Draft
Proposed ESA Recovery Plan for

Snake River Spring/Summer Chinook Salmon
and
Snake River Steelhead

Prepared by the
National Marine Fisheries Service,
Northwest Region

December 2013

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1 ▪ Introduction

This is a plan for the protection and restoration of Snake River spring/summer Chinook salmon and Snake River steelhead. Historically, the fish runs ranged as far as Shoshone Falls in Idaho, and spawned and rearing in parts of the Snake River system extending across the states of Oregon, Washington and Idaho. Some of this historical range became unreachable with the development of hydroelectric dams that blocked access to several historically important spawning and rearing areas for the fish, including areas of the Snake River basin above Hells Canyon Dam. Major tributaries still available to the fish runs include the Grande Ronde and Imnaha Rivers in Oregon, the Salmon and Clearwater Rivers in Idaho, and the Tucannon River in Washington.

The Snake River is believed to have once been the Columbia River's most important drainage for salmon and steelhead production, producing 39 to 45 percent of all Columbia River spring and summer Chinook and 55 percent of summer steelhead (NMFS 1995). The fish runs, revered by Native Americans and local communities and prized by fisheries, began to weaken by the early 1900s and continued to decline. Today the remaining runs are a fraction of their former size.

The two species of salmon and steelhead are now listed under the Endangered Species Act of 1973 (ESA).

- The Snake River spring/summer Chinook *(Oncorhynchus tshawytscha)* evolutionarily significant unit (ESU) was listed as a threatened species on April 22, 1992 and the listing was reaffirmed on June 28, 2005.

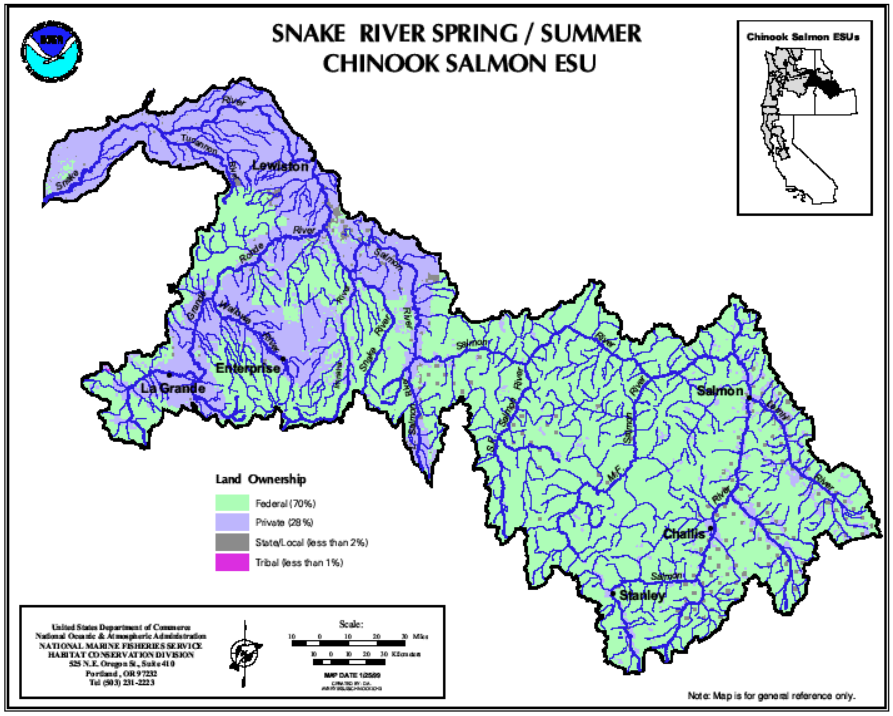

Figure 1-1. Snake River Spring/Summer Chinook Salmon Evolutionarily Significant Unit.

- The Snake River steelhead *(Oncorhynchus mykiss)* distinct population segment (DPS) was originally listed as threatened as an ESU on August 18, 1997. This listing was reaffirmed on January 5, 2006 and the species was delineated as an anadromous, steelhead-only DPS.

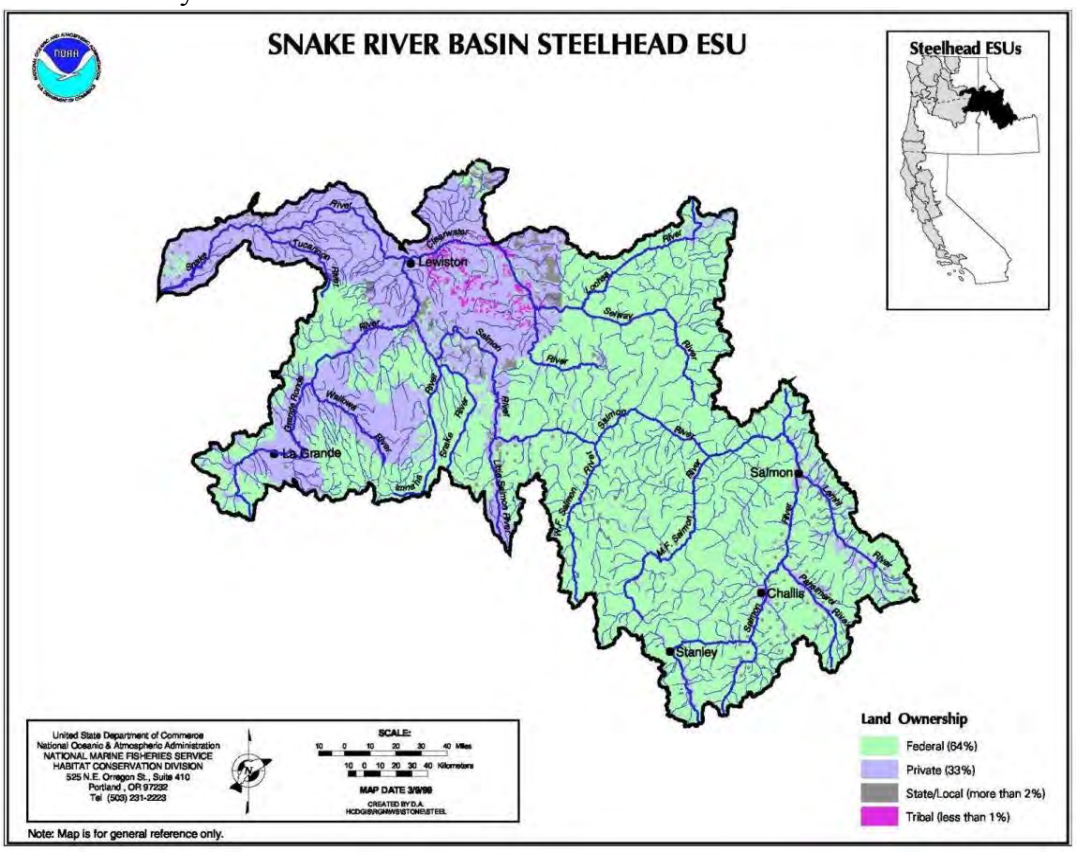

Figure 1-2. Snake River Steelhead Distinct Population Segment.

