural variation, with their essential cold water habitats connected to allow their diverse life history forms to persist into the foreseeable future; therefore the species would be brought to the point where the protections of the Act are no longer necessary.

It is important to note that the revised draft recovery plan identifies prioritized recovery actions we believe are necessary to address specific threat factors affecting bull trout in all existing 110 core areas within the 6 recovery units. Under the revised draft recovery plan all bull trout core areas have potential to contribute to the conservation of the species. We developed the proposed recovery criteria thresholds with the understanding that some bull trout local populations or core areas may be lost in the future. This loss could occur due to a variety of unforeseen factors, including the effects of small population size and isolated local populations, and the future effects of climate change. If recovery criteria are met in a recovery unit in the future, the Service may initiate an assessment of whether recovery has been achieved and if designation as a DPS and delisting is warranted.

G. Distinct Population Segment(s) and the Coterminous United States Population

In the future we may determine, in coordination with our partners, whether pursuing the potential reclassification of the listed coterminous United States population of bull trout into multiple DPSs is a practical approach to delisting bull trout once recovery has been achieved. Section 3 of the Act defines "species" to include "any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." In 1996, the Service and National Marine Fisheries Service published a joint policy guiding the recognition of DPSs of vertebrate species (61 FR 4722-4725). Under this policy, we consider two factors to determine whether the population segment is a valid DPS and thus eligible for listing, reclassification, or delisting: (1) discreteness of the population segment in relation to the remainder of the taxon, and (2) the significance of the population segment to the taxon to which it belongs. If a population meets both tests, it can be designated a DPS. The population segment's conservation status would then be evaluated according to the standards in section 4 of the Act for listing, delisting, or reclassification (i.e., a determination would be made whether the DPS is endangered or threatened).

As previously described, our initial analyses for listing bull trout under the Act divided the species into five DPSs (Columbia River, Klamath River, Jarbidge River, Saint Mary-Belly River, and Coastal-Puget Sound). Collectively, these five DPSs covered the range of the species within the United States, excluding populations in Canada and Alaska. Two of these DPSs (Columbia River and Klamath River) were listed separately under the Act as threatened in 1998 (USFWS 1998a). The Jarbidge River DPS was emergency listed as endangered in 1998 (USFWS 1998b), and later listed with the Coastal Puget Sound and Saint Mary-Belly River as threatened in 1999 (USFWS 1999b). Subsequently, all five DPSs were combined into a single DPS, covering the species' range in the coterminous United States, and listed as threatened on November 1, 1999 (USFWS 1999a). This listing rule provided efficiency because all five DPSs were considered "threatened," and adhered to contemporary DPS guidance to "use sparingly" such designations as directed by Congress. The coterminous U.S. listing rule recognized the five DPSs as useful subdivisions for purposes of section 7 consultation and they continued to be used in the organization of the 2002 and 2004 draft recovery plans (USFWS 2002b, 2004b).

Simultaneously accounting for progress towards recovery and delisting among such disparate habitats as the Klamath Basin in southwest Oregon and the Saint Mary River basin in north-central Montana is difficult and often impractical because the biological status and threats for these populations are so different from one another. Therefore, in this plan we define consistent yet distinct recovery criteria for each of the recovery units in order to reflect the unique biology, geography, and management requirements for bull trout in each recovery unit.

To make comparisons among recovery unit alternatives we developed a rule set to apply the DPS criteria (USFWS 1996) specifically to bull trout (Table 3). The "*discreteness*" criterion directs that a potential DPS must be "markedly separate." To evaluate this, we determined that each unit must exhibit significant genetic divergence at either the mitochondrial or microsatellite DNA level; be relatively isolated from adjacent units; and/or exhibit significant life-history differences.

The single DPS recognized as a result of the 1999 coterminous U.S. listing does not include the Canadian portion of bull trout range. We have and will continue to work with Canada on application of a similar assessment process so we can cooperatively evaluate trans-boundary populations as well as populations at larger regional or range-wide scales. Applicable trans-boundary core areas, from the west to east part of bull trout range, include Chilliwack, Skagit, Kootenai River, Lake Koocanusa, Flathead Lake, and Saint Mary River.

The "*significance*" criterion directs that a potential DPS must typically meet one or more of three factors: occupy a unique ecological setting; create a significant gap in the range of the larger biological entity if lost; and/or differ markedly from other units. To evaluate the "ecological setting" factor our rule set specified that bull trout would have a unique life-history (similar to the "*discreteness*" criterion), unique species assemblage, and/or occupy a unique ecological zone. To evaluate the "significant gap" factor our rule set specified that bull trout would have to be lost from a major drainage basin, or a major portion of the Columbia River basin. To evaluate the "differs markedly" factor our rule set specified that bull trout would exhibit significant genetic divergence at either the mitochondrial or microsatellite DNA level (similar to the "*discreteness*" criterion); and/or would lack a shared evolutionary future due to a low likelihood of individuals from separate units interacting.

Based on this analysis, we concluded that six recovery units as presented in Figure 5 comported most closely with our DPS policy and criteria: (1) Coastal; (2) Klamath; (3) Mid-Columbia; (4) Upper Snake; (5) Columbia Headwaters; and (6) Saint Mary. All six recovery units exhibited a clear pattern of differentiation at the microsatellite DNA level and therefore met the "discreteness" criterion. In addition, a loss of any of the six units would result in a significant gap in the range of bull trout; there were unique species assemblages; and there was a moderate degree of genetic distance, or potentially significant evolutionarily divergence, at the microsatellite DNA level, so these six recovery units therefore met the "significance" criterion as well. There were multiple options for describing the number and spatial arrangement of recovery units under consideration, especially within the Columbia River Basin, but the chosen alternative appeared to work best in satisfying the DPS criteria while being used sparingly.

Because the six recovery units were described with full consideration of the DPS policy, each of them may qualify as a separate DPS under the Act and reclassification of bull trout into six separate entities under the Act may be possible. All six recovery units operate as biologically distinct entities and each face different suites of site-specific threats. For that reason, recovering and delisting bull trout simultaneously across all six recovery units range-wide may not be necessary. Because at present none of these recovery units has been designated as a DPS through a formal rule-making process, the DPS discussion in this revised draft recovery plan does not constitute designation of any recovery unit as a DPS. Thus, bull trout remain listed as a single DPS in the coterminous United States. We are proposing recovery criteria in this revised draft recovery plan to be applied at the recovery unit scale to facilitate independent management and achievement of recovery goals which when achieved may lead to delisting at the recovery unit (i.e., DPS) scale.

H. Recovery Actions

Recovery of bull trout will entail effectively managing threats to ensure the long-term persistence of populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat conditions and access to them that allow for the expression of various life-history forms within each of six recovery units. Specifically, recovery actions described in the following categories, and when implemented and effective, should:

- Protect, restore, and maintain suitable habitat conditions for bull trout that promote diverse life history strategies and conserve genetic diversity.
- Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout. Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, and considering the effects of climate change. Structured decision making processes (e.g., Structured Decision Making (SDM), Bayesian Modelling, etc.) can provide a framework for local working groups to identify assumptions and adaptively respond to new monitoring data and outcomes of recovery actions. It is also important to develop a decision framework) to assess climate change effects to bull trout and allocate conservation resources and funding to ensure that future bull trout conservation efforts are allocated to those areas with the anticipated future coldest water temperatures that offer the greatest long-term benefit to bull trout conservation. As part of any potential delisting process the Service will need to review

information and data regarding the status of the species. Though we have not proposed specific demographic criteria, demographic data will need to be reviewed in any future delisting analysis.

The following recovery action categories were previously developed in cooperation with Federal, State, local, and other partners to be implemented in core areas for each of the six recovery units. For each recovery unit, comprehensive recovery unit implementation plans (RUIPs) and implementation schedules that include core area specific recovery actions will be completed and made available for public review and comment prior to being included in the final recovery plan (See Part III, Tables 3 and 4 for template examples).

In addition to these recovery actions, ongoing enforcement of State fishing regulations continues to be necessary to protect bull trout from the impacts of legal angling and poaching, especially in areas with large, migratory adult bull trout. In watersheds where angling for bull trout is legal, the appropriate limits and restrictions should be continued. In certain core areas, unintentional bycatch of bull trout in fisheries targeting other species (hooking mortality) can be a significant source of bull trout mortality; programs for angler outreach and education about bull trout identification should be continued. Specific local actions needed to address angling impacts in specific core areas may be identified as appropriate in the RUIPs.

1. Protect, restore, and maintain suitable habitat conditions for bull trout that promote diverse life history strategies and conserve genetic diversity.

Habitat restoration should be done where necessary to maintain and improve water quality and conserve suitable cold water habitat, providing passage at migration barriers, restore impaired instream and associated riparian habitats. If appropriate, focus these recovery efforts on those locations that provide the greatest resiliency against difficult-to-manage threats such as climate change.

Habitat maintenance and restoration may involve implementing appropriate grazing and forest management practices, mitigating the effects of past forest harvest and forest road system construction, urban and rural development planning to consider development effects to bull trout, and considering the effects from future climate change on land management activities. Land managers with potential to implement these restoration activities include Federal agencies (particularly U.S. Forest Service and Bureau of Land Management), State agencies, Tribes, and private landowners.

Promoting and restoring connectivity, both within core areas and with riverine or coastal FMO habitat, should encourage the full expression of known migratory life history strategies (fluvial, adfluvial, anadromous, amphidromous), and allow appropriate genetic interaction and demographic exchanges among core areas. Recovery actions that address migratory connectivity may include culvert removal, fish ladder installation, management of dams to provide seasonally appropriate instream flows or avoid entrainment or dewatering, decommissioning dams where appropriate and feasible, and removal of falls or natural barriers. Connectivity management or inter-population transfers should be considered where needed to meet recovery goals under the guidance of a genetic management plan to maintain genetic diversity and regionally appropriate genetic composition.

Coastal Recovery Unit

Watersheds should be managed to maintain a diversity of bull trout life history types (anadromous or amphidromous in Puget Sound (Chester Morse Lake, Chilliwack River, Lower Skagit River, Nooksack River, and Puyallup River core areas) and Olympic Peninsula (Dungeness River, Elwha River, Hoh River, Queets River, Quinault River, Skokomish River core areas) core areas, adfluvial in Chester Morse and Odell Lakes). For example, within the Puget Sound and Olympic Peninsula core areas, bull trout use marine and estuarine FMO habitats, and restoring impaired estuarine and near shore marine habitats is considered an important component of bull trout recovery. Specific recovery actions may include removing or modifying structures such as riprap, dikes, and tide gates; restoring tidal flow to coastal wetlands; contaminant remediation; or restoring eelgrass or kelp beds. Active, ongoing partnerships such as the Puget Sound Partnership and Puget Sound Nearshore Ecosystem Restoration Project are already contributing to bull trout recovery through restoration projects in these habitats. Conservation of the transboundary Chilliwack and Upper Skagit core areas should be planned in coordination with the British Columbia government to effectively address fisheries management, forestry practices, and mining development in these core areas.

Recent dam removals and ongoing habitat restoration within the Elwha River core area should provide an opportunity to evaluate the effectiveness of removing large scale passage barriers and to determine whether formerly ‘resident’ bull trout populations can re-establish their historic anadromous life history. Ongoing negotiations through the Federal Energy Regulatory Commission relicensing process are providing additional opportunities for bull trout passage at a number of dam locations in the Coastal Recovery Unit (e.g., the Lewis River project in the Lewis River core area, Cushman Dam in the Skokomish River core area).

Additionally, ongoing interagency recovery planning and implementation efforts for listed salmon populations should complement bull trout recovery in the Coastal Recovery Unit where the listed species ranges overlap. Generally, salmon recovery actions also function to improve habitat for bull trout; often spawning and rearing habitat for salmon and steelhead is concurrently used as FMO habitat by bull trout. Moreover, restoration of chinook and steelhead runs in Olympic Peninsula and Puget Sound core areas (e.g., the Elwha basin restoration in the Elwha core area, ongoing projects in Lewis and Skokomish core areas) also benefits bull trout by providing juvenile salmonids as forage fish.

The recent reintroduction of bull trout in the Clackamas River basin in Oregon may restore an extirpated population and create a new additional core area within the Coastal Recovery Unit. Restoring bull trout in other core areas along the Lower Columbia River (Hood River, Klickitat River, Upper Deschutes basin, and White Salmon River core areas); bull trout populations that have been extirpated may help meet recovery criteria in the Coastal Recovery Unit.

Klamath Recovery Unit

Within the Klamath Recovery Unit, at least nine historic local populations of bull trout have become extirpated, and restoring additional local populations will be necessary to achieve recovery. Restoring local populations would involve evaluating where suitable habitats can be maintained or restored, and prioritized for habitat restoration and suitability of translocating genetically appropriate donor populations. Recent recovery efforts have identified restoring bull trout spawning/rearing and FMO habitats in the Wood River valley and reconnecting these habitats to Agency Lake; restoring and reconnecting both occupied and unoccupied habitats in the Sycan River core area and in the North and South Fork Sprague River through stream restoration, water management, and removal of existing migration barriers and entrainment.

Mid-Columbia River Recovery Unit

Upland management and riparian restoration actions should be implemented by land management agencies throughout the region, in coordination with private landowners. In general, the major actions needed in eastern Washington and northeastern Oregon watersheds are screening of irrigation diversions, removing culverts or other fish passage barriers, and improving instream flow to allow connectivity between FMO and spawning/rearing habitat.

Fish passage needs to be established at several Bureau of Reclamation dams in the Yakima core area. In core areas adjoining the Snake River (e.g., Grande Ronde, Imnaha, Powder, Pine, Indian, and Wildhorse), effects of the Snake River dams and various tributary reservoirs on bull trout movement should be assessed; two-way fish passage should be established if feasible to restore population connectivity within or between core areas.

The Imnaha, Grande Ronde, Walla Walla, Wenatchee, and Clearwater core areas currently contain the most stable bull trout populations in the recovery unit and should be particularly managed to maintain these populations in suitable habitat and prevent introduction of new threats.

Upper Snake River Recovery Unit

The numerous localized fish habitat restoration projects in the Salmon River basin that are implemented by Federal, State, and private partners (U.S. Forest Service, Bureau of Land Management, Upper Salmon Basin Watershed Program) should continue and be expanded if possible, to protect and maintain the currently robust population.

In southwestern Idaho, the National Forests, Idaho Department of Fish and Game, and cooperating private landowners should continue to implement upland and stream habitat restoration actions. Fish passage barriers within the following core areas (e.g., Arrowrock, Squaw Creek, North Fork Payette, and Deadwood core areas) should be evaluated and addressed to improve bull trout population connectivity.

Columbia Headwaters Recovery Unit

Ongoing programs to implement fish habitat restoration projects, including Forest Service and Montana Fish, Wildlife, and Parks restoration activities, the Avista Native Salmonid Restoration Program, habitat conservation plans, and public/private partnerships should be continued and expanded. In Montana, the U.S. Forest Service Montana Bull Trout Conservation Strategy (USFS 2013) provides a detailed, watershed-specific breakdown of the habitat restoration actions needed on National Forest lands. Full implementation of this strategy will substantially contribute to achieving bull trout recovery within spawning and rearing habitat in headwaters streams.

Several habitat restoration actions have been implemented or planned on National Forest lands within the Idaho portion of this recovery unit. For example, Avista Utilities and the Idaho Panhandle National Forest are planning to breach two splash dams on Marble Creek in the Coeur d'Alene Lake core area, which would restore upstream fish passage and allow recolonization of the upper tributaries by bull trout.

The large-scale connectivity improvement actions currently in progress should continue to be implemented. Construction of fish ladders for successful upstream passage at Cabinet

Gorge and Noxon Dams will be necessary for long-term resolution of the population connectivity issues on the Clark Fork River. On the Pend Oreille River, construction of a fish ladder for permanent passage at Albeni Falls Dam, as well as completion of the Box Canyon Dam and Boundary Dam fish passage currently in progress, will be critical to improve population connectivity and recover bull trout in this recovery unit. Instream flows in FMO habitat throughout the recovery unit should be implemented with sufficient water quality and quantity to allow bull trout movement and population connectivity. However, implementation of new connectivity actions to remove fish passage barriers should be considered in the context of their site-specific effects on non-native fish invasion as well as bull trout movement.

Multiple irrigation diversions in this recovery unit, in mainstem rivers and lower reaches of tributaries, need to be screened to prevent entrainment of bull trout.

Saint Mary Recovery Unit

The current design and management of the Saint Mary Diversion for the Milk River Project is the primary factor affecting bull trout in the Saint Mary Recovery Unit. The Saint Mary Diversion is operated by the Bureau of Reclamation and recovery actions identified as necessary to conserve bull trout include: constructing a screen at the Saint Mary Diversion to eliminate entrainment of bull trout, develop fish passage facilities, and secure an instream flow for bull trout in Swiftcurrent Creek and the Saint Mary River to prevent dewatering and provide suitable bull trout habitat. Ensure that improvements to the BOR Saint Mary Diversion will be completed while continuing to evaluate instream flow needs and operational considerations. All these measures should be developed in coordination with the resolution of Blackfoot Tribal and downstream water rights issues.

2. Prevent and reduce negative effects of non-native fishes and other non-native taxa on bull trout.

In many core areas, non-native fishes including lake trout (predation and competition), brown trout (competition), brook trout (competition and hybridization), and northern pike (predation and competition) are impacting bull trout.

Management options to address non-native fish effects may include angler bounties or liberalized fishing regulations, targeted electrofishing or netting, application of piscicides, or creation of passage barriers. However, the feasibility of controlling non-native fishes varies widely, depending on the specific species present, physical and biological characteristics of the watershed, availability of funding for control actions, and the public involvement and perception of control activities. Non-native fish control actions should be carefully planned with attention to site-specific conditions and public outreach.

Coastal Recovery Unit

Brook trout have been identified as impacting bull trout in 9 of 21 core areas within this recovery unit. Specific core areas targeted for brook trout management include the Puyallup (Carbon River), Upper Skagit, Elwha, and Nooksack core areas in Washington.

In Oregon in the Odell Lake core area, introduced lake trout populations, managed by the Oregon Department of Fish and Wildlife as a trophy fishery; should be evaluated for their potential impact to bull trout and appropriate action taken if required to meet recovery goals and criteria.

Klamath Recovery Unit

Competition and hybridization with brook trout is considered the primary threat to bull trout recovery in all three core areas comprising the Klamath Recovery Unit. The Service supports ongoing brook trout control efforts and re-establishing bull trout populations without hybrid elements. The feasibility of brook trout removal in adjacent stream reaches where historic bull trout local populations were extirpated should be explored to determine whether brook trout can be managed and bull trout re-established.

Brown trout, which occur in the Upper Klamath Lake and Upper Sprague River core areas, may also threaten bull trout, but competitive interactions between the species in these core areas are poorly understood. Interactions between bull trout and brown trout should be studied, and control measures implemented where appropriate and feasible to prevent or reduce effects on bull trout.

Mid-Columbia River Recovery Unit

Brook trout are identified as a threat to bull trout within 10 core areas in this recovery unit; in Oregon they are probably the most significant threat facing the species. In this recovery unit the level of effect from brook trout on bull trout is site-specific and variable depending on a number of factors (e.g., baseline habitat condition, amount of available habitat, bull trout access to refugia, brook trout densities, and water temperature). At sites where effects of brook trout are significant and control actions are feasible, brook trout populations should be reduced to minimize these effects. High priority areas include the John Day and Umatilla basins. Measures to prevent spread of brook trout to new streams should be considered and implemented where appropriate.

Upper Snake River Recovery Unit

Brook trout are identified as a primary threat in eight core areas within this recovery unit. Brook trout removal efforts should be implemented where feasible and biologically supportable. Preventing spread of brook trout into new drainages should be prioritized (e.g., in the North Fork Malheur River).

Columbia Headwaters Recovery Unit

Non-native fishes constitute a major threat to be addressed in core areas throughout this recovery unit, including lake trout (5 of 15 complex core areas and 8 of 20 simple core areas), brook trout (14 of 15 complex core areas and 7 of 20 simple core areas), brown trout (9 of 15 complex core areas), and northern pike (7 of 15 complex core areas and 2 of 20 simple core areas). Walleye and bass may also have negative effects on bull trout in warmer lake and reservoir waters where they have been introduced.

Lake trout are actively spreading through new core areas in this recovery unit and are causing severe negative effects to bull trout where they become established in adfluvial lake habitat; arresting and reversing this process is critical to recovering bull trout in this recovery unit. The major methods currently used to control lake trout are gill netting, often targeted to spawning and nursery sites, and angler bounties. Lake trout control projects are ongoing in several lakes in Idaho and Montana (e.g., Upper Priest Lake, Lake Pend Oreille, Flathead Lake, and several lakes in Glacier National Park); none are complete but several are showing substantial signs of progress in reducing lake trout populations. Lake trout control should be continued with ongoing evaluation of effectiveness, and expanded to additional lakes as deemed necessary and beneficial, with the target of substantially reducing or extirpating lake trout populations, in part to forestall invasion of new areas and allow co-occurring bull trout populations to recover. In Flathead Lake, the Confederated Salish and Kootenai Tribes have published a final environmental impact statement implementing an intensive effort to reduce lake trout populations through focused angling, gill netting and trap netting (CSKT 2014). Because of the size of Flathead Lake and the magnitude of the lake trout population (an estimated 1.6 million fish), this effort would be substantially more difficult and expensive than in smaller lakes, but if successful would improve adfluvial bull trout populations throughout watersheds connected with Flathead Lake.