A combination of factors related to human development in the Columbia Basin over the last two centuries contributed to the decline of these spring/summer Chinook and steelhead populations. The fish rely on habitats across a wide geographic range during their life cycle — and meet risks at each stage. They begin life in the gravel of freshwater streams of the Snake River basin, up to 900 miles inland from the Pacific Ocean and 6,500 feet above sea level. As juveniles, they travel downstream from their natal streams, through the Snake and Columbia Rivers to the ocean, passing up to eight major hydroelectric dams and undergoing extraordinary metabolic changes as they adapt to salt water. After one to five years traveling hundreds of miles in the ocean, the adults retrace their journey up the Columbia and Snake Rivers, and through the mainstem hydroelectric system, to return to their natal streams to spawn. At each stage in this life cycle, the fish are exposed to habitat degradation, fisheries, effects of hatcheries, and other factors that challenge their survival.

These factors also affect several other salmon and steelhead species in the region. Snake River spring/summer Chinook salmon and steelhead are among 19 ESUs or DPSs of salmon and steelhead in the Pacific Northwest listed as threatened or endangered under the ESA, including

two other Snake River species: fall Chinook salmon and sockeye salmon.[1] An ESU or DPS is a group of Pacific salmon or steelhead, respectively, that is discrete from other groups of the same species and that represents an important component of the evolutionary legacy of the species. Under the Endangered Species Act, each ESU or DPS is treated as a species.[2] Twenty-one species of salmon and steelhead in the Pacific Northwest are not listed under the ESA because they return in healthy numbers.

NOAA's National Marine Fisheries Service (NMFS) is required, pursuant to Section 4(f) of the Endangered Species Act of 1973, to develop recovery plans for marine species listed under the ESA.[3] Recovery plans identify actions needed to restore threatened and endangered species to the point that they are again self-sustaining elements of their ecosystems and no longer require the protections of the ESA.

A recovery plan serves as a road map for species recovery—it lays out where we need to go and how best to get there. Without a plan to organize, coordinate and prioritize the many possible recovery actions on the part of federal, state, and tribal agencies, local watershed councils and districts, and private citizens, our efforts may be inefficient or even ineffective. Prompt development and implementation of a recovery plan will help target limited resources effectively.

Recovering Snake River spring/summer Chinook salmon and steelhead requires far-reaching actions that address the many factors that challenge their survival. The long-term biological success of these species reflects their ability to make use of diverse habitats from high mountain streams to the ocean. Thus, their resilience in the face of change depends on maintaining genetic, phenotypic, and behavioral diversity over a wide geographic area. Human activities, however, have dramatically changed the conditions encountered by Snake River spring/summer Chinook salmon and steelhead. Although many of the harmful effects on fish habitat are due to past practices, current human uses of the land and river systems continue to threaten the viability of Snake River salmon and steelhead across much of their range.

Improving survival throughout the Columbia River and its estuary is particularly important for the Snake River species because of the length of their migration, from the mouth of the Columbia to higher reaches of Snake River tributaries and back again to the ocean. Snake River species pass up to eight major dams as the travel through 320 miles of the Columbia migration corridor, and then swim on into the altered waters of the Snake and its tributaries. These waters, however, are also important to the human populations living near them, for transportation, irrigation, and recreation. Balancing these often-competing uses is the challenge for recovery planning.

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[1] For updates on the number of ESA-listed salmon and steelhead, see the "Snapshot" link at http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/.

[2] A DPS is defined based on discreteness in behavioral, physiological, and morphological characteristics, whereas the definition of an ESU emphasizes genetic and reproductive isolation. (For a fuller explanation, see Section 1.4.4.)

[3] As anadromous species whose life cycles encompass freshwater, estuarine, and marine ecosystems, salmon and steelhead fall under the jurisdiction of NMFS. Steelhead, the migratory form of *O. mykiss* are distinct from rainbow trout, the resident form of *O. mykiss*. Rainbow trout are under the jurisdiction of the U.S. Fish and Wildlife Service. This recovery plan addresses steelhead and not rainbow trout, as is consistent with the ESA listing decision.

Fortunately, scientific understanding of the threats to Snake River spring/summer Chinook salmon and steelhead is growing, as is interest in aligning hydropower operations, land use, hatchery priorities, and harvest practices with conservation objectives for salmon and steelhead. Collaborations between federal, state, tribal, and local entities continue to improve salmonid survival throughout the Columbia River and restore estuary habitats that are essential for juvenile fish to feed, grow, and make the transition to saltwater. More people in the Snake River basin also recognize the opportunities and benefits of actively protecting and restoring stream corridors, wetlands, stream flows, and other natural features that support native fish and wildlife populations. Management of upland areas is changing to protect and restore watershed function. Cities are undertaking urban watershed protection and restoration. Recovery planning is an opportunity to search for the common ground, to organize protection and restoration of salmonid habitat, and to secure the economic and cultural benefits of healthy watersheds and rivers.

The primary goal of ESA recovery plans is for a listed species to reach the point at which they no longer need the protection of the Endangered Species Act and thus can be delisted. For salmon and steelhead, recovery plans, including this plan, are based on associated locally developed recovery plans. These locally developed recovery plans may address not just delisting, but also local interests and needs based on social, economic, and ecological values. To address these interests, some locally produced recovery plans include "broad sense goals" that go beyond the requirements for delisting. Although the broad sense goals in the locally produced recovery plans may be stated in slightly different ways, they usually share some combination of the following elements: ensuring long-term persistence of viable populations of naturally produced salmon and steelhead distributed across their native range, enjoying the social and cultural benefits of meaningful harvest opportunities that are sustainable over the long-term, and pursuing salmon recovery using an open and cooperative process that respects local customs and benefits local communities and economies.

The broad sense goal of ensuring the long-term persistence of viable populations of naturally produced salmon and steelhead distributed across their native range is consistent with ESA delisting, and NMFS' approach to recovery planning has been to use open and collaborative processes with extensive local engagement. NMFS is supportive of the broad sense recovery goals in locally developed plans and believes that the most expeditious way to achieve them is by achieving viability of natural populations and delisting. Upon delisting, NMFS will work with co-managers and local stakeholders, using our non-ESA authorities, to pursue broad sense recovery goals while continuing to maintain robust natural populations. Recovery goals and delisting criteria are discussed in more detail in Chapter 3.

1.1 Endangered Species Act Requirements

Section 4(f) of the ESA requires that a recovery plan be developed and implemented for species listed as endangered or threatened under the statute.

ESA section 4(a)(1) lists factors for re-classification or delisting that are to be addressed in recovery plans:

A. The present or threatened destruction, modification, or curtailment of [the species'] habitat or range
B. Over-utilization for commercial, recreational, scientific or educational purposes
C. Disease or predation
D. The inadequacy of existing regulatory mechanisms
E. Other natural or human-made factors affecting its continued existence

ESA section 4(f)(1)(B) directs that recovery plans, to the extent practicable, incorporate all of the following:

1. A description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species
2. Objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this chapter, that the species be removed from the list
3. Estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal

In addition, it is important for recovery plans to provide the public and decision makers with a clear understanding of the goals and strategies needed to recover a listed species and the science underlying those conclusions (NMFS 2006).

Once a species is deemed recovered and therefore removed from a listed status, section 4(g) of the ESA requires the monitoring of the species for a period of not less than five years to ensure that it retains its recovered status.

1.2 How NMFS Will Use the Plan

Although recovery plans are not regulatory and their implementation is voluntary, they are important tools that help:

- Provide context for regulatory decisions.
- Guide decision making by federal, state, tribal, and local jurisdictions.
- Provide criteria for status reporting and delisting decisions.
- Organize, prioritize, and sequence recovery actions.
- Organize research, monitoring, and evaluation efforts.

NMFS will encourage federal agencies and non-federal jurisdictions to seriously consider the recovery plans as they make the following sorts of decisions and allocate their resources:

- Actions carried out to meet Federal ESA section 7(a)(1) obligations to use their programs in furtherance of the purposes of the ESA and to carry out programs for the conservation of threatened and endangered species
- Actions that are subject to ESA sections 4d, 7(a)(2), or 10
- Hatchery and Genetic Management Plans and permit requests
- Harvest plans and permits

- Selection and prioritization of subbasin planning actions
- Development of research, monitoring, and evaluation programs
- Revision of land use and resource management plans
- Other natural resource decisions at the state, tribal, and local levels

NMFS will emphasize recovery plan information in ESA section 7(a)(2) consultations, section 10 permit development, and application of the section 4(d) rule by considering:

- The importance of affected populations to listed species viability
- The importance of the action area to affected populations and species viability
- The relation of the action to recovery strategies and management actions
- The relation of the action to the research, monitoring, and evaluation plan for the affected species

In implementing these programs, recovery plans will be used as a reference and a source of context, expectations, and goals. NMFS staff will encourage the federal "action agencies" to describe in their biological assessments how their proposed actions will affect specific populations and limiting factors identified in the recovery plans, and to describe any mitigating measures and voluntary recovery activities in the action area.

1.3 Geographic Setting

The spring/summer Chinook salmon and steelhead populations addressed in this recovery plan spawn and rear in the Snake River basin. The Snake River basin encompasses an area of 107,000 square miles, covering roughly half of the total area of the Columbia River basin (219,000 square miles) (Figure 1-3). The Snake River is the 10th longest river system in the United States and the largest and longest tributary of the Columbia River. It extends over 1,000 miles from its headwaters in Yellowstone National Park, Wyoming, and drops nearly 7,000 feet in elevation before joining the Columbia River near Pasco, Washington. It drains approximately 87 percent of the state of Idaho, over 18 percent of the state of Washington, and about 17 percent of the state of Oregon. Naturally spawned populations of Snake River spring/summer Chinook salmon and steelhead inhabit streams from the upper Grande Ronde region (northeast Oregon) and the lower Snake at its confluence with the Columbia River (southeast Washington) to the upper reaches of the Salmon, Pahsimeroi, and Lemhi rivers (central Idaho). Hells Canyon Dam, completed in 1967 without fish passage, blocks access to historical habitat stretching some 368 miles across southern Idaho to the 212-foot Shoshone Falls, which once formed the natural limit to anadromous fish migration. This recovery plan is limited to the Snake River basin and its tributaries below Hells Canyon Dam.

[Figure 1-3 Map of Snake River Basin]

1.3.1 Topography and Land Use

The Snake River basin is characterized by dramatic changes in elevation, from 12,662 feet at Mount Borah in the headwaters of the Pahsimeroi River to 340 feet at the Snake's confluence with the Columbia River. Terrestrial habitats in the basin include high elevation deserts, alpine peaks, temperate rain forests, and the deepest river canyon in North America (Hells Canyon). Temperatures and precipitation vary widely, usually depending on elevation, with cooler and wetter climates in the mountainous areas and warmer and drier climates in the lower elevations of the province.

Within the Snake River basin, land use ranges from agriculture and rangeland to cities and recreation in the largest contiguous wilderness in the lower 48 states. Of the 31,862 square miles of land in the Snake River recovery domain, 69.4 percent is federally owned, 24.3 percent is privately held, and 6.5 percent is partitioned for state and tribal use. Although population growth in the basin is not keeping pace with other areas in the Pacific Northwest, development is occurring and tends to be concentrated in the valley bottoms. Figure 1-4 shows land use and cover in the Snake River basin. The individual recovery plans for the Idaho, Oregon and Washington management units describe the areas diverse geographic characteristics and land use in more detail.