After control efforts have successfully reduced lake trout populations, ongoing monitoring will be necessary. If populations are not fully extirpated, ongoing control measures at lesser intensity are likely to be necessary to maintain them at low levels.

Brown trout and brook trout control is needed in some stream habitat where overlap with bull trout distribution exists or is likely to develop in the future. Brook trout are established in numerous upper watershed streams throughout the recovery unit. Particularly in Montana, brown trout populations have recently expanded from mainstem rivers into upper watersheds and tributary streams at multiple locations, perhaps facilitated by drought and warmer stream temperatures. Northern pike and smallmouth bass populations are also expanding in warmer lake, reservoir, and mainstem habitats. Electrofishing, netting, or application of piscicides may be used to experimentally suppress brook trout, brown trout, or northern pike populations. Depending on the location, such efforts may be expensive and labor intensive; selective removal by anglers through fisheries management may also be an option. In certain cases, creating or maintaining barriers to isolate watersheds that have not yet been invaded may be advisable, although this measure must be weighed against the resulting losses of connectivity and life history diversity for bull trout populations.

<u>Saint Mary Recovery Unit</u>

Non-native fish effects on bull trout in the Saint Mary Recovery Unit are relatively minor. Lake trout and northern pike are native to these watersheds and historically coexisted with bull trout. Brook trout have been introduced in areas where bull trout occur but no hybridization has been detected and they are not considered a factor affecting bull trout conservation in the Saint Mary Recovery Unit.

3. Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery actions.

Effective monitoring programs are needed to determine whether recovery actions for bull trout are successful and to help determine where and when recovery criteria have been achieved. Monitoring may include assessing distribution, population status, life history, migratory movements, and genetic characteristics of bull trout in each recovery unit. In addition, evaluating monitoring efforts, management practices such as those for water diversion screening, grazing, timber harvest, and riparian management should be evaluated for their effectiveness in reducing impacts on bull trout.

Future climate change impacts on bull trout will require development of a decision framework to help inform where climate change effects are most likely to impact bull trout. The identification of core areas and watersheds that are most likely to maintain habitats suitable for bull trout over the foreseeable future under probable climate change scenarios will also help guide the allocation of bull trout conservation resources to improve the likelihood of success.

Interspecific interactions (particularly with brook trout, brown trout, and lake trout) should be further studied under a variety of environmental conditions to identify appropriate and cost-effective management methods and assess under what circumstances bull trout may be able to coexist with minimal adverse effects.

Significant research and monitoring projects that have been identified as important in each recovery unit are listed below:

Coastal Recovery Unit

Identify characteristics of high-quality marine FMO habitat and determine priority management actions for protection and restoration of marine FMO habitat.

Complete genetic baseline data on bull trout populations in Puget Sound (Chester Morse Lake, Chilliwack, Lower Skagit, Nooksack, and Puyallup core areas) to determine whether anadromous bull trout from different core areas partition use of marine FMO habitat or use it uniformly.

Monitor bull trout in core areas where connectivity to historic FMO areas has been re-established (*e.g.*, Skokomish River to Hood Canal; Elwha River to Strait of Juan de Fuca; Lewis, Deschutes, and White Salmon Rivers to mainstem Columbia River). Identifying what habitat is currently being used by these fish (e.g., whether fish are successfully occupying historic FMO habitat, being blocked by migration barriers, or using new areas that have not been targeted for conservation) is important for effective management of FMO habitat.

Identify appropriate source populations for possible reestablishment of extirpated populations in Hood River, Klickitat, and White Salmon core areas.

Klamath Recovery Unit

Conduct suitability assessment of watersheds with former or potential bull trout habitat, to describe major obstacles to habitat restoration, improved connectivity, and suppressing non-native brook trout and prioritize reintroduction efforts.

Identify appropriate source populations and assess need for captive propagation of bull trout to support reintroduction efforts in Klamath Recovery Unit watersheds where local populations have been extirpated. Effects of non-native fishes and dispersal barriers largely prohibit natural recolonization within this recovery unit, and poor demographic health of bull trout populations suggests that a controlled propagation program may be necessary to support reintroduction efforts and prevent extirpation of additional local populations. Propagation may involve various methods, including but not limited to *in situ* rearing of larvae and/or juveniles in semi-natural environments, cages, or ponds, or more intensive (traditional) hatchery methods. These efforts could contribute to reestablishment of local populations in all three core areas of the Klamath Recovery Unit.

Mid-Columbia Recovery Unit

Conduct experimental research on methods to effectively remove brook trout.

Additional study of genetic structure of core areas along the Snake River above the dams; these data may inform management of the Powder River as a possibly distinctive population, and could affect the delineation between Mid-Columbia and Upper Snake Recovery Units.

Updated survey and distribution data for core areas, for many of which recent information is incomplete (Powder, John Day, Umatilla, and Grande Ronde core areas).

Upper Snake Recovery Unit

Assess need and potential for connectivity among core areas within this recovery unit (genetic and demographic viability of peripheral core areas, assessment of feasibility of passage through Upper Snake mainstem, feasibility of other options for restoring connectivity (e.g., periodic translocation from Salmon watershed).

Columbia Headwaters Recovery Unit

Continue to study lake trout control efforts to assess and implement methods that are cost-effective and minimize bycatch of bull trout and other non-target species. Electrofishing over lake trout spawning sites to kill eggs has shown promise as an effective method in preliminary studies, but needs to be implemented and assessed in larger-scale field trials. Modelling of lake trout population dynamics in a variety of lakes should be done to better assess the level of effort necessary for successful control efforts and ongoing maintenance.

Identify factors limiting bull trout populations in the Coeur d’Alene Lake core area (e.g., upper headwaters of Saint Joe River where habitat appears to be suitable but population remains low).

Saint Mary Recovery Unit

None identified.

III. Implementation Framework

The final bull trout recovery plan will describe the principal actions needed to advance the recovery of bull trout in the six recovery units within the coterminous United States; and include individual **Recovery Unit Implementation Plans (RUIPs)** for each recovery unit that will provide site specific detail at the core area scale. To enhance the effectiveness of this recovery plan, the RUIPs should be updated regularly (at least every 5 years) to reflect the lessons learned and refinements to the recovery strategy.

The RUIPs for each recovery unit that will be developed and made available as drafts for public review and comment prior to being incorporated as part of the final recovery plan. These RUIPs are intended to describe and prioritize core area specific recovery actions. These recovery actions will be developed through an interagency collaboration of interested and knowledgeable Federal, Tribal, State, private and other parties. In many parts of the range, local interagency bull trout working groups have previously identified recovery actions necessary for local bull trout core area conservation, and are already implementing conservation actions. Therefore, we anticipate that in many areas, developing a RUIP will build upon existing efforts and information.

Each RUIP will include an **Implementation Schedule** that outlines core area specific recovery actions and estimated costs for bull trout recovery. An implementation schedule is a *guide* for meeting the recovery goals, objectives, and criteria discussed in Parts I and II of this plan. The implementation schedule indicates the listing factor being addressed by each recovery action, recovery action descriptions, responsible parties, and estimated costs. The initiation and completion of recovery actions for bull trout is subject to the availability of funds, as well as other constraints affecting the parties involved.

While we have the statutory responsibility for developing and implementing this recovery plan for bull trout, recovery of bull trout across the coterminous United States will require the involvement of Federal, Tribal, State, private, and local interests. This revised draft recovery plan takes into account the expertise and contributions of numerous individuals and agencies since the 1999 listing of bull trout. The continued expertise and contributions of these, and additional agencies and interested parties, is needed to implement the recovery actions identified in this plan. Each recovery action described in the Implementation Schedule for each recovery unit lists the primary agency or responsible party, having the authority for implementing recovery actions, along with other groups, such as Tribal, State, private, and other organizations, that also may wish to be involved in bull trout recovery implementation. The listing of a responsible party does not require, nor imply a requirement, that the identified party has agreed to implement the recovery action(s) or to secure the funding for implementing the action(s). When more than one party is listed, the most logical lead agency (based on authorities, mandates, and capabilities) will be identified in bold type.

To allow public review and comment on the draft RUIPs for each recovery unit, including the draft implementation schedule and total estimated recovery costs, we will publish a Notice of Availability (NOA) announcing their availability for review in the Federal Register at least 90 days prior to completing the final bull trout recovery plan. Draft RUIPs will be updated to final form based on public comment and then incorporated into the final bull trout recovery plan. The implementation schedules from the final RUIPs will collectively constitute the bull trout implementation schedule for the final recovery plan. The range-wide total cost of recovery and time required for recovery will be determined by combining information in the final RUIPs.

A template example of a recovery unit specific implementation schedule is found in Table 3.

Each Recovery Unit Implementation Plan (RUIP) will include the following components:

Introduction: A brief description of the recovery unit in the overall context of bull trout recovery. This should include a list of core areas in the recovery unit, description of overall population status and significance of the various threats in each core area, and a summary of current status of conservation actions. If additional maps are needed for clarification of recovery actions, beyond those presented here in the revised draft recovery plan, they may be included in this section. Watersheds in the recovery unit that are expected to most effectively maintain cold water temperatures in the face of climate change may be identified and prioritized for management actions. Any core areas where expression of migratory life history is not considered an important element of bull trout conservation (e.g. due to potential for connectivity to result in adverse effects from invasive nonnative species) should be identified.

Stepdown Narrative. A list of individual recovery actions needed within the recovery unit (specific numbered step-down actions under the general recovery actions 1 [management of habitat & connectivity], 2 [non-native fish management], and 3 [research and monitoring] identified in section II.H above). For each action a brief narrative discussion should describe any appropriate details of methods, rationale, scope, and implementation considerations. These actions will likely include but need not be limited to the recovery unit specific actions discussed in section II.H of this document, above.

Implementation Schedule. The draft RUIP will also include a recovery unit specific draft of the implementation schedule, describing the responsible parties and cost estimate breakdown for recovery actions.

Each recovery unit specific Implementation Schedule will include the following components:

- Action Priority: Assigned # 1,2 or 3 based on the following definitions;
  Priority 1 – An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future;
  Priority 2 – An action that must be taken to prevent a significant decline in species population or habitat quality;
  Priority 3 - All other actions necessary to meet the recovery objectives.
- Action Number: Number of action from stepdown narrative.
- Action Description: Brief descriptive title of recovery action.
- Threat Factor: Listing factor (A through E) or threat category addressed by the action.
- Core Area: Designated core area(s) where the recovery action should be targeted.
- Action Duration: Indicates the number of years estimated to complete the action, or other codes defined as follows:
  Continual (C) – An action that will be implemented on a routine basis once begun.
  Ongoing (O) – An action that is currently being implemented and will continue until no longer necessary.
  To be Determined (TBD) – The action duration is not known at this time or implementation of the action is dependent on the outcome of other recovery actions.
- Responsible Parties: Agencies and others with responsibility or authority to implement proposed recovery actions.
- Estimated Costs: Estimated costs assigned to each action identified in the Implementation Schedule, both for the first five years after release of the recovery plan and for the total estimated cost of recovery (based on time to recovery, for Continual or Ongoing actions).
- Time to Recovery: Estimated time before this recovery unit could meet recovery criteria, if recovery actions are successfully implemented.

Table 3. Template example of a recovery unit specific implementation schedule. These will be developed through an interagency collaboration of interested Federal, Tribal, State, private, and other parties.

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Time to Recovery (estimated time required to meet recovery criteria within this recovery unit													
Estimated total cost of recovery actions within this recovery unit													

IV. References

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V. APPENDICES

APPENDIX A. Glossary of Terms

Adfluvial bull trout. Bull trout that migrate from tributary streams to a lake or reservoir to mature (one of three commonly recognized bull trout life histories). Adfluvial bull trout return to a tributary to spawn.

Alevin. A newly-hatched trout or salmon still attached to the yolk sac.

Allacustrine. A fish that rears in lakes and spawns in outlet tributaries of lakes.

Alluvial. Pertaining to or composed of silts and clays (usually) deposited by a stream or flowing water. Alluvial deposits may occur after a flood event.

Anadromous (fish). A fish that is born in fresh water, migrates to the ocean to grow and live as an adult, and then returns to fresh water to spawn (reproduce).

Amphidromous (fish). A fish that migrates between fresh water and salt water at a period in its life cycle not directly related to reproduction (e.g., returning to fresh water at a juvenile or immature stage).

Bayesian Modelling. A branch of mathematical probability theory that allows scientists to model uncertainty about natural resource issues and possible outcomes of interest by modifying *a priori* probabilities in response to observational evidence.

Char. A fish belonging to the genus *Salvelinus* and related to both the trout and salmon. The bull trout, Dolly Varden, and the Mackinaw (or lake trout) are all members of the char family. Char live in the icy waters (both fresh and marine) of North America and Europe.

Complex Core Area. A core area that contains multiple interacting bull trout local populations. Complex core areas contribute significantly to the viability of a recovery unit.

Core area. The combination of core habitat (*i.e.*, habitat that could supply all elements for the long-term security of bull trout) and a core population (a group of one or more local bull trout populations that exist within core habitat) constitutes the basic unit on which to gauge recovery within a recovery unit. Core areas require both habitat and bull trout to function, and the number (replication) and characteristics of local populations inhabiting a core area provide a relative indication of the core area's likelihood to persist. A core area represents the closest approximation of a biologically functioning unit for bull trout. Core areas are presumed to reflect the metapopulation structure of bull trout (see metapopulation).

Core habitat. Habitat that encompasses spawning and rearing habitat (resident populations), with the addition of foraging, migrating, and overwintering habitat if the population includes migratory fish. Core habitat is defined as habitat that contains, or if restored would contain, all of the essential physical elements to provide for the security of and allow for the full expression of life history forms of one or more local populations of bull trout. Core habitat may include currently unoccupied habitat if that habitat contains essential elements for bull trout to persist or is deemed critical to recovery.

Core population. A group of one or more bull trout local populations that exist within core habitat.

Demographically stable. Term applied to how a 'recovered' bull trout population can be described in terms of size, age structure, and density. Implies that bull trout populations, at the local population, core area or recovery unit scale, interact with their surrounding environment so that their population scale status is stable or increasing based on measurements and calculations of population size, density, and age structure. (i.e. ecologically viable)

Distinct Population Segment (DPS). A listable entity under the Endangered Species Act that meets tests of discreteness and significance according to U.S. Fish and Wildlife Service policy. The Service has identified six bull trout recovery units in this draft plan consistent with the criteria in the DPS policy

Embeddedness. The degree to which large particles (boulders, gravel) are surrounded or covered by fine sediment, usually measured in classes according to percentage covered.

Effective population size. The number of breeding individuals that would give rise to the same amount of random genetic drift as the actual population, if ideal conditions held.

Entrainment. Process by which aquatic organisms are pulled through a diversion, turbine, spillway, or other device.

Extirpation. The elimination of a species from a particular local area.

Fish ladder. A device to help fish swim around a dam.

Floodplain. Adjacent to stream channels, areas that are typified by flat ground and are periodically submerged by floodwater.

Fluvial bull trout. Bull trout that migrate from tributary streams to larger rivers to mature (one of three bull trout life histories). Fluvial bull trout migrate to tributaries to spawn.

Foraging, migrating, and overwintering habitat (FMO habitat). Relatively large streams and mainstem rivers, including lakes or reservoirs, estuaries, and nearshore environments, where subadult and adult migratory bull trout forage, migrate, mature, or overwinter. This habitat is typically downstream from spawning and rearing habitat and contains all the physical elements to meet critical overwintering, spawning migration, and subadult and adult rearing needs.

Foreseeable Future. The Act does not define the term "foreseeable future". However, in a general sense, the foreseeable future is the period of time over which events can be reasonably be anticipated. For a threatened species, such as bull trout, the Service interprets the foreseeable future as the extent of time over which we can reasonably rely on predictions about the future in making determinations about the future conservation status of the species. For the bull trout 5-year review (USFWS 2008a) a manager panel defined a reasonable timeframe for the foreseeable future as 4 to 10 bull trout generations (approximately 20 to 70 years).

Geographic Region. Comprised of neighboring core areas that share similar bull trout genetic, geographic (hydrographic), and/or habitat characteristics. Conserving bull trout in Geographic Regions allows for the maintenance of broad representation of genetic diversity; neighboring core areas to benefit from potential source populations in the event of local extirpations and provides a broad array of options among neighboring core areas to contribute recovery under uncertain environmental change.

Headwaters. The source of a stream. Headwater streams are the small swales, creeks, and streams that are the origin of most rivers. These small streams join together to form larger streams and rivers or run directly into larger streams and lakes.

Hybridization. Any crossing of individuals of different genetic composition, typically different species, that results in hybrid offspring.

Lacustrine. Relating to lake habitat.

Legacy effects. Impacts from past activities (usually a land use) that continue to affect a stream or watershed in the present day.

Local population. A group of bull trout that spawn within a particular stream or portion of a stream system. Multiple local populations may exist within a core area. A local population is considered to be the smallest group of fish that is known to represent an interacting reproductive unit. For most waters where specific information is lacking, a local population may be represented by a single headwater tributary or complex of headwater tributaries. Gene flow may occur between local populations (*e.g.*, those within a core population), but is assumed to be infrequent compared with that among individuals within a local population.

Manage Threats. Threats to bull trout are addressed (i.e. managed) so that ecologically viable populations of bull trout that have 1) stable or increasing trends 2) a distribution within the recovery unit that promotes a mosaic pattern in representative habitats across the recovery unit 3) diverse life history strategies within populations and 4) connectivity between populations and core areas to the maximum extent possible.

Metapopulation. A population structure where a group of semi-isolated local populations of bull trout are interconnected and that probably share genetic material. Core areas represent the functional equivalent of a metapopulation structure for bull trout, and the local populations within these core areas are interconnected by occasional dispersal between them and therefore share some genetic characteristics.

Migratory corridor (bull trout). Stream reaches used by bull trout to move between habitats. A section of river or stream used by fish to access upstream spawning areas or downstream lake environments.

Migratory life history form (bull trout). Bull trout that migrate from spawning and rearing habitat to lakes, reservoirs, or larger rivers to grow and mature.

Nonnative species. Species not indigenous to an area, such as brook trout in the western United States. Also referred to as exotic or invasive species.

Piscicide. A chemical substance poisonous to fish.

Primary Threat. Threat factors known or demonstrated (i.e. non-speculative) to impact or affect bull trout survival, growth, reproduction, distribution, migration etc., and their suitable cold water habitat.

Recovery unit (general). A population unit of a listed entity that is geographically or otherwise identifiable and is essential to the recovery of the entire listed entity. Recovery units are individually necessary to conserve genetic robustness, demographic robustness, important life history stages, or some other feature necessary for long-term sustainability of the entire listed entity. Recovery criteria for the listed entity should address each identified recovery unit, and every recovery unit must be recovered, before the species can be delisted.

Recovery unit (bull trout). Bull trout recovery units are the major units for managing recovery efforts; each recovery unit is described in a separate chapter in the recovery plan. Most recovery units consist of one or more major river basins. Several factors were considered in identifying recovery units, for example, biological and genetic factors, political boundaries, and ongoing conservation efforts. In some instances, recovery unit boundaries were modified to maximize efficiency of established watershed groups, encompass areas of common threats, or accommodate other logistic concerns. Recovery units may include portions of mainstem rivers (*e.g.*, Columbia and Snake rivers) when biological evidence warrants inclusion. Biologically, bull trout recovery units are considered groupings of bull trout for which gene flow was historically or is currently possible.

Redd. A nest constructed by female fish of salmonid species in streambed gravels where eggs are deposited and fertilization occurs. Redds can usually be distinguished in the streambed gravel by a cleared depression, and an associated mound of gravel directly downstream.

Research Needs Area. Those geographic locations (e.g., watershed) where bull trout are known to occur historically, but the current status and historical use of the area are uncertain. These areas may have been historically occupied or had a few contemporary or historic observations to suggest at least some current or potential level of use and there was uncertainty with respect to their role in recovery. Generally, this is an area that may be necessary for recovery where there is some viable information about bull trout use and has a possibility of importance to recovery however, the use is undetermined.

Resident life history form. Bull trout that do not migrate, but that reside in tributary streams their entire lives (one of three bull trout life cycles).

Salmonid. Fish of the family Salmonidae, including trout, salmon, chars, grayling, and whitefish. In general usage, the term most often refers to salmon, trout, and chars.

Simple Core Area. We define a Simple Core Area as a core area that contains one bull trout local population. Simple core areas are almost always small in scope, with a population size that is necessarily restricted by the size of the habitat. Typically, simple cores are ecologically if not physically isolated from other core areas by natural, not anthropogenic factors (e.g., natural barriers, thermal gradients, or large spatial separation from other core areas) that have been operable for thousands of years.

Source population. Strong local populations within a metapopulation that contribute emigrating individuals to other local populations and reduce the risk of local extinctions (see stronghold).

Spawning and rearing habitat (SR habitat). Stream reaches and the associated watershed areas that provide all habitat components necessary for spawning and juvenile rearing for a local bull trout population. Spawning and rearing habitat generally supports multiple year classes of juveniles of resident or migratory fish and may also support subadults and adults from local populations of resident bull trout.

Spillway. That part of a dam that allows high water to flow (spill) over the dam.

Stochastic. The term is used to describe natural events or processes that are subject to random or unpredictable variation. Examples include environmental conditions such as rainfall, runoff, and storms, or life-cycle events, such as survival or fecundity rates.

Stronghold. A watershed, multiple watersheds, basin or other defined spatial units (e.g., core areas) where bull trout populations are strong and diverse, and the habitat has high intrinsic potential to support bull trout or suite of species. Important characteristics of bull trout strongholds include intact and well-connected habitat, presence of robust migratory populations, presence of the native fish fauna, resilient to perturbations, and retains the genetic and phenotypic diversity of the species. Strongholds can act as source populations.

Structured Decision Making (SDM). SDM is an organized approach to identifying and evaluating creative options and making choices in complex natural resource decision situations.

Take. Activities that harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or attempt to engage in any such conduct to a species listed under the Endangered Species Act.

Water right. Any vested or appropriation right under which a person may lawfully divert and use water. It is a real property right appurtenant to and severable from the land on or in connection with which the water is used; such water right passes as an appurtenance with a conveyance of the land by deed, lease, mortgage, will, or inheritance.

Watershed. The area of land from which rainfall (and/or snow melt) drains into a stream or other water body. Watersheds are also sometimes referred to as drainage basins or drainage areas. Ridges of higher ground generally form the boundaries between watersheds. At these boundaries, rain falling on one side flows toward the low point of one watershed, while rain falling on the other side of the boundary flows toward the low point of a different watershed.

Year class (cohort). Fish in a stock born in the same year. For example, the 1987 year class of bull trout includes all bull trout born in 1987, which would be age 1 in 1988. Occasionally, a stock produces a very small or very large year class, which can be pivotal in determining stock abundance in later years.

APPENDIX B. List of Threats and Factors Affecting Bull Trout in the Coterminous United States, listed by Recovery Unit and Core Area.

The table of threats in this section was derived from information assembled in the Core Area Templates (USFWS 2008) in coordination with various State, Federal, and Tribal partners, and additional assessments developed by the Service in 2010 and 2011. We solicit public comment and input on the accuracy and completeness of the threat descriptions in this table. In the final recovery plan the table will be updated and refined as appropriate.

The threats in this table have been identified as problems or factors that may affect bull trout local populations in each core area at present or in the foreseeable future (in consideration of present and future climate change). They can range in severity from serious imminent threats to documented, but relatively minor issues that should nonetheless be evaluated for their potential impact. The threats identified for each core area are not necessarily listed in rank order of severity. The mechanisms and impacts of these threats are discussed in greater detail in Section I under Factors Affecting the Species, and in the Recovery Strategy. This table functions as a crosswalk linking the threat types with the specific core areas where they are active. Moreover, while the discussion of Recovery Actions (Section II) is presented at the recovery unit level, this table provides supporting information to inform which recovery actions should be appropriately applied in each core area. A more detailed discussion of core area specific threats and recovery actions will be provided in the recovery unit implementation plans (RUIPs) that will be developed and included in the final recovery plan.

RECOVERY UNIT **Geographic Region** Core Area – Complex *Core Area - Simple*	Number of Local Populations	THREATS			
COASTAL RECOVERY UNIT					
Lower Columbia					
Clackamas	recently re-introduced	Connectivity impairment (hydroelectric and diversion dams)	Upland/ riparian land management (legacy timber harvest and roads)	Angling impacts (incidental catch from other fisheries)	
Hood River	2	Connectivity impairment (Clear Branch Dam)	Instream impacts (irrigation diversions and low instream flows)	Upland/ riparian land management (agricultural use and roads; turbidity and water temperature)	Small population size (genetic & demographic stochasticity)
Klickitat River	1	Upland/ riparian land management (legacy timber harvest and roads)	Nonnative fishes (brook trout)	Small population size (genetic & demographic stochasticity)	
Lewis River	3	Connectivity impairment (Swift, Yale, and Merwin Dams)	Nonnative fishes (brook trout near power canal &Yale Reservoir)	Upland/ riparian land management (legacy timber harvest and roads; residential development in Pine Creek watershed)	Angling impacts (incidental catch from other fisheries)

RECOVERY UNIT __Geographic Region__ **Core Area – Complex** ***Core Area - Simple***	Number of Local Populations	THREATS			
Lower Deschutes River	**5**	**Nonnative fishes (brook trout)**	**Connectivity impairment (Opal Springs hydro, Pelton Round-Butte Hydro Electric Project)**	**Small Population Size (Warm Springs Local Population)**	
Odell Lake	**1**	**Nonnative fishes (lake trout, brook trout hybridization)**	**Connectivity impairment (barriers on Trapper Creek and Odell Creek)**	**Angling impacts (incidental catch from kokanee & lake trout fisheries)**	**Small population size (genetic & demographic stochasticity)**
Upper Willamette River	**4**	**Connectivity impairment (Trail Bridge, Hills Creek, Lookout Point, and Cougar Dams)**	**Nonnative fishes (brook trout, rainbow trout, warmwater game fish in reservoirs)**	**Angling impacts (incidental catch from other fisheries)**	**Lack of anadromous forage fish (salmon & steelhead)**
__**Olympic Peninsula**__					
Dungeness River	**2**	**Instream impacts (poor instream flow & dewatering in lower river)**	**Upland/ riparian land management (poor structural complexity & high water temperatures in lower river)**	**Lack of anadromous forage fish (salmon & steelhead)**	**Small population size (genetic & demographic stochasticity)**

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Elwha River	**2**	**Connectivity impairment (Elwha & Glines Canyon Dams)**	**Nonnative fishes (brook trout)**	**Lack of anadromous forage fish (salmon & steelhead)**	
Hoh River	**2**	**Upland/ riparian land management (legacy timber harvest and roads)**			
Queets River	**1**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Angling impacts (incidental catch from other fisheries)**		
Quinault River	**2**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Angling impacts (incidental catch from other fisheries)**		
Skokomish River	**2**	**Connectivity impairment (Cushman Dams on North Fork; aggraded reaches in lower South Fork)**	**Nonnative fishes (brook trout); lack of anadromous forage fish (salmon/steelhead)**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Small population size (genetic & demographic stochasticity)**

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
<u>Puget Sound</u>					
Nooksack River	**10**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Connectivity impairment (Bellingham Water Diversion on Middle Fork Nooksack)**		
Chilliwack River*	**3 within U.S**	**Angling impacts (incidental catch from other fisheries; coordinate with British Columbia)**	**Upland/ riparian land management (legacy timber harvest and roads; agricultural/ urban impacts in lower Chilliwack & Fraser; coordinate with British Columbia)**		
Lower Skagit River	**21**	**Lack of anadromous forage fish (salmon & steelhead)**	**Upland/ riparian land management (legacy timber harvest and roads; urban development in middle Skagit / lower Sauk rivers)**		

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Upper Skagit River*	**8 within U.S.**	**Upland/ riparian land management (legacy timber harvest and roads; coordinate with British Columbia)**	**Water quality (mining contaminants - Azurite Mine, Imperial Metals Giant Copper property, and recreational mining; coordinate with British Columbia)**	**Nonnative fishes (brook trout; coordinate with British Columbia)**	
Stillaguamish River	**4**	**Upland/ riparian land management (legacy timber harvest and roads; urban development)**	**Small population size (genetic & demographic stochasticity)**		
Snohomish & Skykomish Rivers	**4**	**Upland/ riparian land management (urban development)**			
Chester Morse Lake	**4**	**Reservoir operations**			

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Puyallup River	**4**	**Connectivity impairment (Buckley Diversion, Mud Mountain Dam, & Electron Dam; low flows in bypass reaches)**	**Nonnative fishes (brook trout in Carbon River)**	**Upland/ riparian land management (urban development)**	**Small population size (genetic & demographic stochasticity)**
KLAMATH RECOVERY UNIT					
<u>Klamath</u>					
Upper Klamath Lake	**2**	**Nonnative fishes (brook trout hybridization, brown trout)**	**Connectivity impairment (Wood River to Agency Lake; lack of fluvial/adfluvial life history)**	**Small population size (genetic & demographic stochasticity)**	**Instream impacts (entrainment, low instream flows, water temperature, sedimentation)**
Sycan River	**1**	**Nonnative fishes (brook trout hybridization)**	**Connectivity impairment (migration barriers within core area; restricted fluvial life history)**	**Small population size (genetic & demographic stochasticity)**	**Instream impacts (entrainment, low instream flows, water temperature, sedimentation)**

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Upper Sprague River	**5**	**Nonnative fishes (brook trout hybridization, brown trout)**	**Connectivity impairment (migration barriers within core area; restricted fluvial life history)**	**Small population size (genetic & demographic stochasticity)**	**Instream impacts (entrainment, low instream flow, water temperature, sedimentation)**
MID-COLUMBIA RECOVERY UNIT					
<u>Upper Mid-Columbia</u>					
Methow River	**10**	**Upland/ riparian land management (legacy timber harvest and roads; water temperature)**	**Instream impacts (entrainment, low flows)**	**Connectivity impairment (Chief Joseph Dam; Rocky Reach, Rock Island, and Wells Dams on Columbia; other barriers)**	**Nonnative fishes (brook trout, especially in Twisp River, Beaver Creek)**
Entiat River	**2**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Instream impacts (entrainment)**	**Connectivity impairment (Chief Joseph Dam; Rocky Reach, Rock Island, and Wells Dams on Columbia; other barriers)**	**Nonnative fishes (brook trout)**

RECOVERY UNIT **__Geographic Region__** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Wenatchee River	**7**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Nonnative fishes (brook trout, especially in Chiwawa, Little Wenatchee, Nason Creek)**		
Yakima River	**15**	**Connectivity impairment (lack of passage at Keechelus, Kachess, Cle Elum, Bumping, & Tieton Dams; other barriers)**	**Instream impacts (entrainment, low instream flows)**	**Upland/ riparian land management (legacy timber harvest and roads; recreation; grazing impacts; water temperature)**	**Nonnative fishes (brook trout hybridization, especially in Waptus, North Fork Tieton, Upper Yakima; brown trout in Cle Elum)**
__Lower Mid-Columbia__					
Upper Mainstem John Day River	**2**	**Connectivity impairment (passage barriers)**	**Instream impacts (entrainment, low instream flows, water temperature)**	**Upland/ riparian land management (grazing and agricultural impacts)**	

RECOVERY UNIT **<u>Geographic Region</u>** Core Area – Complex *Core Area - Simple*	Number of Local Populations	THREATS			
Middle Fork John Day River	**3**	**Instream impacts (low instream flows)**	**Connectivity impairment (water temperature)**	**Upland/ riparian land management (legacy timber harvest and roads; water temperature, poor structural complexity)**	**Small population size (genetic & demographic stochasticity)**
North Fork John Day River	**7**	**Nonnative fishes (brook trout hybridization)**	**Connectivity impairment (passage barriers, water temperature; entrainment in Pete Mann Ditch)**	**Upland/ riparian land management (grazing and agricultural impacts; water temperature, sedimentation)**	**Small population size (genetic & demographic stochasticity)**
Umatilla River	**2**	**Connectivity impairment (passage barriers, water temperature)**	**Instream impacts (low instream flows, water temperature)**	**Angling impacts**	**Small population size (genetic & demographic stochasticity)**
Walla Walla River	**3**	**Connectivity impairment (passage barriers, water temperature)**	**Instream impacts (low instream flows, water temperature)**		

RECOVERY UNIT **Geographic Region** Core Area – Complex *Core Area - Simple*	Number of Local Populations	THREATS			
Touchet River	3	Connectivity impairment (passage barriers, water temperature)	Instream impacts (low instream flows)	Upland/ riparian land management (grazing and agricultural impacts; water temperature, sedimentation)	
Lower Snake					
Tucannon River	5	Upland/ riparian land management (recreation impacts)	Lack of anadromous forage fish (salmon & lamprey)	Instream impacts (loss of habitat complexity, sedimentation, water temperature)	
Asotin Creek	2	Lack of anadromous forage fish (salmon & lamprey)	Instream impacts (low instream flows)	Connectivity impairment (passage barriers, water temperature)	Upland/ riparian land management (residential development, agriculture, grazing; loss of habitat complexity, water temperature)

RECOVERY UNIT **Geographic Region** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Lookingglass / Wenaha	**4**	**Connectivity impairment (weir at Lookingglass Fish Hatchery)**			
Wallowa / Minam	**6**	**Nonnative fishes (brook trout, in all areas except Lake Creek; and lake trout in Wallowa Lake)**			
Upper Grande Ronde	**6**	**Instream impacts (sedimentation, entrainment, low flows, water temperature)**	**Connectivity impairment (passage barriers, water temperature)**	**Nonnative fishes (brook trout)**	
Imnaha River	**8**	**None**			
Little Minam River	**1**	**None**			
Sheep Creek	**1**	**Upland/ riparian land management (trail use)**			
Granite Creek	**1**	**Upland/ riparian land management (trail use)**			

RECOVERY UNIT **<u>Geographic Region</u>** Core Area – Complex *Core Area - Simple*	Number of Local Populations	THREATS			
<u>Mid-Snake</u>					
Powder River	**10**	**Nonnative fishes (brook trout hybridization)**	**Instream impacts (sedimentation, entrainment, low flows, water temperature)**	**Upland/ riparian land management (legacy timber harvest and roads; mining; grazing; and agricultural impacts)**	**Connectivity impairment (Mason and Thief Valley Dams within core area, and mainstem Snake River dams, passage barriers, water temperature)**
Hells Canyon Complex (Pine, Indian, & Wildhorse Creeks)	**3**	**Connectivity impairment (dams at Oxbow Reservoir within core area, and mainstem Snake River dams)**	**Nonnative fishes (brook trout)**	**Instream impacts (flow depletion, dewatering)**	
<u>Clearwater</u>					
North Fork Clearwater River	**12**	**Nonnative fishes (brook trout)**	**Upland/ riparian land management**	**Connectivity impairment**	
Lochsa River	**8**	**Upland/ riparian land management**	**Connectivity impairment**		

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Selway River	**10**	**Nonnative fishes (brook trout)**	**Upland/ riparian land management**	**Connectivity impairment**	
South Fork Clearwater River	**5**	**Instream impacts**	**Nonnative fishes (brook trout)**	**Upland/ riparian land management (mining impacts)**	
UPPER SNAKE RECOVERY UNIT					
<u>Salmon</u>					
Little-Lower Salmon River	**7**	**Upland/ riparian land management (legacy timber harvest and roads; pesticide use / chemical spill risk; grazing impacts; streambank instability)**	**Instream impacts (low instream flows)**		
South Fork Salmon River	**27**	**Connectivity impairment (passage barriers)**	**Upland/ riparian land management (legacy timber harvest and roads; wildfire potential; pesticide use / chemical spill risk)**	**Nonnative fishes (brook trout in tributaries and mainstem)**	

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Middle Salmon River – Chamberlain	**9**	**None**			
Middle Salmon River – Panther	**20**	**Upland/ riparian land management (grazing impacts; mining)**	**Nonnative fishes (brook trout in tributaries and mainstem)**		
Middle Fork Salmon River	**28**	**None**			
Lake Creek	**1**	**Upland/ riparian land management (streambank instability)**			
Opal Lake	**1**	**Upland/ riparian land management(grazing impacts)**			
Upper Salmon River	**18**	**Nonnative fishes (brook trout in tributaries and mainstem; lake trout)**	**Instream impacts (entrainment, low instream flows)**	**Upland/ riparian land management (legacy timber harvest and roads; grazing)**	**Connectivity impairment (passage barriers)**
Pahsimeroi River	**8**	**Connectivity impairment (passage barriers)**	**Instream impacts (entrainment, low instream flows)**		

RECOVERY UNIT Geographic Region Core Area – Complex *Core Area - Simple*	Number of Local Populations	THREATS			
Lemhi River	**6**	**Connectivity impairment (passage barriers)**	**Instream impacts (entrainment, low instream flows)**	**Nonnative fishes (brook trout in tributaries and mainstem)**	
Payette					
North Fork Payette River	**1**	**Instream impacts (entrainment, low instream flows)**	**Upland/ riparian land management (legacy timber harvest and roads; grazing; sedimentation)**		
Middle Fork Payette River	**3**	**Connectivity impairment (passage barriers)**	**Upland/ riparian land management (legacy timber harvest and roads; wildfire potential)**		
Upper South Fork Payette River	**11**	**Connectivity impairment (passage barriers)**	**Upland/ riparian land management (legacy timber harvest and roads; pesticide use / chemical spill risk)**	**Nonnative fishes (brook trout in tributaries and mainstem)**	

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Deadwood River	**6**	**Connectivity impairment (passage barriers)**	**Upland/ riparian land management (legacy timber harvest and roads; wildfire potential)**		
Squaw Creek	**4**	**Connectivity impairment (passage barriers)**	**Instream impacts (entrainment)**	**Upland/ riparian land management (legacy timber harvest and roads; grazing; sedimentation)**	**Nonnative fishes (brook trout in tributaries and mainstem)**
<u>Boise</u>					
Arrowrock Reservoir	**18**	**Connectivity impairment (passage barriers)**	**Instream impacts (entrainment)**	**Upland/ riparian land management (legacy timber harvest and roads; grazing impacts)**	
Anderson Ranch Reservoir	**11**	**Upland/ riparian land management (legacy timber harvest and roads; pesticide use / chemical spill risk)**	**Instream impacts (entrainment)**	**Connectivity impairment (passage barriers)**	

RECOVERY UNIT **<u>Geographic Region</u>** Core Area – Complex *Core Area - Simple*	Number of Local Populations	THREATS			
<u>Weiser</u>					
Weiser River	**5**	**Instream impacts (entrainment, low instream flows, poor habitat complexity)**			
<u>Little Lost</u>					
Little Lost River	**10**	**Connectivity impairment (passage barriers)**	**Nonnative fishes (brook trout in tributaries and mainstem)**	**Angling impacts**	**Upland/ riparian land management (grazing impacts)**
<u>Jarbidge</u>					
Jarbidge River	**6**	**Upland/ riparian land management (road maintenance)**			
<u>Malheur</u>					
North Fork Malheur	**5**	**Connectivity impairment (dewatering/low flows, entrainment, thermal barriers)**	**Upland/ riparian land management (legacy timber harvest and roads; grazing impacts)**		

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Upper Malheur	**3**	**Nonnative fishes (potential for invasion by brook trout)**	**Connectivity impairment (dewatering/low flows, entrainment, thermal barriers)**	**Upland/ riparian land management (legacy timber harvest and roads; grazing impacts)**	
COLUMBIA HEADWATERS RECOVERY UNIT					
<u>Clark Fork</u>					
Lake Pend Oreille	**33**	**Connectivity impairment (passage at Albeni Falls, Boundary, & Box Canyon Dams on Pend Oreille River; and Cabinet Gorge, Noxon Rapids, & Thompson Falls Dams on Clark Fork River)**	**Nonnative fishes (lake trout, brook trout, brown trout, northern pike, walleye, kamloops, smallmouth bass)**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Water quality (mining contaminants)**

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Priest Lakes	**5**	**Nonnative fishes (lake trout in Upper Priest Lake & Priest Lake, vulnerability to reinvasion through Thorofare; brook trout hybridization)**	**Upland/ riparian land management (legacy timber harvest and roads, agriculture)**	**Connectivity impairment (culverts)**	**Angling impacts**
Middle Clark Fork	**9**	**Nonnative fishes (lake trout, brook trout hybridization, brown trout, northern pike)**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Angling impacts**	**Small population size (genetic & demographic stochasticity)**
Upper Clark Fork	**3**	**Nonnative fishes (brook trout hybridization, brown trout)**	**Water quality (contaminants)**	**Connectivity impairment (connection among local populations; dewatering & thermal barriers)**	**Small population size (genetic & demographic stochasticity)**
Clearwater River & Lakes	**4**	**Nonnative fishes (brook trout, brown trout, northern pike; potential for invasion by lake trout)**	**Connectivity impairment (passage at Emily-A and Rainy Dams - resolved)**	**Upland/ riparian land management (legacy timber harvest and roads)**	

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Blackfoot River	**6**	**Water quality (contaminants)**	**Upland/ riparian land management (livestock grazing, legacy timber harvest and roads)**	**Nonnative fishes (brook trout hybridization, brown trout)**	**Instream impacts (dewatering, instream flow and habitat in lower tributaries/ mainstem FMO)**
Rock Creek	**9**	**Nonnative fishes (brook trout hybridization, brown trout)**	**Angling impacts**	**Upland/ riparian land management (livestock grazing)**	
Bitterroot River	**11**	**Connectivity impairment (dewatering, instream flow and habitat in lower tributaries/mainstem FMO)**	**Nonnative fishes (brook trout hybridization, brown trout, northern pike)**	**Upland/ riparian land management (residential development)**	