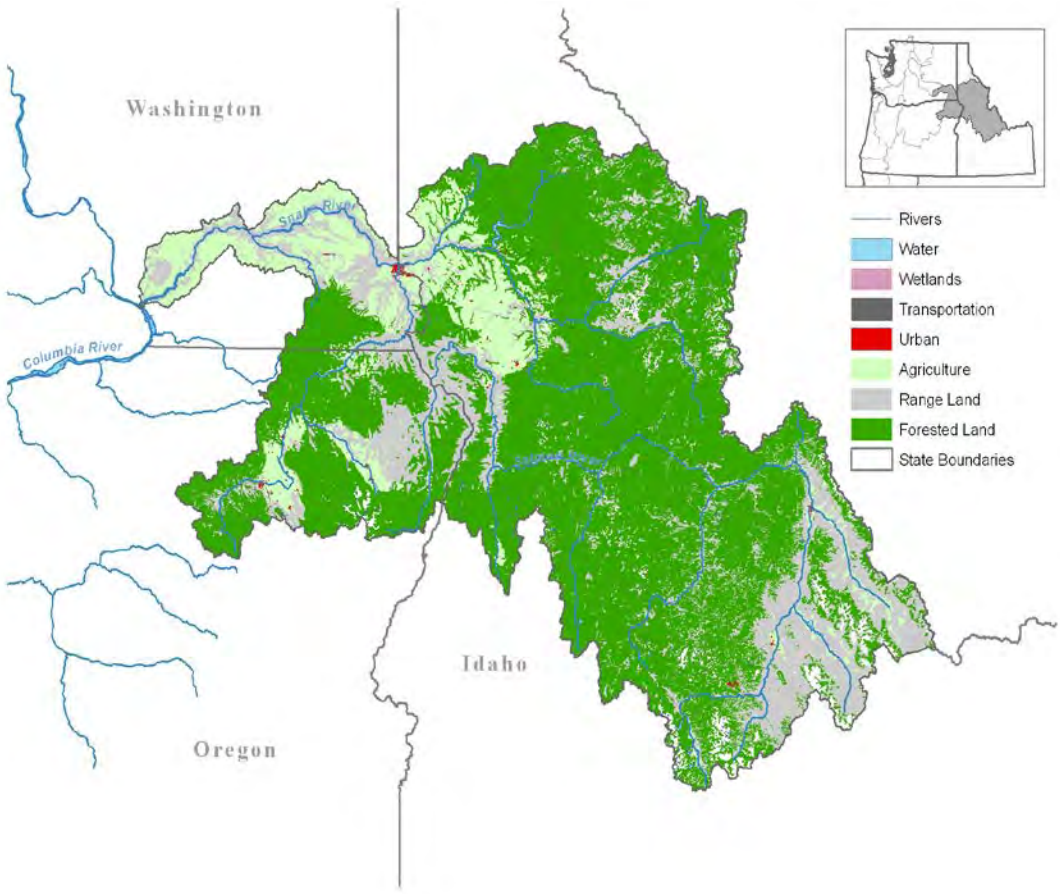


Figure 1-4. Land use and cover in the Snake River basin.

1.4 Species Covered by the Plan

This plan addresses two salmon and steelhead species in the Pacific Northwest that have been listed as threatened or endangered under the ESA: Snake River spring/summer Chinook salmon and Snake River steelhead. Two other Snake River species, fall Chinook salmon and sockeye salmon, are also listed under the ESA; however, separate recovery plans are being developed for these ESA-listed species.

Because ESA recovery is predicated on having enough natural production for the ESU to be self-sustaining, natural populations are the primary focus of most of the analyses and recovery actions in this plan. However, NMFS recognizes that in certain circumstances, hatchery populations are closely related to local natural populations and are representative of the genetic legacy of the ESU or DPS in question. NMFS' 2005 hatchery listing policy provides that the agency will include in ESUs or DPSs hatchery programs that are no more than moderately divergent from a natural population that is included in the ESU or DPS (70 Federal Register 37204). For this reason, each of the species described below consists of both natural- and hatchery-origin fish.

1.4.1 Snake River Spring/Summer Chinook

The Snake River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*) ESU for federal ESA-listed salmon was listed as a threatened species on April 22, 1992 (57 FR 14658) and the listing was reaffirmed on June 28, 2005 (70 FR 37160). The ESU includes all naturally spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins (see Figure 1-1). The ESU also includes 15 artificial propagation programs: the Tucannon River conventional Hatchery, Tucannon River Captive Broodstock Program, Lostine River, Catherine Creek, Lookingglass Hatchery, Upper Grande Ronde, Imnaha River, Big Sheep Creek, McCall Hatchery, Johnson Creek Artificial Propagation Enhancement, Lemhi River Captive Rearing Experiment, Pahsimeroi Hatchery, East Fork Captive Rearing Experiment, West Fork Yankee Fork Captive Rearing Experiment, and the Sawtooth Hatchery spring/summer-run Chinook hatchery programs (70 FR 37160).

1.4.2 Snake River Steelhead

The Snake River steelhead *(Oncorhynchus mykiss)* DPS for federal ESA-listed steelhead was listed as threatened on August 18, 1997 (62 FR 43937). This listing was reaffirmed on January 5, 2006 (71 FR 834). The Snake River steelhead DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassable barriers in streams in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho (see Figure 1-2). It also includes six artificial propagation programs: Tucannon River, Dworshak National Fish Hatchery (NFH), Lolo Creek, North Fork Clearwater, East Fork Salmon River, and the Little Sheep Creek/Imnaha River steelhead hatchery programs (71 FR 834).

Inland steelhead in the Columbia River basin, including Snake River steelhead, are commonly referred to as either A-run or B-run steelhead, based on migration timing and differences in age

and size at return. A-run steelhead occur throughout the steelhead streams in the Snake River basin, while B-run steelhead are thought to produce only in the Clearwater and Salmon Rivers.

1.4.3 Blocked Areas

Historically, the Snake River spring/summer Chinook salmon ESU and Snake River steelhead DPS included populations above the Hells Canyon Dam complex and above dams in the Clearwater River drainage. Hydroelectric dams have blocked access and inundated important historical spawning and rearing areas for Snake River spring/summer Chinook salmon and steelhead in these areas. In all, approximately 2,500 miles of historical anadromous fish habitat have been lost to barrier dams and inundation (IDFG 1985).

Construction of the Hells Canyon hydroelectric complex along the Idaho-Oregon border in the 1960s completed the extirpation of anadromous species in the Snake River and all tributaries above Hells Canyon Dam. Major tributaries upstream from Hells Canyon Dam that once supported anadromous fish include the Wildhorse, Powder, Burnt, Weiser, Payette, Malheur, Owyhee, Boise, Bruneau, and Jarbidge Rivers, and Salmon Falls Creek.

Several dams influence salmon and steelhead production in the Clearwater River drainage. Construction of Lewiston Dam on the lower Clearwater River mainstem in 1927 blocked anadromous fish passage until the early 1940s, and is believed to have caused the extirpation of native Chinook, but not steelhead, in the Clearwater drainage above the dam site. Dworshak Dam, completed in 1971, caused the extirpation of steelhead and Chinook runs to the North Fork Clearwater River. Harpster Dam, located on the South Fork Clearwater River, completely blocked steelhead and Chinook from reaching spawning habitat from 1949 to 1963; however, the dam was removed in 1963 and fish passage was restored to approximately 500 miles of suitable spawning and rearing habitat.

The ICTRT has determined that a number of potential historical steelhead populations existed above the Hells Canyon Dam complex on the mainstem Snake River that are now extirpated. Habitat analyses and historical records also indicate that the area above Hells Canyon Dam likely supported several additional spring/summer Chinook salmon populations; however, no biological data are currently available to assess the historical relationships among populations in the extirpated areas (ICTRT 2008). Based on the extirpated status of populations, the blocked areas are not expected to contribute to recovery of the ESU and DPS, and are not included in the recovery scenario for the species. Instead, NMFS considers rebuilding these extirpated populations a longer-term goal. It will support future efforts to restore salmon and steelhead populations in the blocked areas through reintroduction.

1.5 Context of Plan Development

This recovery plan is the product of a collaborative process initiated by NMFS and strengthened through regional and local participation. Throughout the recovery planning process, NMFS collaborated with the states of Idaho, Oregon and Washington, as well as with other federal agencies, tribal and local governments, representatives of industry and environmental groups, other stakeholders and the public.

While NMFS is directly responsible for ESA recovery planning for salmon and steelhead, the agency believes that ESA recovery plans for salmon and steelhead should be based on the many state, regional, tribal, local and private conservation efforts already underway throughout the region. Local support of recovery plans by those whose activities directly affect the listed species, and whose actions will be most affected by recovery efforts, is essential. NMFS therefore supports and participates in locally led collaborative efforts to develop recovery plans that involve local communities; state, tribal, and federal entities; and other stakeholders.

NMFS developed this ESU-level recovery plan by synthesizing material from (1) three geographically based and locally developed recovery plans for Oregon, Idaho and Washington populations of Snake River spring/summer Chinook salmon and steelhead; (2) related recovery plan modules; (3) the work of the Interior Columbia Technical Recovery Team; and (4) additional analyses by technical experts, as needed. The draft plan went through multiple reviews and revisions in response to comments from both technical reviewers and committee members.

1.5.1 Recovery Domains and Technical Recovery Teams

Currently, there are 19 ESA-listed ESUs and DPSs of Pacific salmon and steelhead in the Pacific Northwest. NMFS' Northwest Region also shares jurisdiction of an additional ESU, Southern Oregon/Northern California coho salmon, with the agencies Southwest Region. For the purpose of recovery planning for these species, the Northwest Region designated five geographically based "recovery domains": the Interior Columbia; Willamette-Lower Columbia; Puget Sound and Washington Coast; Oregon Coast; and Southern Oregon/Northern California Coast (Figure 1-5). The range of the listed Snake River salmon and steelhead species is in the Snake River subdomain of the Interior Columbia domain.

For each domain, NMFS appointed a team of scientists with extensive geographic and species expertise to provide a solid scientific foundation for recovery plans. The charge of each Technical Recovery Team (TRT) was to define the historical population structure of each ESU or DPS, to recommend biological viability criteria for each ESU and DPS and the component populations, to provide scientific support to local and regional recovery planning efforts, and to provide scientific evaluations of proposed recovery plans. The Interior Columbia Technical Recovery Team (ICTRT) includes biologists from NMFS' Northwest Fisheries Science Center, state agencies, tribal entities, and academic institutions.

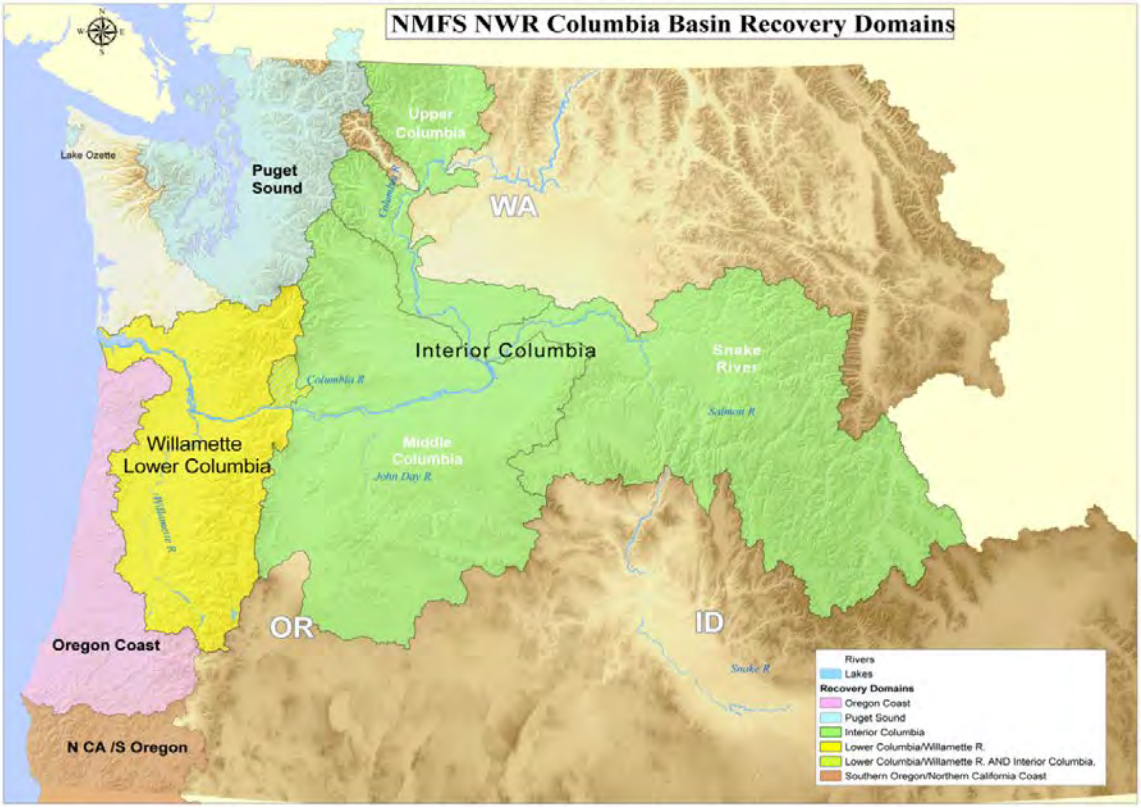


Figure 1-5. NMFS Pacific Northwest Salmon and Steelhead Recovery Domains.

Each TRTs used the same biological principles to develop its recommended ESU and population viability criteria. These viability criteria will be used in combination with criteria based on mitigation of the factors for decline to determine whether a species has recovered sufficiently to be down-listed or delisted. The biological principles that underlie the viability criteria are described in the NMFS' technical memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000). A viable ESU or DPS is defined as naturally self-sustaining over the long term. McElhany et al. describe viable salmonid populations (VSP) in terms of four parameters: abundance, population productivity or growth rate, population spatial structure, and diversity.

Each TRT's recommendations are based on the VSP framework and considerations related to data availability, the unique biological characteristics of the ESU or DPS and the habitats in the domain, and the TRT members' collective experience and expertise. Although NMFS has encouraged the TRTs to develop regionally specific approaches to evaluating viability and identifying factors limiting recovery, each TRT has worked from a common scientific foundation to ensure that the recovery plans are scientifically sound and based on consistent biological principles.

NMFS and local recovery planning groups used the TRT recommendations to develop goals for the recovery plans. As the agency with ESA jurisdiction for salmon and steelhead, NMFS makes final determinations of ESA delisting criteria.

1.5.2 Management Unit Plans and Integration of Management Unit Plans

In each domain, NMFS has worked with state, tribal, local and other federal entities to develop planning forums, building to the extent possible on ongoing, locally led recovery efforts. NMFS defined "management units" for recovery planning based on jurisdictional boundaries, as well as areas where local planning efforts were underway (Figure 1-6). To accommodate the different planning efforts and jurisdictional boundaries, NMFS partitioned the Snake River subdomain into three separate management units for spring/summer Chinook salmon and steelhead: the northeast Oregon unit, southeast Washington unit, and Idaho unit.

Three separate management unit plans have been developed for the management units. All three plans were developed in coordination with respective state, federal, and local agencies, tribes, and others. This ESU-level recovery plan synthesizes relevant information from the three management unit plans for northeast Oregon, southeast Washington, and Idaho.