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
West Fork Bitterroot River	**6**	**Nonnative fishes (brook trout hybridization, brown trout; potential for invasion of Painted Rocks Reservoir by lake trout or northern pike)**	**Upland/ riparian land management (legacy timber harvest and roads, residential development)**		
<u>Coeur d'Alene</u>					
Coeur d'Alene Lake	**4**	**Nonnative fishes (brook trout, northern pike, chinook salmon)**	**Upland/ riparian land management (legacy timber harvest and roads; water temperature/ sedimentation)**		
<u>Kootenai</u>					
Kootenai River	**8**	**Nonnative fishes (brook trout hybridization in West Fisher, Pipe, & O'Brien Creeks; brown trout)**	**Instream impacts (flow depletion)**	**Upland/ riparian land management (legacy timber harvest and roads; water temperature)**	

RECOVERY UNIT __Geographic Region__ **Core Area – Complex** ***Core Area - Simple***	Number of Local Populations	THREATS			
Lake Koocanusa*	**2**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Angling impacts**	**Instream impacts (entrainment)**	**Nonnative fishes (brook trout)**
Bull Lake	**1**	**Connectivity impairment (connections among Lake Creek & 3 branches of Keeler Creek: dewatering, instream flow, beaver dams)**	**Angling impacts**	**Nonnative fishes (brook trout hybridization in Lake Creek & Keeler Creek, brown trout)**	
__Flathead__					
Flathead Lake*	**22**	**Nonnative fishes (lake trout in Flathead Lake and connecting systems, brook trout hybridization, northern pike in Flathead River; potential for brown trout/walleye/bass invasion)**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Angling impacts**	**Connectivity (connection with Hungry Horse Reservoir core area)**

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Whitefish Lake	**1**	**Nonnative fishes (brook trout hybridization; lake trout and northern pike in Whitefish Lake & connecting systems; potential for brown trout/walleye/bass invasion)**	**Upland/ riparian land management (legacy timber harvest and roads; residential development; sedimentation)**	**Angling impacts**	
Upper Whitefish Lake	**1**	**Connectivity impairment (dewatering)**	**Angling impacts**	**Upland/ riparian land management (legacy timber harvest and roads)**	
Upper Stillwater Lake	**1**	**Nonnative fishes (brook trout hybridization in Stillwater River system; lake trout and northern pike in Upper Stillwater Lake & connecting systems; potential for brown trout/walleye/bass invasion)**	**Angling impacts**	**Upland/ riparian land management (legacy timber harvest and roads)**	
Hungry Horse Reservoir	**10**	**Angling impacts**			

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Swan Lake	**9**	**Nonnative fishes (lake trout in Swan Lake, brook trout hybridization, northern pike; potential for brown trout/walleye/ bass invasion)**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Angling impacts (bycatch from lake trout gillnetting)**	
Lindbergh Lake	**1**	**Angling impacts**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Nonnative fishes (lake trout, brook trout)**	
Doctor Lake	**1**	**none**			
Holland Lake	**1**	**Angling impacts**	**Upland/ riparian land management (legacy timber harvest and roads; residential development)**	**Nonnative fishes (brook trout; lake trout; potential for northern pike invasion)**	
Big Salmon Lake	**1**	**Angling impacts**			
Isabel Lakes	**1**	**Angling impacts**	**Water quality (contaminants from atmospheric sources)**		

RECOVERY UNIT **<u>Geographic Region</u>** Core Area – Complex *Core Area - Simple*	Number of Local Populations	THREATS			
Harrison Lake	**1**	**Nonnative fishes (lake trout, brook trout)**	**Angling impacts**	**Water quality (contaminants from atmospheric sources)**	
Lincoln Lake	**1**	**Nonnative fishes (brook trout)**	**Angling impacts**	**Water quality (contaminants from atmospheric sources)**	
Trout/Arrow Lakes	**1**	**Angling impacts**	**Water quality (contaminants from atmospheric sources)**		
Logging Lake	**1**	**Nonnative fishes (lake trout)**	**Angling impacts**	**Water quality (contaminants from atmospheric sources)**	
Quartz Lakes	**1**	**Nonnative fishes (lake trout)**	**Angling impacts**	**Water quality (contaminants from atmospheric sources)**	
Lower Quartz Lake	**1**	**Nonnative fishes (lake trout)**	**Angling impacts**	**Water quality (contaminants from atmospheric sources)**	
Bowman Lake	**1**	**Nonnative fishes (lake trout)**	**Angling impacts**	**Water quality (contaminants from atmospheric sources)**	
Upper Kintla Lake	**1**	**none**			

RECOVERY UNIT __Geographic Region__ **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Akokala Lake	**1**	**Angling impacts**	**Water quality (contaminants from atmospheric sources)**	**Nonnative fishes (potential for lake trout invasion)**	
Frozen Lake	**1**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Angling impacts**		
Cyclone Lake	**1**	**Angling impacts**	**Upland/ riparian land management (legacy timber harvest and roads)**	**Nonnative fishes (potential for lake trout invasion)**	
SAINT MARY RECOVERY UNIT					
__**Saint Mary**__					
Saint Mary River*	**4**	**Connectivity impairment (migration barriers, dewatering)**	**Instream impacts (Saint Mary irrigation diversion and Sherburne Dam operations: entrainment in Saint Mary Canal)**	**Upland/ riparian land management (residential development near village of Saint Mary; impacts from livestock grazing on Blackfeet Reservation)**	
Slide Lake	**1**	**none**			

RECOVERY UNIT **<u>Geographic Region</u>** **Core Area – Complex** ***Core Area - Simple***	**Number of Local Populations**	**THREATS**			
Cracker Lake	**1**	**Angling impacts (occasional poaching)**			
Red Eagle Lake	**1**	**Angling impacts**			

*** Transboundary core area – coordinate with Canada**

APPENDIX C. Interagency, Intergovernmental and State Consultation, Cooperation, and Protective Regulations

Interagency Consultation (Section 7) Species and Critical Habitat

Recovery is both a process, consisting of discrete actions to conserve listed species, and a biological condition of listed species such that self-sustaining and self-regulating populations can be supported as persistent members of the ecosystems upon which they depend. The Endangered Species Act (Act) clearly envisions recovery plans as the central organizing tool for guiding each species' recovery. In part, a recovery plan establishes the context for Federal agencies in fulfilling their obligations under section 7(a)(1) of the Act, which calls on all Federal agencies to utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species. In addition, recovery plans guide Federal agencies in developing conservation measures and in fulfilling their obligations under section 7(a)(2) of the Act, which requires Federal agencies to conduct their actions in a manner that avoids jeopardizing the continued existence of listed species and avoids the destruction or adverse modification of critical habitat.

Section 3 of the Act defines critical habitat to mean: (i) the specific areas within the geographical area occupied by the species at the time it is listed on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. The term "conservation" is defined in section 3 as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary." Therefore, critical habitat is to include biologically suitable areas that may be necessary to recover the species.

Section 7(a)(2) of the Act requires Federal agencies to consult with the Service to evaluate the impacts that any activities they fund, authorize, or carry out may have on the bull trout or its designated critical habitat. Agencies are required to ensure that such activities are not likely to jeopardize the continued existence of a listed species or adversely modify or destroy critical habitat. To jeopardize the continued existence of the bull trout means to engage in an activity that reasonably would be expected to, directly or indirectly, reduce appreciably the likelihood of both the survival and recovery of the bull trout in the wild by reducing reproduction, numbers and distribution of the bull trout (50 CFR Part 402.03). Critical habitat may be adversely modified or destroyed when, with implementation of a proposed agency action, critical habitat is not reasonably expected to remain functional (or retain the current ability for critical habitat to become functionally established) to serve the intended conservation role for the species (USFWS 2010a). Because the issuance of permits under section 10(a)(1)(B) of the Act constitutes a Federal action or connection and is subject to section 7 consultation, habitat conservation plans developed for actions on private lands must also analyze the potential for adverse effects to the species and its critical habitat. Recovery plans effectively inform the development of these actions. Accordingly, where Federal activities may affect the bull trout and its critical habitat, we will consult with Federal agencies under section 7 to ensure that these actions do not jeopardize the continued existence of the bull trout or adversely modify or destroy its critical habitat. For proposed actions without Federal authorization, funding or approval, the Act requires States or other non-Federal landowners to avoid take of listed species under provisions of section 9 of the Act.

A recovery plan delineates site-specific management actions that we believe are required to recover and/or protect listed species, establishes objective, measurable criteria for downlisting or delisting the species, and estimates time and cost required to carry out these actions. A recovery plan is not a regulatory document and does not obligate cooperating or other parties to undertake specific tasks or expend funds. However, under section 7(a)(1) of the Act, Federal agencies are obligated to implement their programs in a manner that supports conservation of listed species and their critical habitat, and a recovery plan provides an implementation roadmap to accomplish this requirement.

Recovery plans address all areas determined to be important for recovery of listed species and identify needed management measures to achieve recovery. Critical habitat designation is not necessarily intended to encompass a species' entire current range. Because critical habitat designations may exclude areas based on factors such as economic cost, approved or pending management plans, or encouragement of cooperative conservation partnerships with landowners, the areas identified in recovery plans as important for recovery of the species may not be designated as critical habitat.

Areas that are important to the conservation of the species, but are outside the critical habitat designation, will continue to be subject to conservation actions we implement under section 7(a)(1) of the Act. Areas that support species populations are also subject to the regulatory protections afforded by the section 7(a)(2) jeopardy standard, as determined on the basis of the best available scientific information at the time of the agency action.

Recovery actions will likely contribute positively to critical habitat function; however, these actions are designed to promote recovery of the species, and do not directly address threats or criteria for critical habitat conservation. Although criteria focusing on population numbers may be appropriate, most recovery criteria in this plan address specific threats to be removed in order to create or maintain habitat conditions needed to recover the bull trout.

We have developed analytical tools to address the sources of stressors that expose both the bull trout and their designated critical habitat to negative effects associated with agency actions. Currently, we apply an analytical framework for bull trout jeopardy analyses that relies heavily on the importance of known core area populations to the survival and recovery of the bull trout. Core areas form the building blocks that provide conservation of the bull trout's evolutionary legacy as represented by major genetic groups. The analysis required by section 7(a)(2) of the Act is focused not only on these populations but also on the habitat conditions necessary to support reproduction, numbers and distribution of the bull trout. Generally, the jeopardy analysis focuses on the range-wide status of bull trout, the factors responsible for that condition (threats), and what is necessary for this species to survive and recover (criteria). An emphasis is placed on characterizing the condition of bull trout in the area affected by the proposed Federal action and the role of affected populations in the survival and recovery of bull trout. That context is then used to determine the significance of adverse and beneficial effects of the proposed Federal action and any cumulative effects for purposes of making the jeopardy determination.

This recovery plan recognizes core areas as the population units that are necessary to provide for bull trout biological needs in relation to genetic and phenotypic diversity, and spreading the risk of extinction caused by stochastic events. A panel of scientists invited to participate in the bull trout 5-year review process reaffirmed that core areas are appropriate units of analysis by which threats to the bull trout and recovery standards should be measured (Whitesel *et al*. 2004, USFWS 2008). If a proposed Federal action is found to be incompatible with the viability and conservation function of the affected core area, and we find that core area must be conserved in order to conserve the recovery unit overall and the listed entity in the coterminous United States, then a jeopardy finding may be warranted because of this relationship of that core area to the affected recovery unit and to the survival and recovery of the species as a whole.

Section 7(a)(1) of the Act requires all Federal agencies to "utilize their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation of endangered species and threatened species". Hence, Federal agencies have a greater obligation than do other parties, and are required to be pro-active in the conservation of listed species regardless of their requirements under section 7(a)(2) of the Act. The section 7(a)(2) jeopardy analysis considers any conservation measures that go beyond those required to avoid take as proposed by Federal agencies to promote recovery of the bull trout (for example, habitat restoration on federally managed lands).

Tribal Government Consultation

All of our actions involving American Indian Tribal Governments, including our consultation and collaboration, will take place on a government-to-government basis and be consistent with applicable executive and secretarial orders, memoranda, and policies, including Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments"

(November 6, 2000); Secretarial Order 3206, "American Indian Tribal Rights, Federal-Tribal Responsibilities, and the Endangered Species Act" (June 5, 1997); Presidential Memorandum (November 5, 2009); the U.S. Fish and Wildlife Service's Native American Policy (June 28, 1994), and the Endangered Species Act.

We recognize the special government-to-government relationship between the Federal government of the United States and American Indian Tribal governments derived from the Constitution of the United States, treaties, Supreme Court doctrine, and Federal statutes. We acknowledge American Indian Tribal governments as sovereign nations with inherent powers of self-governance.

We also recognize that American Indian Tribes have long worked to conserve and monitor bull trout and other native salmonids on their lands. The efforts of many Tribes have contributed to bull trout conservation and maintained the Tribal cultural values of the bull trout and its habitat. Many Tribal lands have been managed with a holistic perspective, including reserves, modified silvicultural practices, and riparian and aquatic habitat restoration efforts, and therefore can be islands of high quality habitat that support many species as well as healthy ecosystems.

We are committed to engaging in regular and meaningful consultation and collaboration with American Indian Tribal governments to determine what cooperative and voluntary measures Tribes may take to support bull trout recovery actions and address other recovery needs and opportunities for bull trout, recognizing the special status of Tribes and Tribal lands. Consistent with existing laws and policies, and to honor this spirit of consultation and collaboration, we will give deference whenever possible to Tribal recovery plans, habitat and modeling data, and other conservation efforts.

Cooperation with States (Section 6)

Section 6 of the Act facilitates collaboration in species conservation through cooperative agreements with State fish and wildlife agencies provided such states have adequate and active programs for the conservation of species. The Service maintains cooperative agreements with all five states that have bull trout. These states are authorized to implement their conservation programs to conserve bull trout, and any take of bull trout that may result is authorized through an associated section 7 consultation (USFWS 2000). States typically implement recovery-related actions that may take bull trout, such as scientific collecting, control of invasive species, and habitat restoration efforts. They may also facilitate actions by others that may take bull trout (for example, Federal or university fisheries scientists) through their authority to designate others as agents of the State.

States may implement angling regulations protecting fish from human recreation and harvest under this authority. The Service may offer species management authority to states upon achieving recovery targets for core areas identified in each recovery unit (e.g. 4(d) rules, research permits, etc.). Upon completion of a section 7 consultation, States may then choose to implement State-managed fishing seasons in these core areas. All other Federal actions in these core areas would still require consultation as well. For example, a timber sale on Federal land would require completion of a Biological Opinion to authorize any take that may occur.

Enhancement of Survival Permit (Section 10(a)(1)(A))

The Service issues permits authorizing take of bull trout associated with actions that may enhance the propagation or survival of the species, including scientific collecting or research by non-state entities or implementation of other recovery-related activities. For example, active habitat restoration projects such as stream bank stabilization, channel reconstruction, or sediment abatement projects by the Forest Service or through Federal Energy Regulatory Commission (FERC) mitigation programs often involve short-term impacts in order to achieve longer term objectives and are frequently permitted under section 10(a)(1)(A) of the Act. Take of bull trout in the course of scientific research may also be permitted through this method, including broad-scale or site-specific fisheries monitoring such as utilizing electrofishing or other collection methods to document the long-term benefits of habitat restoration or other effects of management. Section 7(a)(2) consultation is also completed for these Federal actions.

Protective Regulations (Section 4(d) rule)

Upon listing of the Klamath and Columbia basin DPSs of bull trout in 1998 (USFWS 1998), we wrote a special rule under section 4(d) of the Act that authorized take of bull trout consistent with State and Tribal fishing regulations existing at the time of listing. This rule was expanded to the entire range of bull trout in the coterminous U.S. in the 1999 listing rule (USFWS 1999a) (50 CFR 17.44 (w)), with the exception of the Jarbidge population for which take prohibitions were reinstated in 2001 (50 CFR 17.44 (x)). All five states prohibited direct harvest of bull trout through angling wherever they occurred, except for one location in Oregon, one in Montana, and several locations in Washington. As bull trout recover, we will consider returning authority back to states to expand state-regulated angling seasons for bull trout in those areas where recovery criteria have been met through a possible 4(d) Rule (see “Cooperation with States” above). In the 1999 listing rule (USFWS 1999a)), we identified our intention to continue to work with States and Tribes in assessing whether fishing regulations at the time of listing are adequate to protect bull trout and in developing management plans and agreements with the objective of recovery.

APPENDIX D. Recovery Unit Maps and Description

These maps delineate core areas, major water bodies, and additional foraging/migration/overwintering (FMO) habitat outside core areas within each of the six recovery units.