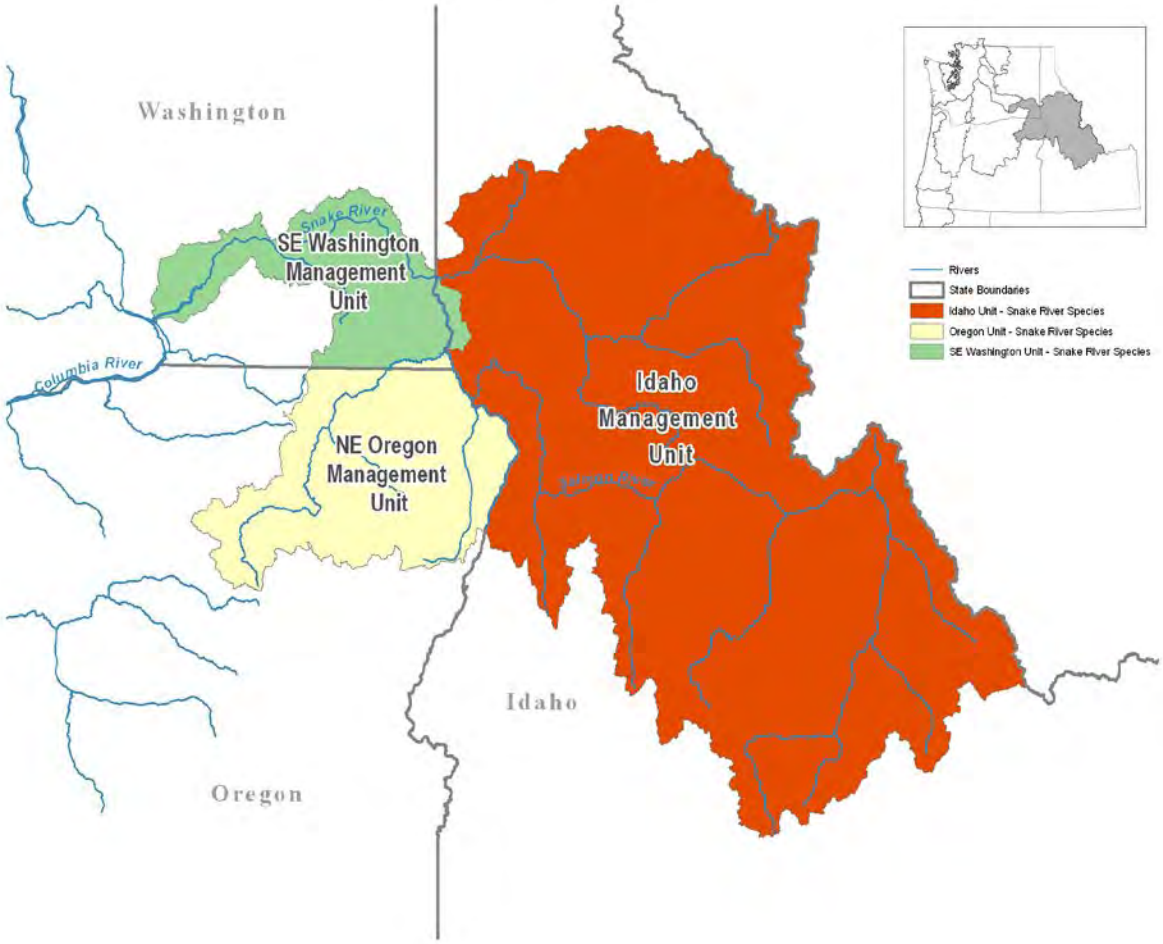


Figure 1-6. Snake River Basin Recovery Subdomain Displaying the Idaho, Northeast Oregon, and Southeast Washington Management Units.

Northeast Oregon Snake River Salmon and Steelhead Recovery Plan

The recovery plan for the northeast Oregon management unit covers Oregon's portion of the Snake River spring/summer Chinook salmon ESU and steelhead DPS, and a small corner of southeast Washington. The populations occupy habitats in the Grande Ronde River and Imnaha River subbasins. The plan was produced through a collaborative process initiated by NMFS and involving wide participation by natural resource agency staff and others. Participants in the process included the state of Oregon, the Grande Ronde Model Watershed, U.S. Fish and Wildlife Service, Bureau of Land Management, Bureau of Reclamation, U.S. Forest Service, ODFW, Oregon Department of Forestry, Oregon Department of Agriculture, the Nez Perce Tribe, the Confederated Tribe of the Umatilla Indian Reservation, Soil and Water Conservation Districts, Wallowa Resources, The Nature Conservancy, Hells Canyon Preservation Council, Farm Bureau, Natural Resources Conservation Service, and others. A sounding board and technical team played key roles in the plan's development. The resulting plan is meant to serve both as a federal recovery plan under the ESA and a state of Oregon conservation plan under Oregon's Native Fish Conservation Policy. The plan also influences actions implemented for the Oregon Plan for Salmon and Watersheds, including those actions coordinated by the Oregon Watershed Enhancement Board. This ESU-level plan includes the *Recovery Plan for Oregon Spring/Summer Chinook Salmon and Steelhead Populations* as Appendix A.

Southeast Washington Snake River Salmon and Steelhead Recovery Plan

The recovery plan for the southeast Washington management unit covers the portion of the Snake River spring/summer Chinook salmon ESU and steelhead DPS in Washington. The plan addresses the spring/summer Chinook salmon and steelhead populations that spawn and rear in Washington tributaries to the lower Snake River, including Asotin Creek and the Tucannon, Walla Walla and Touchet Rivers. The plan also defined actions for recovery of bull trout populations in southeast Washington, which are ESA-listed by U.S. Fish and Wildlife Service. The Snake River Salmon Recovery Board led the recovery planning effort. The board is comprised of government and tribal representatives, landowners, and private citizens. It operates through several committees including a lead entity project review and ranking committee, a regional technical team, and an executive committee. The recovery plan is based primarily on the subbasin plans developed by local entities for the Northwest Power and Conservation Council's Fish and Wildlife Program, as well as other state and local plans and documents. Besides serving as a federal recovery plan under the ESA, the plan will be shared with state and local natural resource agencies and stakeholders to inform future actions to recover the species and their habitats. This ESU-level plan includes the *Snake River Salmon Recovery Plan for Southeast Washington* as Appendix B.

Idaho Snake River Salmon and Steelhead Recovery Plan

The recovery plan for the Idaho management unit covers the portion of the Snake River spring/summer Chinook salmon ESU and steelhead DPS that occurs in Idaho. NMFS led the development of the Idaho recovery plan in coordination with the state of Idaho and other stakeholders. The Idaho recovery plan addresses recovery needs for Snake River spring/summer Chinook salmon populations in the Salmon River basin, and Snake River steelhead populations in the Salmon and Clearwater basins. NMFS and the state of Idaho used information and criteria provided by the ICTRT to identify the specific populations of Idaho Snake River spring/summer Chinook salmon and steelhead. These populations became the focus of recovery actions in the

plan. The agencies solicited comments from stakeholders and other interested parties during the planning process and revised the plan to address concerns raised by the various entities. NMFS and the state of Idaho will work with other federal and state agencies, tribal and local governments, and other parties to implement recovery efforts. This ESU-level plan includes the *Recovery Plan for Idaho Snake River Spring/Summer Chinook Salmon and Steelhead* as Appendix C.