Map A. Coastal Recovery Unit

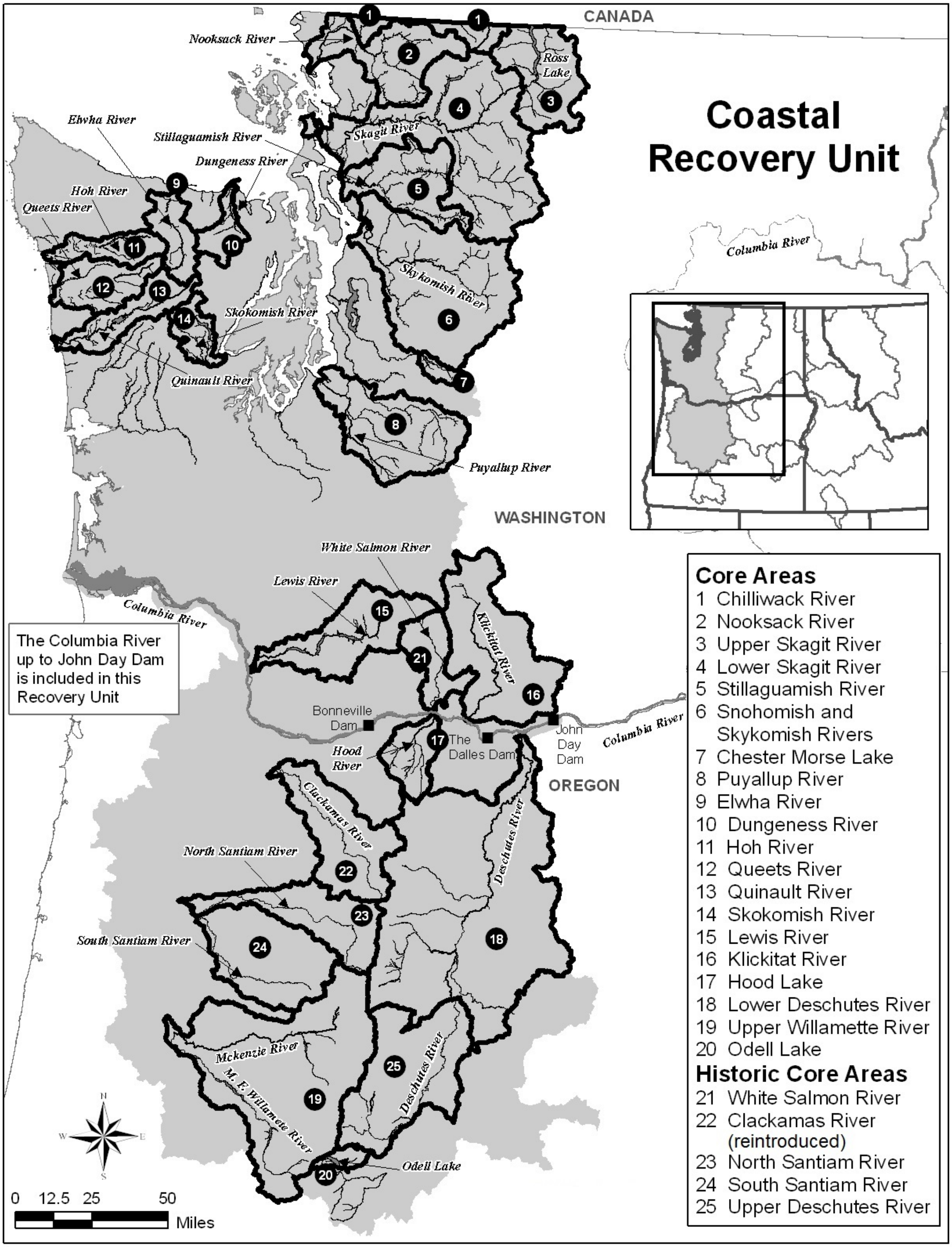
Map B. Klamath Recovery Unit

Map C. Mid-Columbia Recovery Unit

Map D. Upper Snake Recovery Unit

Map E. Columbia Headwaters Recovery Unit

Map F. Saint Mary Recovery Unit

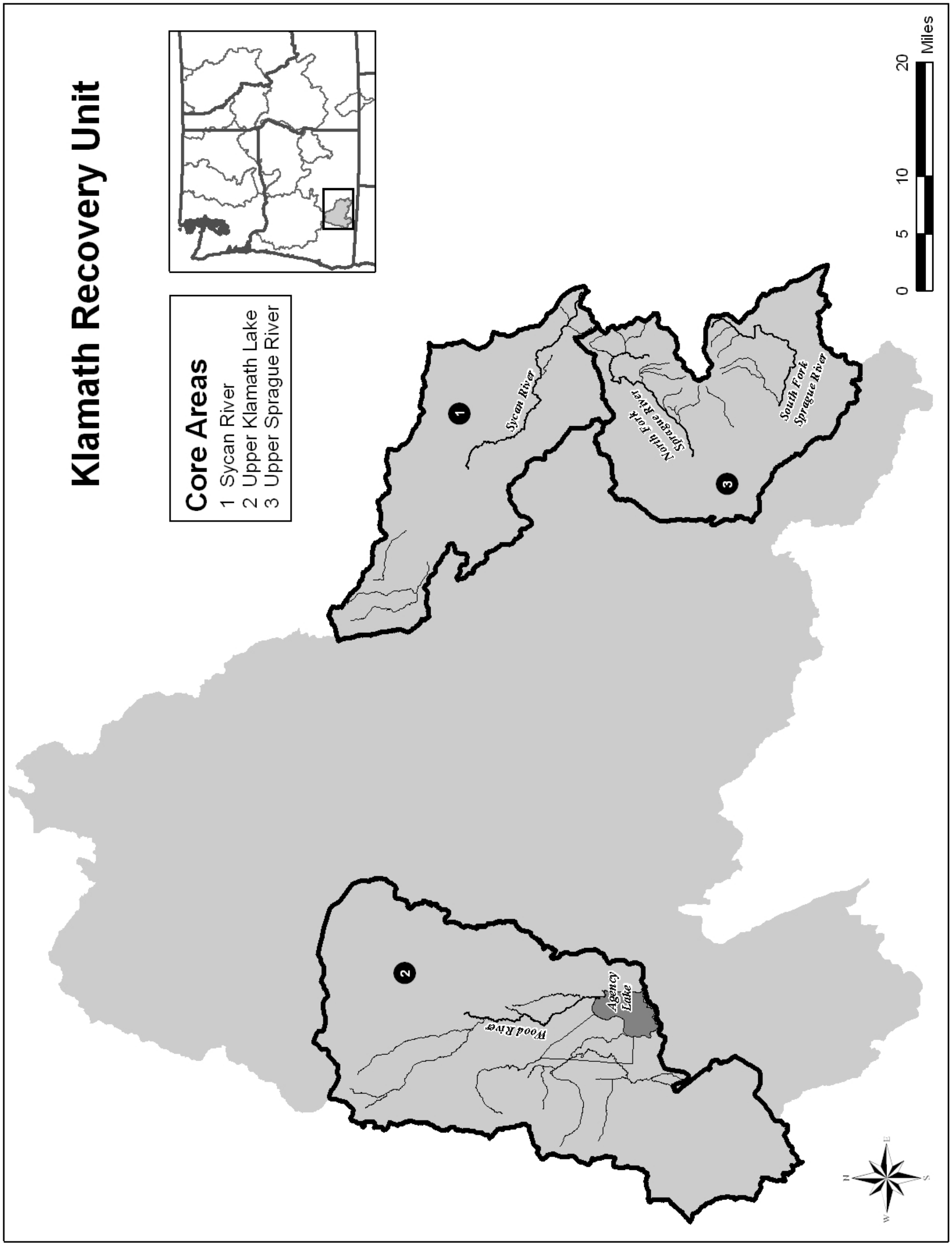

Coastal Recovery Unit
CANADA
WASHINGTON
OREGON
Nooksack River
Ross Lake
Skagit River
Elwha River
Stillaguamish River
Dungeness River
Hoh River
Queets River
Skykomish River
Skokomish River
Quinault River
Puyallup River
Columbia River
White Salmon River
Lewis River
Klickitat River
Bonneville Dam
The Dalles Dam
John Day Dam
Hood River
Clackamas River
North Santiam River
South Santiam River
Deschutes River
Mckenzie River
M. F. Willamette River
Odell Lake
The Columbia River up to John Day Dam is included in this Recovery Unit
0 12.5 25 50
Miles
Core Areas
1 Chilliwack River
2 Nooksack River
3 Upper Skagit River
4 Lower Skagit River
5 Stillaguamish River
6 Snohomish and Skykomish Rivers
7 Chester Morse Lake
8 Puyallup River
9 Elwha River
10 Dungeness River
11 Hoh River
12 Queets River
13 Quinault River
14 Skokomish River
15 Lewis River
16 Klickitat River
17 Hood Lake
18 Lower Deschutes River
19 Upper Willamette River
20 Odell Lake
Historic Core Areas
21 White Salmon River
22 Clackamas River (reintroduced)
23 North Santiam River
24 South Santiam River
25 Upper Deschutes River

Coastal Recovery Unit (Map A)

The Coastal Recovery Unit is located within western Oregon and Washington. Major drainages include the Olympic Peninsula, Puget Sound, Lower Columbia River basins, Upper Willamette River, Hood River, Lower Deschutes River, Odell Lake, and the Lower Mainstem Columbia River. In the Coastal Recovery Unit, we have designated 21 existing bull trout core areas, including the recently reintroduced Clackamas River population, and identified 4 core areas that could be re-established. Ten shared FMO habitats are also identified outside of core areas. Core areas within the recovery unit are distributed among three major geographic regions, Puget Sound (includes one core area that is actually part of the lower Fraser River system), Olympic Peninsula, and Lower Columbia River. The only core areas currently supporting anadromous populations of bull trout are located within the Puget Sound and Olympic Peninsula regions. Although bull trout in the Lower Columbia River region share a genetic past with the Puget Sound and Olympic Peninsula regions, it is unclear whether Lower Columbia River core areas supported the anadromous life history to any significant degree in the past, or could in the future. Historically, the Lower Columbia River region is believed to have largely supported the fluvial life history form; however, hydroelectric facilities built within a number of the core areas have isolated or fragmented watersheds and largely replaced the fluvial life history with the adfluvial form.

Two core areas within the Coastal Recovery Unit (Chilliwack River and Upper Skagit River) are functionally transboundary with British Columbia, Canada. The boundaries of these core areas should extend into British Columbia from a functional standpoint, and our developed recovery targets have taken this into consideration.

There are five core areas within the Coastal Recovery Unit that have been identified as current population strongholds. These are the Lower Skagit and Upper Skagit core areas in the Puget Sound region, the Quinault River core area in the Olympic Peninsula region, and the Lewis River and Lower Deschutes River core areas in the Lower Columbia River region. These are the most stable and abundant bull trout populations in the recovery unit.



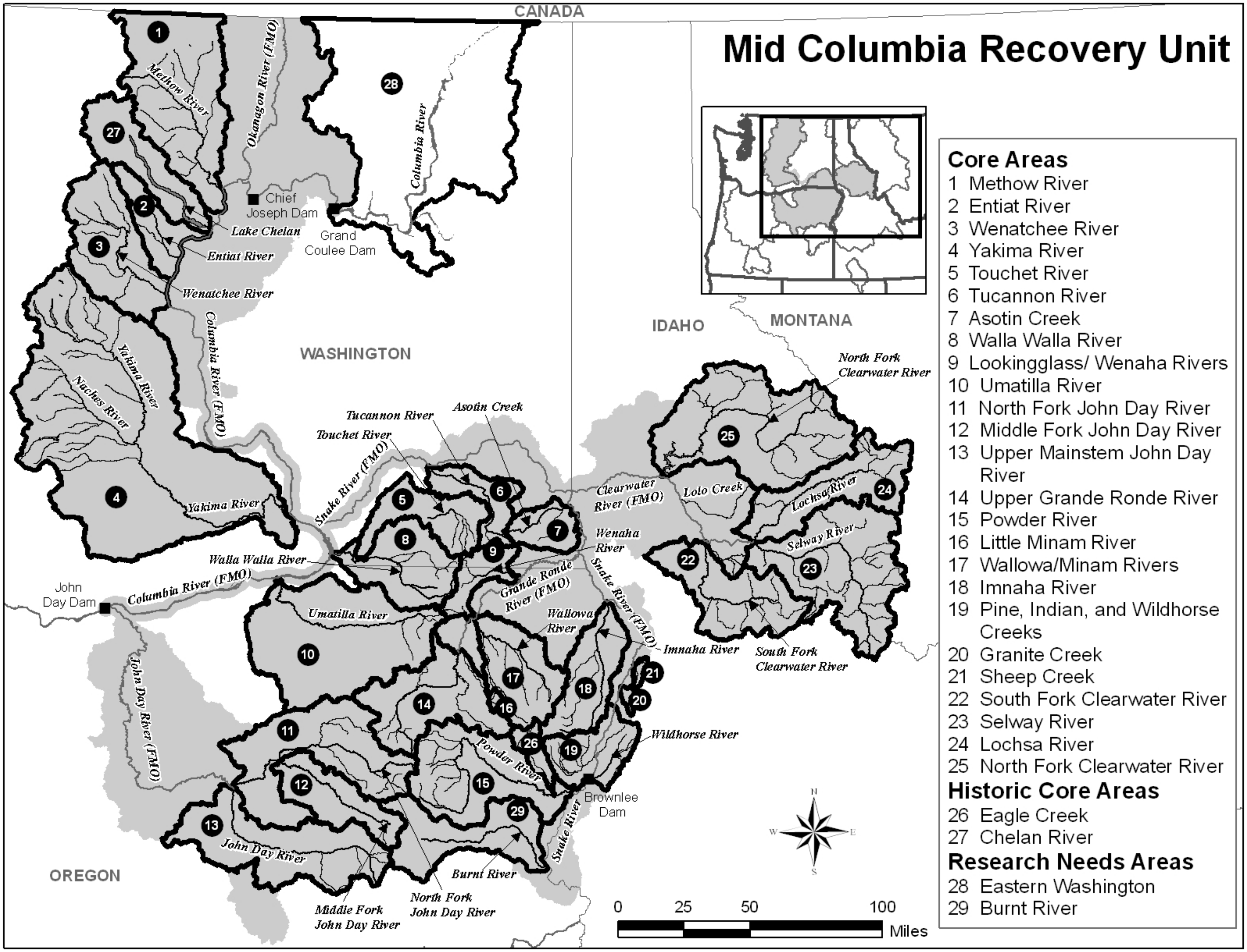
Klamath Recovery Unit
Core Areas
1 Sycan River
2 Upper Klamath Lake
3 Upper Sprague River
Sycan River
North Fork Sprague River
South Fork Sprague River
Wood River
Agency Lake
0
5
10
20
Miles

Klamath Recovery Unit (Map B)

In the Klamath Recovery Unit in southern Oregon, we have designated three bull trout core areas. The Upper Klamath Lake core area is comprised of the northern portion of the lake and its immediate major and minor tributaries. The lake is the collection point for most of drainage tributaries, with a surface area of 37,260 hectares (92,000 acres). It is classified as hypereutrophic (NRC 2004). This core area includes waters draining from Crater Lake National Park south of Scott Peak and from the area west of and including the Williamson River below Klamath Marsh. Also included is the west side of the Winema National Forest from Crater Lake National Park south into the Spencer Creek and Varney Creek drainages on the west side of Klamath Lake. This core area includes two existing local bull trout populations: Threemile Creek and Sun Creek. Sun Creek, in Crater Lake National Park, currently supports the largest local population in the Upper Klamath Lake core area. Major tributaries are the Williamson River and Wood River. Numerous small streams that are spring fed and surface water fed originate along the rim of the basin.

The Sycan River core area is comprised of Sycan Marsh and its tributaries and the Sycan River and its tributaries. The Sycan River originates from springs near 2,133 meters (7,000 feet) on the eastern edge of the Klamath River basin. The river flows through high-elevation meadows and forest lands for 74 kilometers (46 miles). It flows through Sycan Marsh for 15 kilometers (9.3 miles), and then flows through a variety of landscapes until it joins the Sprague River. This core area is composed of the waters that drain into the Sycan Marsh, including Long, Calahan, and Coyote creeks on the west side of the marsh. On the east side of the marsh are the upper Sycan River, Chocktoot Creek, Shake Creek, and their tributaries. The only local population in the Sycan River core area is Long Creek. Bull trout, including a fluvial life-history form, have been found distributed throughout the most of the length of Long Creek.

The Upper Sprague River core area is comprised of drainages of the North Fork and South Fork of the Sprague River. The origins of the North Fork and South Fork of the Sprague River are from small, mainly spring fed, streams, near 2,926 meters (6,900 feet) elevation on the north and southeast sides of Gearhart Mountain. The upper miles of each creek meander through high-elevation meadow and forest lands before being confined by narrow forested canyons (ODFW 1997). The lower stretches of the North Fork and South Fork of the Sprague River meander through the broad, low-gradient Sprague River valley. The Upper Sprague River core area is comprised of the drainages of the North Fork and South Fork of the Sprague River upstream of their confluence, including Deming, Boulder, Dixon, Brownsworth, and Leonard creeks. Deming Creek is believed to support the largest local population of bull trout in the Upper Sprague River core area. Presence/absence surveys in 1998 revealed several fluvial bull trout in the North Fork Sprague River below the confluence with Boulder Creek. Recent surveys have determined bull trout and all other fishes are absent from Sheepy Creek, where a cascade barrier at its terminus is believed to prevent colonization.


Mid Columbia Recovery Unit
CANADA
WASHINGTON
IDAHO
MONTANA
OREGON
Methow River
Okanagon River (FMO)
Columbia River
Chief Joseph Dam
Grand Coulee Dam
Lake Chelan
Entiat River
Wenatchee River
Columbia River (FMO)
Yakima River
Naches River
Snake River (FMO)
Tucannon River
Touchet River
Asotin Creek
Walla Walla River
Clearwater River (FMO)
Lolo Creek
Lochsa River
Selway River
North Fork Clearwater River
Wenaha River
Grande Ronde River (FMO)
Wallowa River
Imnaha River
South Fork Clearwater River
Umatilla River
John Day Dam
John Day River (FMO)
Wildhorse River
Powder River
Brownlee Dam
Snake River
Burnt River
John Day River
Middle Fork John Day River
North Fork John Day River
0 25 50 100 Miles
Core Areas
1 Methow River
2 Entiat River
3 Wenatchee River
4 Yakima River
5 Touchet River
6 Tucannon River
7 Asotin Creek
8 Walla Walla River
9 Lookingglass/ Wenaha Rivers
10 Umatilla River
11 North Fork John Day River
12 Middle Fork John Day River
13 Upper Mainstem John Day River
14 Upper Grande Ronde River
15 Powder River
16 Little Minam River
17 Wallowa/Minam Rivers
18 Imnaha River
19 Pine, Indian, and Wildhorse Creeks
20 Granite Creek
21 Sheep Creek
22 South Fork Clearwater River
23 Selway River
24 Lochsa River
25 North Fork Clearwater River
Historic Core Areas
26 Eagle Creek
27 Chelan River
Research Needs Areas
28 Eastern Washington
29 Burnt River

Mid-Columbia Recovery Unit (Map C)

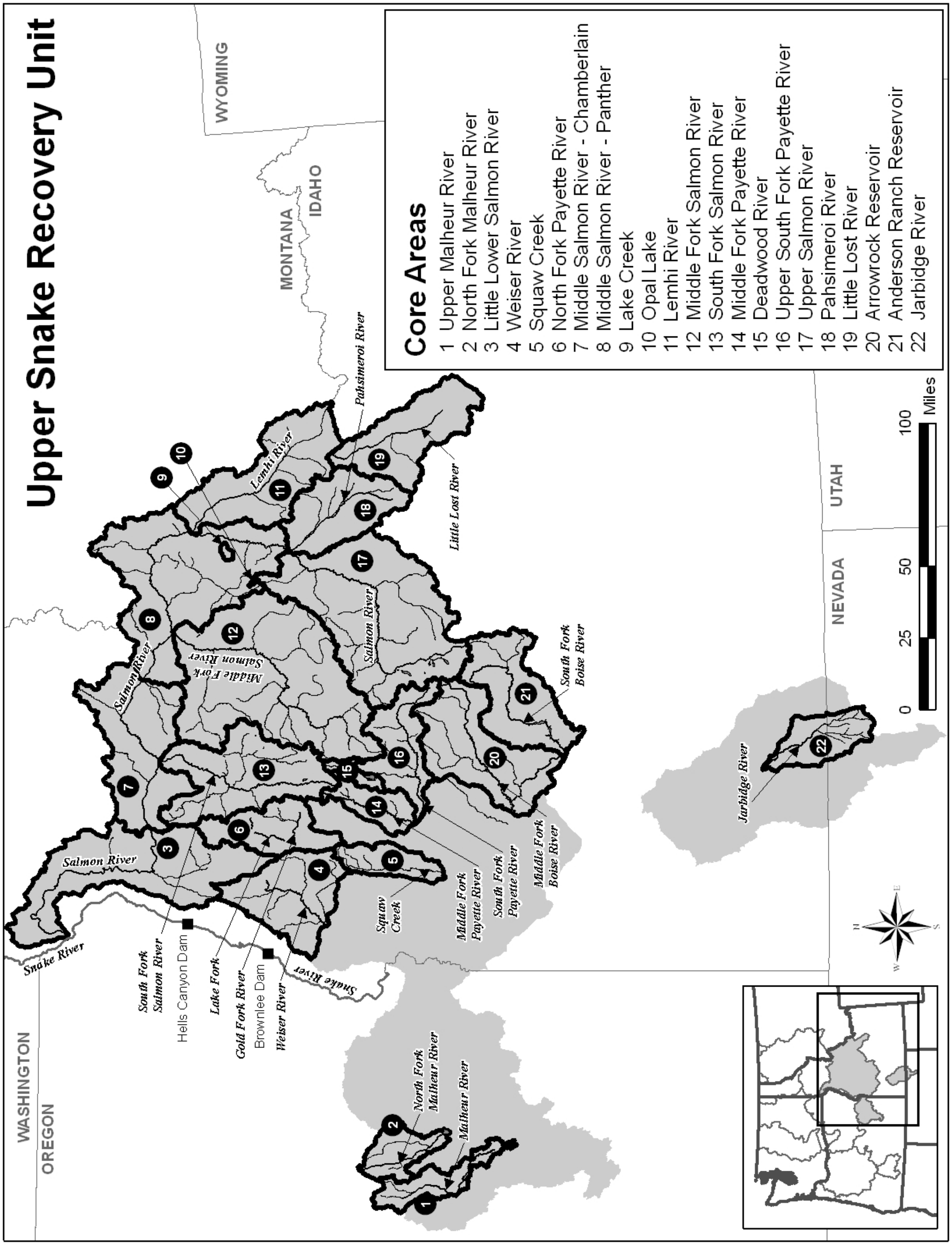
In the Mid-Columbia Recovery Unit, we have designated 29 bull trout core areas, along with 6 FMO habitats. This recovery unit is located within eastern Washington, eastern Oregon, and portions of Idaho. Major drainages include the Yakima River, John Day River, Umatilla River, Walla Walla River, Grande Ronde River, Imnaha River, Powder River, Clearwater River, and small drainages along the Snake River and Columbia River. These core areas include two unoccupied core habitat areas (areas that contain suitable habitat that could potentially support re-established bull trout populations; i.e., the Chelan and Eagle Creek basins), and two unoccupied research needs areas (Burnt River, and Eastern Washington, above Chief Joseph Dam).

The Mid-Columbia Recovery Unit can be divided into four geographic regions: 1) the Lower Mid-Columbia which includes all core areas that flow into the Columbia River below its confluence with the Snake River (i.e., the John Day, Umatilla, and Walla Walla basins); 2) the Upper Mid-Columbia which includes all core areas that flow into the Columbia River above its confluence with the Snake River (i.e., the Yakima and all other basins north to the Canadian border); 3) the Lower Snake which includes all core areas that flow into the Snake River between its confluence with the Columbia River and Hells Canyon Dam (i.e., the Clearwater, Tucannon, Asotin, Grande Ronde, and Imnaha basins along with Granite and Sheep Creeks); and 4) the Mid-Snake which includes all core areas in the Mid-Columbia Recovery Unit that flow into the Snake River above Hells Canyon Dam (i.e., the Powder basin; Pine, Indian and Wildhorse Creeks).

Some changes have been made to core areas since the 2002 Draft Bull Trout Recovery Plan. First, within the Lower Snake geographic region, the Grande Ronde River Core Area has been divided into three separate core areas, along with the Grande Ronde River FMO. These three new core areas include: 1) the Lookingglass Creek – Wenaha River Core Area; 2) the Upper Grande Ronde – Catherine Creek – Indian Creek River Core Area; and 3) the Wallowa River – Minam River Core Area. The decision to split the Grande Ronde into three separate core areas was based on distribution patterns determined from telemetry studies of fish tagged in the Wenaha and Lostine Rivers and Lookingglass Creek, differences in the environmental characteristics among the subdivisions, and the likelihood for genetic exchange and demographic linkage given the size of the Grande Ronde basin. The Little Minam River is still its own core area. Within the Clearwater River basin, the Fish Lake (North Fork Clearwater River) Core Area was absorbed into the North Fork Clearwater River Core Area, and the Fish Lake (Lochsa River) Core Area was absorbed into the Lochsa River Core Area. It was determined that while these two Fish Lake populations are adfluvial, they are not isolated from the other two core areas and represent a continuation of the headwater populations in both the Lochsa River and North Fork Clearwater River core areas. Additionally, the Lower-Middle Clearwater River is no longer a core area, but is now considered FMO habitat because it was determined that Lolo Creek is not a local population, which leaves no local populations in the Lower-Middle Clearwater River.

However, the mainstem Clearwater still provides access to the other core areas in the Clearwater basin, providing essential FMO habitat and connectivity.

In the Mid-Snake geographic region, the Eagle Creek basin was removed from the Powder River Core Area and given its own core area status because it is located some distance from the rest of the Powder River bull trout populations and contains somewhat different habitat. However, the Eagle Creek Core Area is currently unoccupied and is best described as core habitat. Within the Upper-Mid Columbia geographic region, the Chelan basin is now considered its own core area; however, like Eagle Creek, it is currently unoccupied and is best described as core habitat. FMO habitat is also now recognized in the Okanogan River, and the area east of the Okanogan River (upstream from Chief Joseph Dam) is recognized as a research needs area. It is also considered a core area in a basic sense, but is unoccupied and more information needs to be collected in this area to determine its potential for supporting bull trout in the future.

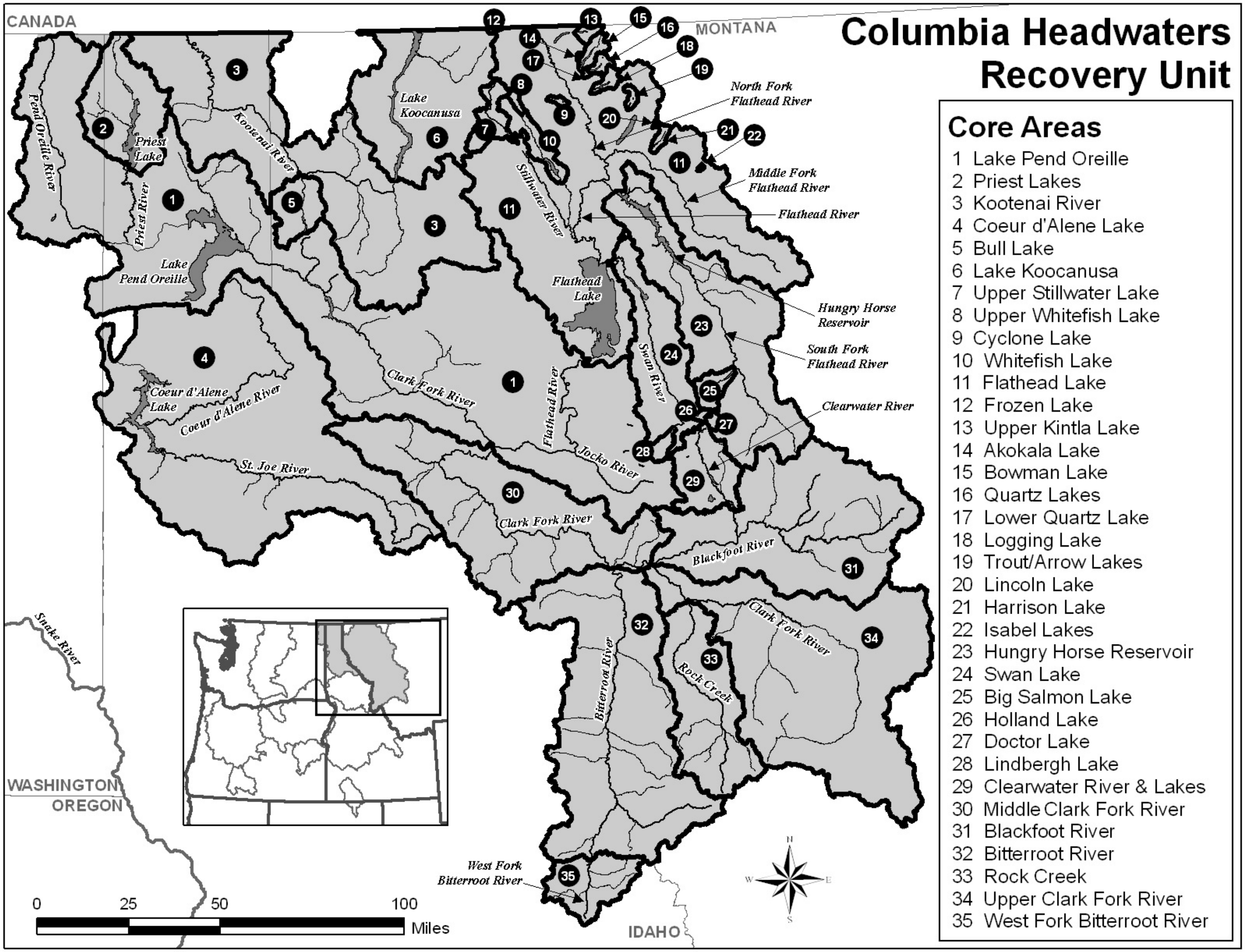


Upper Snake Recovery Unit
Core Areas
1 Upper Malheur River
2 North Fork Malheur River
3 Little Lower Salmon River
4 Weiser River
5 Squaw Creek
6 North Fork Payette River
7 Middle Salmon River - Chamberlain
8 Middle Salmon River - Panther
9 Lake Creek
10 Opal Lake
11 Lemhi River
12 Middle Fork Salmon River
13 South Fork Salmon River
14 Middle Fork Payette River
15 Deadwood River
16 Upper South Fork Payette River
17 Upper Salmon River
18 Pahsimeroi River
19 Little Lost River
20 Arrowrock Reservoir
21 Anderson Ranch Reservoir
22 Jarbidge River
WYOMING
MONTANA
IDAHO
WASHINGTON
OREGON
NEVADA
UTAH
Snake River
Salmon River
Lemhi River
Pahsimeroi River
Little Lost River
Middle Fork Salmon River
South Fork Boise River
Middle Fork Boise River
South Fork Payette River
Middle Fork Payette River
Squaw Creek
Jarbidge River
North Fork Malheur River
Malheur River
South Fork Salmon River
Hells Canyon Dam
Lake Fork
Gold Fork River
Brownlee Dam
Weiser River
0 25 50 100 Miles

Upper Snake Recovery Unit (Map D)

The Upper Snake Recovery Unit occurs within Idaho, Nevada, and Oregon. Major drainages include: the Salmon River, Malheur River, Jarbidge River, Little Lost River, Boise River, Payette River, and the Weiser River. In the Upper Snake Recovery Unit, we have designated 22 bull trout core areas. The only core areas currently supporting adfluvial populations of bull trout are located in the Upper Salmon River, Deadwood River, Anderson Ranch, Arrowrock, Opal Lake, and Lake Creek core areas. All remaining core areas contain resident populations and most have fluvial populations. Large intact habitat exists primarily in the Salmon drainage as this is the only drainage in the Upper Snake Recovery Unit that still flows directly into the Snake River; most other drainages no longer have direct connectivity due to irrigation uses or instream barriers. Bull trout in the Salmon basin share a genetic past with bull trout in the Upper Snake Recovery Unit. Historically, the Upper Snake Recovery Unit is believed to have largely supported the fluvial life history form; however, many core areas are now isolated or have become fragmented watersheds and replaced the fluvial life history with the resident or adfluvial form. The Weiser River, Squaw Creek, and North Fork Payette River core areas only contain resident populations of bull trout.

Some changes to core areas have occurred since the 2002 draft recovery plan. The Lucky Peak core area that was identified in 2002 has been determined to be a population sink with limited reproduction. Based on a review of information, it has been determined through genetic testing that these individuals are identical to individuals from Arrowrock and the current population in the Lucky Peak core area is sustained artificially through entrainment. Based on genetic information, the Malheur Core Area was divided into two separate core areas, the Upper Malheur Core Area and the North Fork Malheur Core Area.



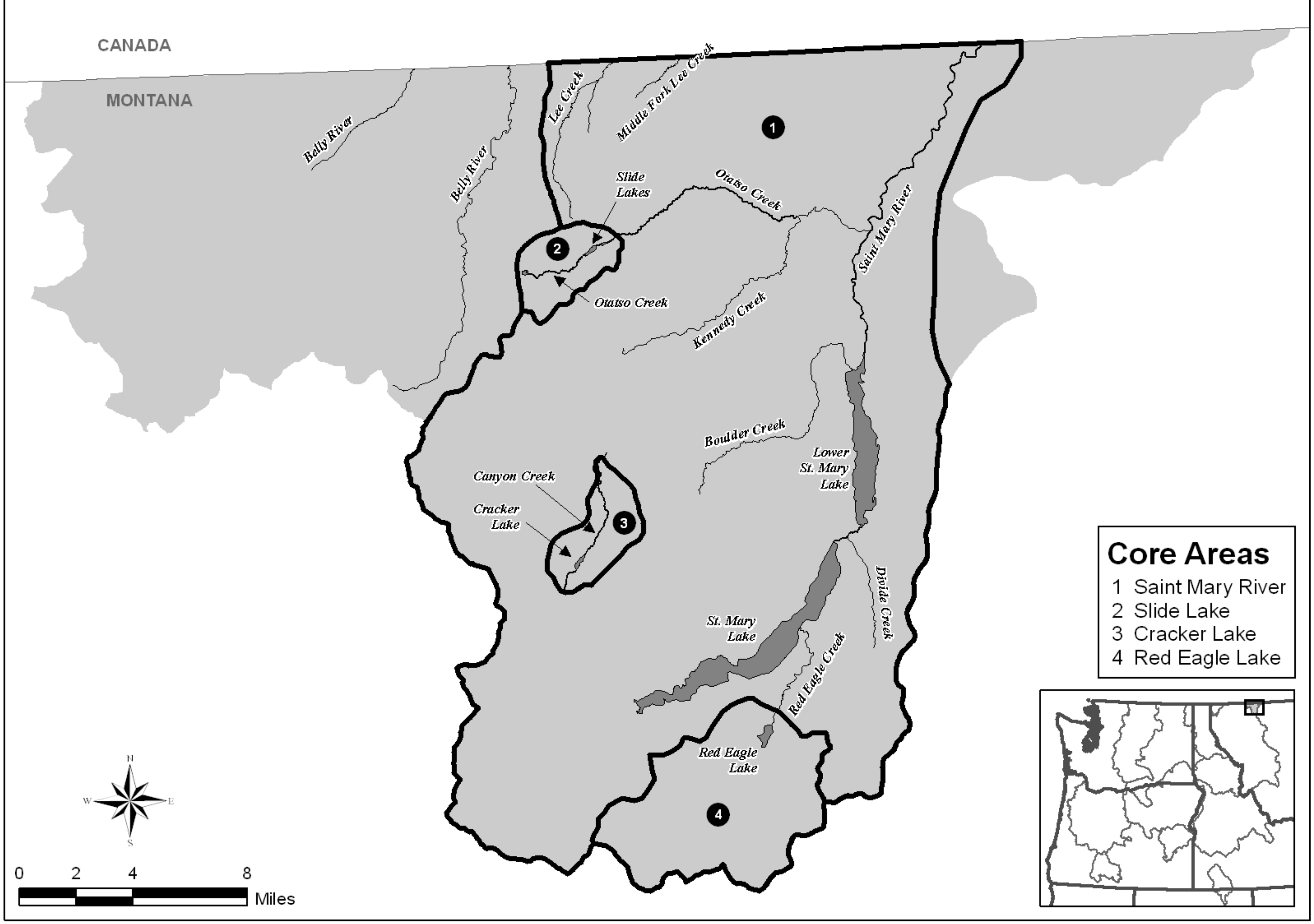
Columbia Headwaters
Recovery Unit
Core Areas
1 Lake Pend Oreille
2 Priest Lakes
3 Kootenai River
4 Coeur d'Alene Lake
5 Bull Lake
6 Lake Koocanusa
7 Upper Stillwater Lake
8 Upper Whitefish Lake
9 Cyclone Lake
10 Whitefish Lake
11 Flathead Lake
12 Frozen Lake
13 Upper Kintla Lake
14 Akokala Lake
15 Bowman Lake
16 Quartz Lakes
17 Lower Quartz Lake
18 Logging Lake
19 Trout/Arrow Lakes
20 Lincoln Lake
21 Harrison Lake
22 Isabel Lakes
23 Hungry Horse Reservoir
24 Swan Lake
25 Big Salmon Lake
26 Holland Lake
27 Doctor Lake
28 Lindbergh Lake
29 Clearwater River & Lakes
30 Middle Clark Fork River
31 Blackfoot River
32 Bitterroot River
33 Rock Creek
34 Upper Clark Fork River
35 West Fork Bitterroot River
CANADA
MONTANA
WASHINGTON
OREGON
IDAHO
Pend Oreille River
Priest Lake
Priest River
Lake Pend Oreille
Kootenai River
Lake Koocanusa
Stillwater River
Flathead Lake
North Fork Flathead River
Middle Fork Flathead River
Flathead River
Hungry Horse Reservoir
South Fork Flathead River
Clearwater River
Swan River
Coeur d'Alene Lake
Coeur d'Alene River
St. Joe River
Clark Fork River
Flathead River
Jocko River
Blackfoot River
Bitterroot River
Rock Creek
West Fork Bitterroot River
Snake River
0
25
50
100
Miles

Columbia Headwaters Recovery Unit (Map E)

The Columbia Headwater Recovery Unit occurs within western Montana, northern Idaho, and the northeastern corner of Washington. Major drainages include the Coeur d'Alene Lake Basin, Kootenai River Basin, and the Clark Fork River Basin. In this plan for the Columbia Headwaters Recovery Unit, we have slightly reorganized the 2002 structure, based on latest available science and fish passage improvements that have rejoined previously fragmented habitats. We have now identified 35 bull trout core areas (compared to 47 in 2002) for this recovery unit. Fifteen of the 35 are referred to as "complex" core areas as they represent larger interconnected habitats, each containing multiple spawning streams considered to host separate and largely genetically identifiable local populations. As such, the 15 complex core areas contain the majority of individual bull trout and the bulk of the designated critical habitat (USFWS 2010a, 2010b).

However, somewhat unique to this recovery unit is the presence of 20 smaller core areas that are each represented by a single local population. For the most part, these "simple" core areas are found in remote glaciated headwater basins, typically in Glacier National Park or federally designated Wilderness Areas. Many are upstream of waterfalls or other natural barriers to fish migration and have persisted for thousands of years despite their small populations and isolated existence. As such, they meet the criteria for core area designation and continue to be valued for their uniqueness, despite limitations of size and scope. Throughout this recovery plan, we often separate our analyses to distinguish between complex and simple core areas in respect to recovery criteria and targets as well as threats.

Saint Mary Recovery Unit



Saint Mary Recovery Unit (Map F)

This recovery unit contains the Saint Mary, Belly, and Waterton River basins from their headwaters to the international boundary with Canada at the 49th parallel. For all of these river basins, the majority of the watershed area is in Canada; the U.S. portion includes headwater spawning habitat and the upper reaches of foraging, migrating, and overwintering habitat in the mainstem of Saint Mary River, Belly River, and in Waterton Lake.

In the Belly River, spawning is known to occur just south of the international boundary, however, no other spawning areas are known within the U.S. In the Waterton Basin, natural fish barriers occur just above Waterton Lake, limiting bull trout distribution. Therefore, though part of the geographically defined recovery unit, neither Belly nor Waterton drainages are considered core areas for the purposes of the recovery plan. The U.S. portions of both drainages are wholly within remote areas of Glacier National Park and thus, subject to few human-caused threats. Furthermore, management options exist only on the Canadian side of the boundary.

Across the International Boundary in Alberta, Canada, the Saint Mary River bull trout population is considered at “high risk,” while the Belly River is rated as “at risk” (Alberta Sustainable Resource Development and Alberta Conservation Association 2009).

APPENDIX E. Proposed Assessment Tool for Describing Effective Management of Threats in Bull Trout Core Areas and Six Recovery Units.

BACKGROUND

Our recovery planning policy (NMFS and USFWS 2010) calls for the design of recovery criteria to address the five statutory listing factors in section 4(a)(1) of the Endangered Species Act, in order to measure whether threats to the species have been ameliorated. Thus, recovery criteria should be applicable to a five-factor threats analysis in a subsequent delisting rule. Because bull trout are geographically widespread and vary substantially within each recovery unit in the nature of the threats that populations face, it is necessary to use an appropriate geographic scale to assess whether management is effectively ameliorating threats. Because threats to bull trout are generally expressed at a metapopulation level and management actions can be effectively planned at that scale, we will explicitly assess threats at the core area scale, in terms of the statutory listing factors, and aggregate these core area assessments to the recovery unit level to determine whether recovery criteria are being met.

Overview of Assessment Process

To objectively evaluate the status of threats across the range of bull trout, the Service has created a structured approach that incorporates the best available data. The results from this assessment tool are integral to evaluate the status of bull trout at the range-wide and recovery unit scales based on the analysis of threats at the core area level. Core area assessments can inform the process of recovery plan development by highlighting and prioritizing management actions that maximize conservation benefits for bull trout. This approach also provides a basis for managers to forecast the influence of individual management actions on status at the aggregated recovery unit level. These core area assessments will also serve as the primary metric to assess the species status in future 5-year reviews and five-factor threats analyses, including any future delisting evaluations.

The Threats Assessment Tool proposed for bull trout as part of the revised draft recovery plan includes the following components (along with the participating or responsible participants), and is fully described below.

- Assessment Workshop Process (Service, State, Federal, Tribal, and others)
- Proposed Threats Assessment Decision Matrix (Service, State, Federal, Tribal, and others)
- Assessment of Threats Effectively Managed (Service)
- Evaluation of Recovery Unit Status (Service)

Assessment Workshop Process

For each recovery unit we plan to convene a workshop or series of workshops to assess the status (threat severity, threat management effectiveness, bull trout demography) of each core area within the recovery unit. We intend to seek broad representation of fisheries biologists knowledgeable about bull trout issues within the recovery unit, including but not limited to biologists from U.S. Geological Survey, U.S. Fish and Wildlife Service Fisheries and Ecological Services field offices, Federal land managers (U.S. Forest Service, National Park Service, Bureau of Land Management), State land management agencies, State fish and game agencies, Tribal fisheries programs, and universities. Our objective is to provide a decision framework that characterizes bull trout status as objectively as possible, with acknowledgment that there are inherent differences among experts in data interpretation and professional opinion. In the workshops we will seek to determine the range of professional opinion on the status of each core area (without seeking group consensus), soliciting an open discussion of current survey and management information and eliciting the rationale and assumptions involved in the status determination and any differences of opinion.

Our goal is to establish a structured, consistent, and objective approach to determining whether the identified primary threats to bull trout are being effectively managed at the core area level. The framework for making these determinations will include a simple, but consistently applied, decision matrix to assess threat severity and management effectiveness for each identified primary threat in the core area.

Assessment of this decision matrix will be informed by existing empirical data on magnitude and trends in bull trout population counts or indices; current or historical spatial distribution, connectivity, and extent of populations; expression of life history strategies; occurrence, magnitude, scope, trends, and severity of threats; and significant conservation measures that are ongoing or have been completed to address primary threats. These data will be interpreted with the best professional judgment of biologists familiar with bull trout populations in the core area. Data sources may include but are not limited to:

- Fisheries survey data (e.g. redd counts, telemetry, creel counts) collected by State, Federal, Tribal, university programs, or other researchers, providing information on population size or indices, historic trends, distribution, and movements for bull trout, forage fish, or non-native predators/competitors in the core area.
- Information from section 7 consultations within the core area, including characterization of habitat impacts, population trends, and baseline within local populations (e.g., analyses under the consultation matrix template [USFWS 1999]). This information may be compiled using data on bull trout effects from the Service's web-based Tracking and Integrated Logging System (TAILS) for section 7 consultations or other information in Service files.

- Compilation of ongoing and completed conservation actions since the time of listing which address the identified primary threats within the core area.
- Threat monitoring, including land management agency assessment of stream habitat conditions, trends, and high priority actions (e.g. USFS 2013), and water quality assessments (impaired waters identified under Clean Water Act 303(d), and total maximum daily load determinations).
- Calculation of an integrated conservation metric for each core area, based on methodology of the NatureServe Conservation Status Assessment Tool created by the International Union for Conservation of Nature (Faber-Langendoen *et al.* 2012). This metric combines available information on bull trout habitat extent, population size, trends, and threats to provide a generalized ordinal representation of current core area conservation status.
- Results of currently ongoing analyses for a new stream temperature data collection, modeling and mapping project, NorWeST (USFS 2014), and the Bull Trout Vulnerability Assessment, which will model probability of bull trout presence and map suitable habitat patches using data on stream temperature, fish presence, local threats, connectivity, and climate sensitivity (J. Dunham *in litt*. 2013). These models are anticipated to be completed over the much of the range of bull trout during 2014. In several core areas we expect local applications of these models to provide detailed analyses that should also help to prioritize management actions in the RUIPs. Potential climate change impacts, while not specifically assessed as an independent threat, will be considered in the context of climatic influence on other threats when determining what recovery actions are needed in core areas.