Relationship between Management Unit Plans and ESU/DPS-level Plan

This ESU-level recovery plan for the Snake River spring/summer Chinook salmon ESU and steelhead DPS is a synthesis of the northeast Oregon, southeast Washington, and Idaho management unit plans. It also provides additional analyses, as appropriate, and summarizes direction from related recovery plan modules that address estuary habitat and hydropower (see Section 1.5.3). The ESU-level recovery plan provides an ESU-level perspective on the baseline status of the Snake River ESU and DPS, goals and delisting criteria, limiting factors, scenarios for reducing threats, recovery actions, implementation, and research, monitoring and evaluation. As required by the ESA, this ESU-level recovery plan fully addresses the recovery needs of the Snake River spring/summer Chinook salmon ESU and steelhead DPS, throughout their life cycle and across their geographic range, which encompasses multiple management units.

The more detailed northeast Oregon, southeast Washington, and Idaho management unit recovery plans are part of this ESU-level plan, which includes them as appendices. By doing so, the ESU-level plan endorses the management unit plans' recommendations and acknowledges that certain recovery decisions (such as decisions about site-specific habitat actions) should be left to local recovery planners and implementers, as represented in the management unit plans.

1.5.3 Recovery Plan Modules and Other Documents

Because of the complexity of the salmonid life cycle, some regional issues that affect the Snake River spring/summer Chinook salmon ESU and steelhead DPS are beyond the scope of any one management plan. NMFS has produced modules to address these regional issues and assist in recovery planning for ESA-listed Columbia Basin salmon and steelhead species. The modules identify and provide direction to address threats in the Columbia mainstem and estuary, through which Snake River salmon and steelhead and other anadromous salmonids must pass as juveniles and returning adults. Recovery plan modules include the Hydro Module, Estuary Module and Harvest Module. The three management unit recovery plans and these modules provide the foundation for, and are appendices to, this comprehensive recovery plan, which addresses the basin-wide needs of Snake River spring/summer Chinook and Snake River steelhead. The modules will be updated periodically to reflect new data.

Hydro Module

NMFS completed the draft Supplemental Recovery Plan Module for Snake River Species Hydropower & Water Storage Projects "Snake River Hydro Module" in February 2012. The document supplements the 2008 Hydro Module for Snake River anadromous fish species listed under the ESA: Snake River steelhead, Snake River spring/summer Chinook, Snake River fall Chinook, and Snake River sockeye. The module discusses limiting factors and threats imposed by the FCRPS, and expected actions (including site-specific management actions), or strategy

options, to address those threats. The FCRPS consists of 14 projects in the Columbia River basin, each comprising dams, powerhouses, and reservoirs that are operated as a coordinated system for power production and flood control. The Hydro Module is a synthesis of information that has undergone public processes for review, including, but not limited to, the FCRPS 2008 Biological Opinion, Federal Energy Regulatory Commission (FERC) licensing proceedings, and Habitat Conservation Plans (HCPs). The draft Snake River Hydro Module is available on the NMFS Web site: www.nwr.noaa.gov/Salmon Recovery Planning/Recovery Domains/Interior-Columbia/Snake/Snake-Plans.cfm.

Estuary Module

The *Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead* (NMFS 2011a) discusses conditions in the lower Columbia River below Bonneville Dam that affect the survival of ESA-listed coho, Chinook, chum, and steelhead from throughout the Columbia Basin. NMFS prepared the document in collaboration with the Lower Columbia Estuary Partnership. Geographically, the module covers the tidally influenced reaches of the lower river, estuary, and plume. The module identifies and prioritizes limiting factors and threats in the estuary that affect salmonid viability and describes 23 broad actions that, if implementation, would increase the survival of salmon and steelhead during their time in the estuary and plume. The module also estimates the cost of implementing the actions and describes monitoring, research, and evaluation needs. This module is incorporated into the recovery plan by reference. It is available on the NMFS web site: www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Estuary-Mod.pdf.

Harvest Module

NMFS has also prepared a draft Harvest Module for the Snake River recovery plan (Harvest Module). The 2010 Harvest Module describes fishery policies, programs, and actions affecting the fish species covered by the Snake River Recovery Plan. The Harvest Module is also available on the NMFS web site: www.nwr.noaa.gov/Salmon Recovery Planning/Recovery Domains/Interior-Columbia/Snake/Snake-Plans.cfm.

Ocean Module: add description

Northwest Fisheries Science Center Documents

This recovery plan draws upon the resources of NOAA's Northwest Fisheries Science Center, which supports research and publishes technical memoranda pertinent to salmon and steelhead recovery plans for the Columbia River basin and Snake River basin species.

1.5.4 Relationship to other Processes

Many different conservation and recovery planning processes in Oregon, Washington, Idaho, and the larger Pacific Northwest region influenced the development of the ESU-level recovery plan. Efforts made through the recovery planning processes attempted to achieve consistency with these other plans and planning processes to the extent possible. These efforts will continue during recovery plan implementation. The implementation processes identified in this ESU-level plan and the three management unit plans provide for continued coordination and communication across the different planning efforts.

Northwest Power and Conservation Council Subbasin Plans

The Northwest Power and Conservation Council (NPCC), created by Congress in 1980, gives the states of Washington, Oregon, Idaho, and Montana a voice in regional energy planning and in mitigating the effects of the Federal Columbia River Power System on fish and wildlife. The NPCC's Columbia Basin Fish and Wildlife Program solicits and evaluates proposals for on-the-ground projects and research to meet these responsibilities. The Bonneville Power Administration (BPA) provides funding for NPCC-identified priority projects. In 2005, the NPCC completed a watershed planning effort that resulted in locally developed plans for designated subbasins in the Columbia Basin, including subbasins within the geographic range of Snake River spring/summer Chinook and steelhead. The subbasin plans provide valuable information on watershed-scale freshwater habitat conditions, limiting factors, and threats, and identify strategies to address those limiting factors and threats. NMFS and its planning partners are using the subbasin plans as building blocks for ESA salmon and steelhead recovery plans. Information from the subbasin plans for areas that historically provided freshwater habitat for Snake River spring/summer Chinook salmon and steelhead has been incorporated into the three management unit plans and this ESU-level recovery plan. NMFS will continue to work with the NPCC and BPA to coordinate implementation of the Columbia River Basin Fish and Wildlife Program and ESA salmon recovery plans. Further information on the NPCC Fish and Wildlife Program and subbasin plans is available at: http://www.nwcouncil.org/fw/.