The time frame over which impacts are projected in this threats assessment process is based on the foreseeable future for evaluation of threatened status. During preparation of the 2008 5 year review (USFWS 2008a), the Service convened a Manager Panel as part of an analysis to determine the risk of extinction. The Manager Panel reviewed information regarding the status of the species, specific risk factors, and the biology of the species with a particular emphasis on the Core Area Assessments (USFWS 2005c). After some deliberation the Manager Panel agreed by consensus that the foreseeable future for bull trout should be defined as being 4 to 10 generations (approximately 28 to 70 years). In this exercise, for consistency, the time frame used for assessing core area status and population persistence is set in the middle of that range, at 50 years.

Proposed Threats Assessment Decision Matrix

For each core area, participating experts should be asked to evaluate all identified primary threats with respect to two independent metrics: threat severity and management effectiveness. The categories used for these metrics are defined below, with several examples to describe circumstances in which these categories could be appropriately applied to particular types of threats (nonnative fish impacts, impaired connectivity, etc.). These metrics are combined into a decision matrix (below) that will be used to assess whether current management or conservation actions effectively address the threat.

For this analysis, threats are classified into several major categories (see Appendix B): Upland/riparian land management (Factor A; including impacts of forestry, grazing, road maintenance, etc. on sedimentation, temperature, and stream habitat); instream impacts (Factor A; instream flow, entrainment); water quality (Factor A; contaminants, mining impacts); nonnative fishes (Factors C and E; including competition, predation, and hybridization effects); connectivity impairment (Factor E: dams, culverts, etc.), forage fish availability (Factor E), and angling impacts (Factors B and D; poaching and by-catch). Projected impacts related to climate change should be incorporated in the analysis in terms of their effects on these threat categories (e.g., through water temperature, instream flow, brown trout colonization) over the foreseeable future. This aggregation of threats is designed for the purpose of general core area status assessment; data arising from section 7 consultations on bull trout are fully applicable to this analysis but the section 7 structure of pathways and indicators used in TAILS (USFWS 1999) uses a slightly different aggregation of threats as appropriate for project-level assessments (see Table E-1 below). We do not anticipate a need to alter the threats classifications currently used in section 7 consultations.

Small population size can also constitute a threat under Factor E (demographic stochasticity, loss of genetic diversity), but threats related to population size are addressed separately as discussed below.

Both axes of the matrix should be evaluated for each combination of core area and threat. As an ancillary exercise, it may be useful to consider each particular threat (e.g., nonnative fishes) at a broader recovery unit level, ranking all core areas in the recovery unit by the relative severity of that threat from most to least affected. This relative ranking could provide a cross-check against core area specific analyses, to improve the consistency of threat evaluations throughout the recovery unit.

Each threat will be individually assessed at the core area level and the Service will make an overall determination for each core area of whether threats are being effectively managed. These core area determinations will then be rolled up to the recovery unit level to assess recovery criteria.

Table E-1. Interrelation between the bull trout pathways and indicators matrix (used in the consulted-on effects database in TAILS) and threat classifications in this proposed assessment tool (Appendix E). Note that consultations primarily address specific project impacts, while an overall assessment of core area threats generally has a broader geographic scope, can aggregate detailed local analyses to a broader level assessment, and involves assessment of core area status over the foreseeable future.

Pathways	**Indicators**	**Assessment Tool Threat Types**
Channel Condition and Dynamics	- Channel bed stability - Floodplain connectivity - Streambank condition - Width/depth ratio	Upland/riparian Land Management [in relation to impacts on stream channel structure]
Disturbance	- Noise disturbance - Other disturbance	This pathway may relate more to localized project impacts than to overall core area condition; but is generally covered under upland/riparian land management.
Flow&Hydrology	- Altered flow patterns - Change in peak/base/summer low flows - Drainage network increase - Springs/seeps/groundwater connections	Instream Impacts [e.g. instream flow, entrainment]
Forage Base	- Prey availability - Species composition	Forage Fish Availability
Habitat Access	- Chemical barriers - Physical barriers	Connectivity Impairment (e.g. dams, culverts)
Habitat Elements	- Cover (other) - Large pools - Large woody debris - Off-channel habitat - Percent fines in gravel - Pool frequency and quality - Refugia - Substrate embeddedness	Upland/riparian Land Management [in relation to impacts on structural features of stream habitat]

Pathways	Indicators	Assessment Tool Threat Types
Population Unit Characteristics	- Direct take (loss) of individuals - Growth and survival - Life history diversity and isolation - Persistence and genetic integrity - Population size	Small Population Size [in relation to genetics and population size] "Growth and survival" indicator could relate to multiple threat types that may affect this.
Water Quality	- Chemical contamination - Nutrients - Other water chemistry - Sediment - Temperature	Upland/riparian Land Management [primarily direct land management impacts on water temperature & sedimentation] Water Quality [primarily in relation to chemical contaminants/nutrients/acidity]
Watershed Conditions	- Riparian condition - Road density and location - Watershed disturbance regime - Watershed disturbance history	Upland/riparian Land Management
[none; significant core area level threat, but not a typical consultation subject]		Nonnative Fishes
[none; significant core area level threat, but not a typical consultation subject]		Angling Impacts

Threat Severity: The degree to which a specific threat would affect bull trout survival and persistence in a core area in the absence of management actions to eliminate or mitigate the threat. This assessment considers both the impacts on persistence of bull trout local populations and the spatial distribution and extent of threats within a core area.

To evaluate the severity of a threat within a core area, consider a hypothetical scenario where the threat remains unmanaged and other threats do not adversely affect bull trout in the core area. Ranking of threat severity should reflect a gradient in the proportion of existing local populations that would be expected to persist over 50 years in this scenario, ranging between the two extremes of extirpation of all local populations and persistence of all local populations at viable levels. Note that if the most probable expected outcome is a major reduction in abundance of a local population over 50 years, the inherent uncertainty of such a long-term projection will likely include some risk of the population being extirpated. Both core areas where some local populations are considered secure and others are expected to be extirpated, and core areas where all local populations have a moderate likelihood of persistence, might fall on similar intermediate positions on this gradient.

Information on bull trout population trends may be used to inform threat severity assessments, but is most clearly applicable in cases where only one significant threat exists in a core area and no significant management is being done. Where multiple threats exist, the actual population trends may be a function of several of them; thus threats could be individually ranked at different severities based on the same population numbers if they are expected to have different degrees of impact on population persistence. Moreover, if a significant threat is being counteracted by ongoing management so that the population remains stable or increasing when it would otherwise be expected to decline, these population benefits should be reflected on the "Management Effectiveness" axis of the matrix rather than "Threat Severity" to avoid double-counting. Using actual population data as a direct surrogate for threat severity could thus result in underestimating the threat severity in absence of management. Other information such as models and status assessments should also be considered when assessing threat severity.

Resiliency of bull trout populations at the recovery unit level is supported by a well distributed expression of migratory life history strategies, which improve population connectivity, reproductive success, and re-colonization. Because of variations among core areas in habitat configuration and threat of invasion by nonnative fishes, each core area should be individually assessed for the relative importance of maintaining or reestablishing various migratory life history strategies. In core areas where expression of migratory life history is important for conservation (as determined in RUIPs), assessment of threat severity should incorporate impacts on life history diversity.

Minor: If unmanaged, threat is not expected to appreciably reduce persistence of bull trout local populations within the core area for the foreseeable future (50 years). If threat occurs broadly throughout the core area, its population-level impacts on local populations are expected to be minor or transient. If any local populations are expected to be substantially reduced by the threat, they are geographically localized (less than approximately 25 percent of local populations in the core area) and are not expected to be extirpated in the foreseeable future. The threat is not expected to substantially spread without management.

Examples:

- Brook trout occur in a core area but are not actively expanding and do not overlap with any bull trout local populations; or brook trout overlap but significant adverse competitive interactions and hybridization are not believed to exist.
- Introduced nonnative fishes occur in mainstem habitat downstream from a bull trout local population, but interactions or impacts are not confirmed (e.g., walleye in the Saint Mary Recovery Unit).
- Lake trout and northern pike in core areas where they historically co-occurred with bull trout fluvial populations (Saint Mary Recovery Unit only) and are not known to adversely affect bull trout.
- In core areas where expression of migratory life history has been identified as important for conservation, a "minor" severity level for a connectivity-related threat would not be expected to result in loss of migratory life history expression. Most or all bull trout spawning/rearing habitat in the core area is connected with the historically occupied FMO habitat within the core area. Dams or reaches with water quality impairment, if present, provide effective two-way passage during most or all periods when bull trout are moving between FMO and spawning/rearing habitat. Dispersal between local populations in the core area is generally active and retains potential for re-colonization and metapopulation function. All migratory life history strategies that were historically present within the system are present.
- Habitat impairment from anthropogenic effects has little or no impact on habitat suitability and distribution for bull trout.

Moderate: If unmanaged, threat is expected to slightly to moderately reduce persistence of bull trout local populations within the core area for the foreseeable future (50 years). Impacts on bull trout in the core area have been documented and are well supported. Impacts from the threat are moderate but geographically widespread within the core area (more than approximately 25 percent of the local populations in the core area are expected to be substantially reduced but are generally not expected to be extirpated); or else the threat is more geographically restricted, but the affected local populations are expected to be severely reduced and are at some risk of extirpation in the foreseeable future. There may be risk of the threat spreading to currently unaffected local populations in the foreseeable future. Few local populations are expected to be extirpated in the foreseeable future by this threat alone, although it may substantially contribute to extirpation risk for local populations in combination with other threats.

Examples:

- Brook trout that co-occur with bull trout local populations, where some adverse competitive interactions are likely or confirmed but hybridization is absent or minimal, and local bull trout populations are expected to persist in the foreseeable future.
- Nonnative warm-water fishes (bass, walleye, etc.) that occur in lakes or mainstem rivers that are used as FMO habitat, and have some adverse effects through competition or predation that may reduce survival/dispersal success, but do not substantially exclude bull trout from using the habitat.
- Lake trout that compete with or prey upon bull trout in large lakes where some negative impacts on bull trout adfluvial populations have been observed but are not expected to significantly compromise their viability/persistence over the foreseeable future.
- In core areas where expression of migratory life history has been identified as important for conservation, a "moderate" severity level for a connectivity related threat may result in partial loss of migratory life history expression within the core area. Spawning/rearing habitat in the core area retains connection with historically occupied FMO habitat, but some local populations may be isolated, or there may be partial or seasonal barriers to dispersal that substantially reduce connectivity or survivorship during dispersal. Dispersal between local populations in the core area may be episodic or seasonally restricted to a few watersheds. Migratory life history strategies that were historically present within the system likely continue to exist but may not be expressed in all local populations.
- Habitat impacts are localized in a few local populations and not throughout the core area, or if widespread are at a degree compatible with persistence of most bull trout local populations at reduced levels.

High: If unmanaged, threat is expected to substantially reduce persistence of bull trout local populations within the core area for the foreseeable future (50 years). Impacts on bull trout in the core area are well supported and geographically widespread (affecting most or all local populations). Without active management affected local populations are generally expected to be severely reduced and are at some risk of extirpation in the foreseeable future. Threat substantially contributes to extirpation risk for local populations, alone or in combination with other threats.

Examples:

- Brook trout that co-occur with bull trout local populations, where hybridization or competition is occurring and may compromise the long-term survival or genetic integrity of local populations.
- Lake trout competition/predation in large lake/riverine systems where it significantly compromises long-term viability/persistence of adfluvial bull trout populations (e.g., Priest Lake or Pend Oreille core areas in the Columbia Headwaters Recovery Unit).
- In core areas where expression of migratory life history has been identified as important for conservation, a “high” severity level for a connectivity related threat is likely to result in loss of migratory life history expression within the core area. Most or all spawning/rearing habitat in the core area is effectively isolated from the historically occupied FMO habitat within or adjacent to the core area, either by physical barriers (dams, dewatered reaches, falls, etc.) that do not provide effective two-way passage or by reaches with water temperatures or water quality unsuitable for bull trout dispersal. Dispersal between local populations in the core area is substantially impaired or absent. Migratory life history strategies that were historically present within the system are currently absent or unusual, and most or all bull trout populations are resident. Connectivity impacts contribute to a significant probability of extirpation in the foreseeable future for a substantial proportion of local populations.
- The majority of local populations within a core area have adverse habitat effects, which could result in extirpation of some local populations in the foreseeable future without active management.

Severe: If unmanaged, threat is expected to severely reduce persistence of bull trout local populations within the core area for the foreseeable future (50 years). Impacts on bull trout in the core area are well supported and affect all local populations. Threat substantially contributes to extirpation risk for local populations. Without active management all local populations are expected to be severely reduced, and most or all local populations are expected to be extirpated in the foreseeable future.

Examples:

- Brook trout that co-occur with bull trout populations with complete or near-complete overlap in distribution, where hybrids are commonly observed and remnant bull trout populations are small and declining in abundance.
- Lake trout competition/predation in highly vulnerable core areas (e.g., small montane lake systems) where bull trout extirpation is likely or expression of adfluvial life history is precluded and bull trout populations are reduced to remnant resident patches.

- In core areas where expression of migratory life history has been identified as important for conservation, a “severe” severity level for a connectivity related threat is consistent with full loss of migratory life history expression within the core area. Spawning/rearing habitat in the core area is restricted and effectively isolated from the historically occupied FMO habitat within or adjacent to the core area, either by physical barriers (dams, dewatered reaches, falls, etc.) that do not provide effective two-way passage or by reaches with water temperatures or water quality unsuitable for bull trout dispersal. Dispersal between local populations in the core area is absent. Migratory life history strategies that were historically present within the system are currently absent, and all bull trout populations are resident. Connectivity impacts contribute to a high probability of extirpation in the foreseeable future for most or all populations.
- Habitat conditions in the core area are generally not suitable for bull trout, such that remaining populations are few, restricted in distribution, and at extreme risk of extirpation within the foreseeable future without active management.

Management Effectiveness: The extent to which current management of this specific threat in a core area is ‘effective’ in reducing the degree of threat or mitigating its impact with respect to bull trout. This axis of the matrix reflects a gradient from the baseline of nonexistent or ineffective management, which does not alter the degree of threat, to management that entirely removes the threat or fully prevents or mitigates its effect on bull trout. Estimates of management effectiveness may be based on the best professional judgment of fisheries biologists who are familiar with the core area, and should be primarily supported where possible by data directly quantifying trends in the threat (e.g., lake trout population indices, fish passage data, sediment load measurements) in conjunction with data on historic changes in management. Surveys documenting bull trout population trends may also be used to inform this assessment to the extent that they can be attributed to particular threats. This association is likely to be most clear when only one threat with a relatively high severity is affecting the population; where multiple threats exist, attribution of their relative effects on bull trout trends should be made with caution. The management actions that are being implemented should be specifically identified when a management effectiveness category is assigned so that it is clear what activities are and are not being included in this assessment. Generally this axis of the matrix should reflect the success of ongoing, active management actions implemented without fundamentally altering existing infrastructure or constraints; thus for connectivity-related threats it could include mitigation such as fish passage facilities or changes in dam operations, while permanent removal of dams or culverts might better be reflected in changes on the “Threat Severity” axis.

None or Ineffective: No significant management of the threat is taking place in this core area, or there is little or no evidence that existing management actions are effectively reducing threat severity.

Partially Effective: Management of the threat is being done with moderate effectiveness or within a limited portion of the core area, including at least some of the local populations affected by the threat. There is evidence that threat severity is being reduced, but this reduction is localized or moderate.

Mostly Effective: Management of the threat is being done in most or all of the core area, including most or all local populations affected by the threat. Threat severity is substantially reduced throughout the core area, but some lesser adverse effects persist; or comparably, the core area is divided between a majority of local populations where the threat has been effectively neutralized and a minority where management remains absent or ineffective.

Effective: Management of this threat reduces risk to all affected local populations, and the threat is largely or completely neutralized, with existing effects on bull trout being minor or absent. Ongoing management may or may not be necessary to maintain this condition.

Outcome: Completion of the recovery unit workshop should allow participating biologists to complete both axes of the matrix for each core area and threat combination, determining the appropriate matrix cell and presenting their assumptions and rationale for making that determination in context of the category definitions. Each of the participants' matrix values will collectively be tallied to express the range of expert opinion.

Threats Assessment Decision Matrix					
		Threat Severity			
		Minor	**Moderate**	**High**	**Severe**
Management Effectiveness	**None or Ineffective**				
	Partially Effective				
	Mostly Effective				
	Effective				

<u>Assessment of Threats Effectively Managed</u>

After the individual threats have been assessed in the Threats Assessment Decision Matrix, the Service will make a determination of whether threats are being effectively managed for the core area. This assessment may include a collective evaluation of all threats within a core area to ensure that interactions and possible cumulative effects of even minor threats are considered.

In recovery units where shared FMO habitat outside core areas has been identified (Appendix G), this assessment should also evaluate whether connectivity and habitat in shared FMO areas is maintained in a condition sufficient for regular bull trout use and successful dispersal among the connecting core areas.

Bull trout population size within a core area, or the best available index from survey data, should be considered in this assessment. Because small population size constitutes a threat under Factor E due to demographic stochasticity and loss of genetic diversity, low populations in a core area could be incompatible with a determination that threats are being effectively managed. However, this threshold also depends on the geographic extent of available habitat within the core area, since geographically smaller core areas inherently have less ability to support a large population and less scope for realistic management to increase populations. Based on our best information about population size and habitat extent, in Appendix B we identify a number of core areas where current population levels appear substantially depressed relative to available habitat, and should be increased before determining that threats are effectively managed. Above this minimal threshold, population size should be considered in combination with other threats; in many core areas there is scope for population improvement in response to amelioration of various threats, and trends in population response can be indicative of threat management effectiveness.

The Service will consider the best available information during this assessment in the context of the requirements of the Endangered Species Act. Service managers will meet to determine whether threats are effectively managed in each core area based on the best available information (matrix cell assignments, supporting data, and rationales) provided to the Service by experts during the recovery unit workshops. Service technical staff familiar with the core areas will provide input to managers at this meeting. If the combination of threat severity and management effectiveness for any individual threat indicates that the threat is not effectively managed to be consistent with bull trout survival and persistence, then the entire core area will be identified as such. All threats will be assessed, and the cumulative effects of multiple threats that are individually minor or moderate could potentially result in a core area not being considered effectively managed.

Evaluation of Recovery Unit Status

The primary recovery 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 stable; (2) managing and ameliorating the primary threats in each of six recovery units at the core area scale such that bull trout will persist well into the future; (3)

work cooperatively with partners to develop and implement bull trout recovery actions in each of the six recovery units; and (4) apply adaptive management principles to implementing the bull trout recovery program to account for new information. Recovery criteria represent our best assessment of the conditions that would most likely result in a determination that listing under the Act is no longer required.

After determining whether threats are effectively managed for a core area, a tally will be produced for each recovery unit that shows all core areas in a recovery unit and the number of local populations in each core area. For each recovery unit, the recovery criteria identified in this recovery plan will be assessed based on the number of core areas where primary threats are nonexistent or have been effectively managed**.**

In order to attain recovered conditions in each of the six recovery units, viable local bull trout populations are necessary across the existing landscape. To achieve viable recovery units, identified significant threats must be effectively managed to produce demographically stable bull trout populations. The recovery strategy presented in this plan is founded in principles of conservation biology and biodiversity, ensuring representation, redundancy, and resiliency. Recovery entails reducing threats to ensure the conservation or restoration of bull trout core areas while striving for representation, resiliency, and redundancy. In order to achieve representation, we have determined the need to largely maintain existing occupancy within most core areas and preserve existing life history forms that are present in these core areas. In order to achieve resiliency, core areas that contain migratory life history expressions should be prioritized for conservation, and some currently "at risk" core areas will need to be improved. Redundancy will be achieved when a mosaic of healthy populations are distributed across the landscape within each of the six recovery units. Additionally, in some recovery units there are areas that were historically occupied by bull trout that are currently unoccupied. While these areas have the potential for re-colonization, there may be areas where re-colonization will not be required for the recovery unit or distinct population segment (DPS) to be recovered. We are not intending that all currently occupied core areas identified in this revised draft recovery plan need to be recovered; however, we recognize that recovery at the recovery unit scale will require improvement in bull trout local populations relative to the time of listing and their habitats in some core areas, while other core areas will only need to be 'maintained' into the foreseeable future.

In summary, ecologically viable populations of bull trout are necessary to produce stable core areas which in turn will result in viable recovery units. These recovery principles take into account the threats and physical or biological needs of bull trout throughout its range and focus on the range-wide recovery needs. This approach to achieving recovery should ensure adequate conservation of genetic diversity, life history features, and broad geographical representation (i.e., adequate spatial distribution) of bull trout populations in the six recovery units that comprise the coterminous population of bull trout.

APPENDIX F. Comparison of Current and Former Core Area and Recovery Unit Classifications

This table provides a crosswalk between the structure of core areas and recovery units that was used in the previous draft bull trout recovery plans (USFWS 2002a, 2004a, 2004b) and 5-year review (USFWS 2008a) and that used in this current revised draft recovery plan, with a key to the core area maps in Appendix D. Based on the most current available information, several core areas have been split or combined, additional core areas that were historically occupied are identified, and those that did not fit our core area definition have been removed. Core area changes will be discussed in detail in the recovery unit implementation plans.

Current Revised Draft Recovery Plan (2014)				Previous Draft Recovery Plans (2002 and 2004) and 5-year Review (2008)	
Map Key in Appendix D	**Current Core Area**	**Current Recovery Unit**	**Area Status**	**Former Core Area**	**Former Recovery Unit**
1 (Map A)	Chilliwack River	Coastal	Occupied	Chilliwack River	Puget Sound
2 (Map A)	Nooksack River	Coastal	Occupied	Nooksack River	Puget Sound
3 (Map A)	Upper Skagit River	Coastal	Occupied	Upper Skagit River	Puget Sound
4 (Map A)	Lower Skagit River	Coastal	Occupied	Lower Skagit River	Puget Sound
5 (Map A)	Stillaguamish River	Coastal	Occupied	Stillaguamish River	Puget Sound
6 (Map A)	Snohomish and Skykomish Rivers	Coastal	Occupied	Snohomish and Skykomish Rivers	Puget Sound
7 (Map A)	Chester Morse Lake	Coastal	Occupied	Chester Morse Lake	Puget Sound
8 (Map A)	Puyallup River	Coastal	Occupied	Puyallup River	Puget Sound
9 (Map A)	Elwha River	Coastal	Occupied	Elwha River	Olympic Peninsula
10 (Map A)	Dungeness River	Coastal	Occupied	Dungeness River	Olympic Peninsula
11 (Map A)	Hoh River	Coastal	Occupied	Hoh River	Olympic Peninsula
12 (Map A)	Queets River	Coastal	Occupied	Queets River	Olympic Peninsula
13 (Map A)	Quinault River	Coastal	Occupied	Quinault River	Olympic Peninsula
14 (Map A)	Skokomish River	Coastal	Occupied	Skokomish River	Olympic Peninsula
15 (Map A)	Lewis River	Coastal	Occupied	Lewis River	Lower Columbia River Basin
16 (Map A)	Klickitat River	Coastal	Occupied	Klickitat River	Lower Columbia River Basin

Current Revised Draft Recovery Plan (2014)				Previous Draft Recovery Plans (2002 and 2004) and 5-year Review (2008)	
Map Key in Appendix D	**Current Core Area**	**Current Recovery Unit**	**Area Status**	**Former Core Area**	**Former Recovery Unit**
17 (Map A)	Hood River	Coastal	Occupied	Hood River	Hood River Basin
18 (Map A)	Lower Deschutes River	Coastal	Occupied	Lower Deschutes River	Deschutes River Basin
19 (Map A)	Upper Willamette River	Coastal	Occupied	Upper Willamette River	Willamette River Basin
20 (Map A)	Odell Lake	Coastal	Occupied	Odell Lake	Odell Lake
21 (Map A)	White Salmon River	Coastal	Historic	[not identified as core area]	Lower Columbia River Basin
22 (Map A)	Clackamas River	Coastal	Occupied (reintroduced)	[not identified as core area]	Willamette River Basin
23 (Map A)	North Santiam River	Coastal	Historic	[not identified as core area]	Willamette River Basin
24 (Map A)	South Santiam River	Coastal	Historic	[not identified as core area]	Willamette River Basin
25 (Map A)	Upper Deschutes River	Coastal	Historic	[not identified as core area]	Deschutes River Basin
1 (Map B)	Sycan River	Klamath	Occupied	Sycan River	Klamath River
2 (Map B)	Upper Klamath Lake	Klamath	Occupied	Upper Klamath Lake	Klamath River
3 (Map B)	Upper Sprague River	Klamath	Occupied	Upper Sprague River	Klamath River
1 (Map C)	Methow River	Mid Columbia	Occupied	Methow River	Upper Columbia River
2 (Map C)	Entiat River	Mid Columbia	Occupied	Entiat River	Upper Columbia River
3 (Map C)	Wenatchee River	Mid Columbia	Occupied	Wenatchee River	Upper Columbia River
4 (Map C)	Yakima River	Mid Columbia	Occupied	Yakima River	Middle Columbia River
5 (Map C)	Touchet River	Mid Columbia	Occupied	Touchet River	Umatilla-Walla Walla River Basins
6 (Map C)	Tucannon River	Mid Columbia	Occupied	Tucannon River	Snake River Washington
7 (Map C)	Asotin Creek	Mid Columbia	Occupied	Asotin Creek	Snake River Washington

Current Revised Draft Recovery Plan (2014)				Previous Draft Recovery Plans (2002 and 2004) and 5-year Review (2008)	
Map Key in Appendix D	**Current Core Area**	**Current Recovery Unit**	**Area Status**	**Former Core Area**	**Former Recovery Unit**
8 (Map C)	Walla Walla River	Mid Columbia	Occupied	Walla Walla River	Umatilla-Walla Walla River Basins
9 (Map C)	Lookingglass/Wenaha Rivers	Mid Columbia	Occupied	Grande Ronde River (in part)	Grande Ronde River Basin
10 (Map C)	Umatilla River	Mid Columbia	Occupied	Umatilla River	Umatilla-Walla Walla River Basins
11 (Map C)	North Fork John Day River	Mid Columbia	Occupied	North Fork John Day River	John Day River
12 (Map C)	Middle Fork John Day River	Mid Columbia	Occupied	Middle Fork John Day River	John Day River
13 (Map C)	Upper Mainstem John Day River	Mid Columbia	Occupied	Upper Mainstem John Day River	John Day River
14 (Map C)	Upper Grande Ronde River	Mid Columbia	Occupied	Grande Ronde River (in part)	Grande Ronde River Basin
15 (Map C)	Powder River	Mid Columbia	Occupied	Powder River (in part)	Hells Canyon Complex
16 (Map C)	Little Minam River	Mid Columbia	Occupied	Little Minam River	Grande Ronde River Basin
17 (Map C)	Wallowa/Minam Rivers	Mid Columbia	Occupied	Grande Ronde River (in part)	Grande Ronde River Basin
18 (Map C)	Imnaha River	Mid Columbia	Occupied	Imnaha River	Imnaha-Snake Rivers
19 (Map C)	Pine, Indian, and Wildhorse Creeks	Mid Columbia	Occupied	Pine, Indian, and Wildhorse Creeks	Hells Canyon Complex
20 (Map C)	Granite Creek	Mid Columbia	Occupied	Granite Creek	Imnaha-Snake Rivers
21 (Map C)	Sheep Creek	Mid Columbia	Occupied	Sheep Creek	Imnaha-Snake Rivers
22 (Map C)	South Fork Clearwater River	Mid Columbia	Occupied	South Fork Clearwater River	Clearwater River
23 (Map C)	Selway River	Mid Columbia	Occupied	Selway River	Clearwater River
24 (Map C)	Lochsa River (in part)	Mid Columbia	Occupied	Lochsa River	Clearwater River

Current Revised Draft Recovery Plan (2014)				Previous Draft Recovery Plans (2002 and 2004) and 5-year Review (2008)	
Map Key in Appendix D	**Current Core Area**	**Current Recovery Unit**	**Area Status**	**Former Core Area**	**Former Recovery Unit**
24 (Map C)	Lochsa River (in part)	Mid Columbia	Occupied	Fish Lake (Lochsa River)	Clearwater River
25 (Map C)	North Fork Clearwater River (in part)	Mid Columbia	Occupied	North Fork Clearwater River	Clearwater River
25 (Map C)	North Fork Clearwater River (in part)	Mid Columbia	Occupied	Fish Lake (North Fork Clearwater River)	Clearwater River
	none [Clearwater FMO only]	Mid Columbia	FMO only	Middle-Lower Clearwater River	Clearwater River
26 (Map C)	Eagle Creek	Mid Columbia	Historic	Powder River (in part)	Hells Canyon Complex
27 (Map C)	Chelan River	Mid Columbia	Historic	[not identified as core area]	Upper Columbia River
28 (Map C)	Eastern Washington	Mid Columbia	Research Needs Area	[not identified as core area]	Northeast Washington
29 (Map C)	Burnt River	Mid Columbia	Research Needs Area	[not identified as core area]	Hells Canyon Complex
1 (Map D)	Upper Malheur River	Upper Snake	Occupied	Malheur River (in part)	Malheur River Basin
2 (Map D)	North Fork Malheur River	Upper Snake	Occupied	Malheur River (in part)	Malheur River Basin
3 (Map D)	Little Lower Salmon River	Upper Snake	Occupied	Little Lower Salmon River	Salmon River
4 (Map D)	Weiser River	Upper Snake	Occupied	Weiser River	Southwest Idaho River Basins
5 (Map D)	Squaw Creek	Upper Snake	Occupied	Squaw Creek	Southwest Idaho River Basins
6 (Map D)	North Fork Payette River	Upper Snake	Occupied	North Fork Payette River	Southwest Idaho River Basins
7 (Map D)	Middle Salmon River - Chamberlain	Upper Snake	Occupied	Middle Salmon River - Chamberlain	Salmon River

Current Revised Draft Recovery Plan (2014)				Previous Draft Recovery Plans (2002 and 2004) and 5-year Review (2008)	
Map Key in Appendix D	**Current Core Area**	**Current Recovery Unit**	**Area Status**	**Former Core Area**	**Former Recovery Unit**
8 (Map D)	Middle Salmon River - Panther	Upper Snake	Occupied	Middle Salmon River - Panther	Salmon River
9 (Map D)	Lake Creek	Upper Snake	Occupied	Lake Creek	Salmon River
10 (Map D)	Opal Lake	Upper Snake	Occupied	Opal Lake	Salmon River
11 (Map D)	Lemhi River	Upper Snake	Occupied	Lemhi River	Salmon River
12 (Map D)	Middle Fork Salmon River	Upper Snake	Occupied	Middle Fork Salmon River	Salmon River
13 (Map D)	South Fork Salmon River	Upper Snake	Occupied	South Fork Salmon River	Salmon River
14 (Map D)	Middle Fork Payette River	Upper Snake	Occupied	Middle Fork Payette River	Southwest Idaho River Basins
15 (Map D)	Deadwood River	Upper Snake	Occupied	Deadwood River	Southwest Idaho River Basins
16 (Map D)	Upper South Fork Payette River	Upper Snake	Occupied	Upper South Fork Payette River	Southwest Idaho River Basins
17 (Map D)	Upper Salmon River	Upper Snake	Occupied	Upper Salmon River	Salmon River
18 (Map D)	Pahsimeroi River	Upper Snake	Occupied	Pahsimeroi River	Salmon River
19 (Map D)	Little Lost River	Upper Snake	Occupied	Little Lost River	Little Lost River
20 (Map D)	Arrowrock Reservoir	Upper Snake	Occupied	Arrowrock Reservoir	Southwest Idaho River Basins
	None	Upper Snake	N/A	Lucky Peak Reservoir	Southwest Idaho River Basins
21 (Map D)	Anderson Ranch Reservoir	Upper Snake	Occupied	Anderson Ranch Reservoir	Southwest Idaho River Basins
22 (Map D)	Jarbidge River	Upper Snake	Occupied	Jarbidge River	Jarbidge River
1 (Map E)	Lake Pend Oreille (in part)	Columbia Headwaters	Occupied	Lake Pend Oreille	Clark Fork River Basin

Current Revised Draft Recovery Plan (2014)				Previous Draft Recovery Plans (2002 and 2004) and 5-year Review (2008)	
Map Key in Appendix D	**Current Core Area**	**Current Recovery Unit**	**Area Status**	**Former Core Area**	**Former Recovery Unit**
1 (Map E)	Lake Pend Oreille (in part)	Columbia Headwaters	Occupied	Cabinet Gorge Reservoir	Clark Fork River Basin
1 (Map E)	Lake Pend Oreille (in part)	Columbia Headwaters	Occupied	Clark Fork River (Section 3)	Clark Fork River Basin
1 (Map E)	Lake Pend Oreille (in part)	Columbia Headwaters	Occupied	Lower Flathead River	Clark Fork River Basin
1 (Map E)	Lake Pend Oreille (in part)	Columbia Headwaters	Occupied	Noxon Rapids Reservoir	Clark Fork River Basin
1 (Map E)	Lake Pend Oreille (in part)	Columbia Headwaters	Occupied	Pend Oreille River	Northeast Washington
2 (Map E)	Priest Lakes	Columbia Headwaters	Occupied	Priest Lakes	Clark Fork River Basin
3 (Map E)	Kootenai River	Columbia Headwaters	Occupied	Kootenai River	Kootenai River Basin
4 (Map E)	Coeur d'Alene Lake	Columbia Headwaters	Occupied	Coeur d'Alene Lake	Coeur d'Alene Lake Basin
5 (Map E)	Bull Lake	Columbia Headwaters	Occupied	Bull Lake	Kootenai River Basin
6 (Map E)	Lake Koocanusa (in part)	Columbia Headwaters	Occupied	Lake Koocanusa	Kootenai River Basin
6 (Map E)	Lake Koocanusa (in part)	Columbia Headwaters	Occupied	Sophie Lake	Kootenai River Basin
7 (Map E)	Upper Stillwater Lake	Columbia Headwaters	Occupied	Upper Stillwater Lake	Clark Fork River Basin
8 (Map E)	Upper Whitefish Lake	Columbia Headwaters	Occupied	Upper Whitefish Lake	Clark Fork River Basin
9 (Map E)	Cyclone Lake	Columbia	Occupied	Cyclone Lake	Clark Fork River Basin

Current Revised Draft Recovery Plan (2014)				Previous Draft Recovery Plans (2002 and 2004) and 5-year Review (2008)	
Map Key in Appendix D	**Current Core Area**	**Current Recovery Unit**	**Area Status**	**Former Core Area**	**Former Recovery Unit**
		Headwaters			
10 (Map E)	Whitefish Lake	Columbia Headwaters	Occupied	Whitefish Lake	Clark Fork River Basin
11 (Map E)	Flathead Lake (in part)	Columbia Headwaters	Occupied	Flathead Lake	Clark Fork River Basin
11 (Map E)	Flathead Lake (in part)	Columbia Headwaters	Occupied	Kintla Lake	Clark Fork River Basin
11 (Map E)	Flathead Lake (in part)	Columbia Headwaters	Occupied	Lake McDonald	Clark Fork River Basin
12 (Map E)	Frozen Lake	Columbia Headwaters	Occupied	Frozen Lake	Clark Fork River Basin
13 (Map E)	Upper Kintla Lake	Columbia Headwaters	Occupied	Upper Kintla Lake	Clark Fork River Basin
14 (Map E)	Akokala Lake	Columbia Headwaters	Occupied	Akokala Lake	Clark Fork River Basin
15 (Map E)	Bowman Lake	Columbia Headwaters	Occupied	Bowman Lake	Clark Fork River Basin
16 (Map E)	Quartz Lakes	Columbia Headwaters	Occupied	Quartz Lakes	Clark Fork River Basin
17 (Map E)	Lower Quartz Lake	Columbia Headwaters	Occupied	Lower Quartz Lake	Clark Fork River Basin
18 (Map E)	Logging Lake	Columbia Headwaters	Occupied	Logging Lake	Clark Fork River Basin
19 (Map E)	Trout/Arrow Lakes (in part)	Columbia Headwaters	Occupied	Arrow Lake	Clark Fork River Basin
19 (Map E)	Trout/Arrow Lakes (in part)	Columbia Headwaters	Occupied	Trout Lake	Clark Fork River Basin

Current Revised Draft Recovery Plan (2014)				Previous Draft Recovery Plans (2002 and 2004) and 5-year Review (2008)	
Map Key in Appendix D	**Current Core Area**	**Current Recovery Unit**	**Area Status**	**Former Core Area**	**Former Recovery Unit**
20 (Map E)	Lincoln Lake	Columbia Headwaters	Occupied	Lincoln Lake	Clark Fork River Basin
21 (Map E)	Harrison Lake	Columbia Headwaters	Occupied	Harrison Lake	Clark Fork River Basin
22 (Map E)	Isabel Lakes	Columbia Headwaters	Occupied	Isabel Lakes	Clark Fork River Basin
23 (Map E)	Hungry Horse Reservoir	Columbia Headwaters	Occupied	Hungry Horse Reservoir	Clark Fork River Basin
24 (Map E)	Swan Lake	Columbia Headwaters	Occupied	Swan Lake	Clark Fork River Basin
25 (Map E)	Big Salmon Lake	Columbia Headwaters	Occupied	Big Salmon Lake	Clark Fork River Basin
26 (Map E)	Holland Lake	Columbia Headwaters	Occupied	Holland Lake	Clark Fork River Basin
27 (Map E)	Doctor Lake	Columbia Headwaters	Occupied	Doctor Lake	Clark Fork River Basin
28 (Map E)	Lindbergh Lake	Columbia Headwaters	Occupied	Lindbergh Lake	Clark Fork River Basin
29 (Map E)	Clearwater River & Lakes	Columbia Headwaters	Occupied	Clearwater River & Lakes	Clark Fork River Basin
30 (Map E)	Middle Clark Fork River	Columbia Headwaters	Occupied	Clark Fork River (Section 2)	Clark Fork River Basin
31 (Map E)	Blackfoot River	Columbia Headwaters	Occupied	Blackfoot River	Clark Fork River Basin
32 (Map E)	Bitterroot River	Columbia Headwaters	Occupied	Bitterroot River	Clark Fork River Basin
33 (Map E)	Rock Creek	Columbia	Occupied	Rock Creek	Clark Fork River Basin

Current Revised Draft Recovery Plan (2014)				Previous Draft Recovery Plans (2002 and 2004) and 5-year Review (2008)	
Map Key in Appendix D	**Current Core Area**	**Current Recovery Unit**	**Area Status**	**Former Core Area**	**Former Recovery Unit**
		Headwaters			
34 (Map E)	Upper Clark Fork River	Columbia Headwaters	Occupied	Clark Fork River (Section 1)	Clark Fork River Basin
35 (Map E)	West Fork Bitterroot River	Columbia Headwaters	Occupied	West Fork Bitterroot River	Clark Fork River Basin
1 (Map F)	Saint Mary River (in part)	Saint Mary	Occupied	Saint Mary River	Saint Mary-Belly River Basins
1 (Map F)	Saint Mary River (in part)	Saint Mary	Occupied	Lee Creek	Saint Mary-Belly River Basins
	None	Saint Mary	N/A	Belly River	Saint Mary-Belly River Basins
2 (Map F)	Slide Lake	Saint Mary	Occupied	Slide Lake	Saint Mary-Belly River Basins
3 (Map F)	Cracker Lake	Saint Mary	Occupied	Cracker Lake	Saint Mary-Belly River Basins
4 (Map F)	Red Eagle Lake	Saint Mary	Occupied	Red Eagle Lake	Saint Mary-Belly River Basins

APPENDIX G. Shared Foraging, Migration, and Overwintering (FMO) Habitats by Recovery Unit

Shared FMO Habitat Areas	**Recovery Unit**	**Area Description**
Lower Columbia River FMO	Coastal	Mainstem Columbia River from the mouth to John Day Dam
Puget Sound FMO	Coastal	Nearshore marine habitat on eastern edge of Puget Sound from Nisqually River north to Canadian border
Lower Nisqually River FMO	Coastal	Mainstem lower Nisqually River
Lower Green River FMO	Coastal	Mainstem lower Green River and Sunday Creek
Lake Washington FMO	Coastal	Salmon Bay, Lake Union, and Lake Washington
Samish River FMO	Coastal	Mainstem Samish River
Hood Canal Marine FMO	Coastal	Mainstem Dosewallips River, and nearshore marine habitat in Hood Canal extending from Dabob Bay and the mouth of Union River outward to Hazel Point
Strait of Juan de Fuca FMO	Coastal	Nearshore marine habitat from Pillar Point to Cape George
Pacific Coast FMO	Coastal	Nearshore marine habitat from Grays Harbor to Ozette Lake vicinity, and mainstem riverine habitat Copalis River, Raft River, and Goodman Creek
Grays Harbor/Chehalis River FMO	Coastal	Nearshore marine habitat in Grays Harbor, and mainstem riverine habitat in Humptulips, Chehalis, Wishkah, Wynoochee, Satsop, and

Shared FMO Habitat Areas	Recovery Unit	Area Description
		West Fork Satsop Rivers
Middle Columbia River FMO	Mid-Columbia	Mainstem Columbia River from John Day Dam to Grand Coulee Dam
John Day River FMO	Mid-Columbia	Mainstem John Day River from mouth to confluence of Upper John Day River
Snake River FMO	Mid-Columbia	Mainstem Snake River from mouth to Brownlee Dam
Okanogan River FMO	Mid-Columbia	Mainstem Okanogan River from mouth to Canadian border
Grande Ronde River FMO	Mid-Columbia	Mainstem Grande Ronde River from mouth to Grande Ronde Valley
Clearwater River FMO	Mid-Columbia	Mainstem Clearwater River and Middle Fork Clearwater River from mouth to confluence of Selway and Lochsa Rivers
Malheur River FMO	Upper Snake	Mainstem Malheur River and North Fork Malheur River from mouth to Warm Springs Dam and Agency Valley Dam

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