NMFS' 2008 FCRPS Biological Opinion and 2010 Supplement

The Federal Columbia River Power System (FCRPS) is a series of dams and reservoirs in the Columbia River basin that are managed for multiple purposes: power production, flood control, irrigation, navigation, recreation, and fish, wildlife, and cultural resource protection. Snake River salmon and steelhead pass eight of the dams while migrating through the Columbia and Snake Rivers. In addition, dam-related alterations of natural flow patterns in the mainstem, estuary, and plume are responsible for decreased water velocity, longer migratory travel time (which increases exposure to predators) and higher water temperatures during the spring freshet. Each of these factors is associated with mortality of ESA-listed salmon and steelhead. Under law, the agencies that operate the FCRPS—the Bonneville Power Administration, U.S. Army Corps of Engineers, and Bureau of Reclamation (collectively referred to as the Action Agencies)—must consult with NMFS on proposed FCRPS operations that may affect a listed fish species or its habitat. The product of such consultation is a Biological Opinion (BiOp). NMFS issued the 2008 FCRPS BiOp on May 5, 2008. In February 2010, NMFS issued the 2010 Supplemental BiOp for the FCRPS (NMFS 2010a). This Supplemental BiOp integrated elements from the 2008 BiOp and the Adaptive Management Implementation Plan (AMIP). The AMIP included accelerated and enhanced actions to protect listed Columbia Basin salmon and steelhead. The 2010 Supplemental BiOp is available at:
http://salmonrecovery.gov/Files/BiologicalOpinions/2010/FCRPS_Supplemental_2010_05-20[1].

Columbia River Hatchery Scientific Review Group

In 2005, Congress directed NMFS to implement a hatchery reform effort for the Columbia Basin using the Puget Sound and Coastal Washington hatchery reform project as a model. The resulting Columbia River Hatchery Scientific Review Group (HSRG) conducted a collaborative,

scientific review of hatchery programs in the Columbia Basin and identified alternatives for managing the hatchery programs more efficiently in the future (HSRG 2009). The HSRG concluded that hatcheries play an important role in the management of salmon and steelhead populations in the Pacific Northwest. Nevertheless, the traditional practice of replacing natural populations with hatchery fish to mitigate for habitat loss and mortality resulting from hydropower dams is not consistent with today's conservation principles and scientific knowledge. Hatchery fish cannot replace lost habitat or the natural populations that rely on that habitat.

The HSRG concluded that hatchery programs should be viewed as tools that can be managed as part of a coordinated strategy to meet watershed or regional resource goals, in concert with actions affecting habitat, harvest rates, water allocation, and other factors that influence salmon and steelhead survival. The HSRG reached several conclusions regarding areas where current hatchery and harvest practices need to be reformed through policy, management, research, and monitoring practices:

- Manage hatchery broodstocks to achieve proper genetic integration with, or segregation from, natural populations.
- Promote local adaptation of natural and hatchery populations.
- Minimize adverse ecological interactions between hatchery- and natural-origin fish.
- Minimize effects of hatchery facilities on the ecosystem.
- Maximize survival of hatchery fish.

The HSRG developed three principles for hatchery management that are applicable to hatchery programs across Puget Sound, the Washington Coast, and the Columbia Basin: 1) Develop clear, specific, and quantifiable harvest and conservation goals for natural and hatchery populations within an "all-H" (hatcheries, habitat, hydro, harvest) context. 2) Design and operate hatchery programs in a scientifically defensible manner. 3) Monitor, evaluate, and adaptively manage hatchery programs. The HSRG discusses these principles and 17 associated system-wide recommendations in its System-Wide Report on Columbia River Basin Hatchery Reform. This report and the HSRG's report to Congress on Columbia River Basin Hatchery Reform are available at: http://www.hatcheryreform.us/. NMFS and hatchery program managers consider the HSRG's recommendations in the development of Hatchery Genetic Management Plans (HGMPs). The HGMPs describe hatchery program operations and actions taken to support recovery and minimize ecological or genetic impacts, such as straying and other forms of competition with naturally produced fish.

State-level Planning Processes

The three management units for Snake River spring/summer Chinook salmon and steelhead recovery planning divide the Snake River basin by state boundaries and incorporate direction from related state planning processes. It is NMFS' intent that this ESU-level plan and the management unit plans for northeast Oregon, southeast Washington, and Idaho complement and build on direction defined through the state planning processes.

For the Northeast Oregon recovery plan, NMFS worked with the Oregon Department of Fish and Wildlife and Oregon Governor's Natural Resource Office to develop a recovery plan that would also meet the requirements of a conservation plan under Oregon's Native Fish Conservation Policy. NMFS will continue to work with these departments and other natural resource agencies to set priorities, implement actions and identify future needs to achieve recovery.

For the Southeast Washington recovery plan, NMFS and the Snake River Salmon Recovery Board actively sought to achieve consistency with state of Washington habitat conservation plans, habitat preservation programs, conservation reserve enhancement programs, watershed plans, and other documents and efforts. NMFS and the Snake River Salmon Recovery Board will continue to collaborate and coordinate with these forums during plan implementation to achieve recovery.

For the Idaho recovery plan, NMFS worked together with the state of Idaho to identify the specific Snake River spring/summer Chinook salmon and steelhead populations, and define the strategies and actions focused for their recovery. NMFS will continue to work with the state of Idaho during plan implementation to achieve recovery.

Columbia River Treaty

Efforts through the Columbia River Treaty provide coordinated management of resource management issues related to the Columbia River. The Treaty was signed by the United States and Canada in 1964, and calls for two "entities" to implement the Treaty — a U.S. Entity and a Canadian Entity. The U.S. Entity, created by the President, consists of the Administrator of the Bonneville Power Administration (chair) and the Northwestern Division Engineer (member) of the U.S. Army Corps of Engineers. The Canadian Entity, appointed by the Canadian Federal Cabinet, is the British Columbia Hydro and Power Authority (B.C. Hydro). Currently, the U.S. Entity is undertaking a series of studies, known as the Columbia River Treaty 2014/2024 Review, to evaluate Treaty benefits to the region and consider concerns that reach beyond flood risk management and power generation. More information on these studies and the Treaty are available at: http://www.crt2014-2024review.gov/UsEntity.aspx.

Other Planning Processes

The recovery plan is also based on information and direction from many other planning processes, including tribal resource management plans, local watershed assessments, and federal land management plans and research. Each of these planning efforts reflects the authorities, policies and objectives of the specific organization, government or entity that develop these products; however, actions identified and implemented through these different parties to improve watershed conditions often overlap salmonid recovery efforts. NMFS and the recovery planners continue to coordinate with these different parties and build upon their related efforts to ensure that recovery actions are cost effective and successful.

1.6 Tribal Trust and Treaty Responsibilities

The salmon and steelhead that were once abundant in the watersheds of the Snake River basin were crucial to Native Americans throughout the region. Pacific Northwest Indian tribes today retain strong spiritual and cultural ties to salmon and steelhead, based on thousands of years of

use for tribal religious/cultural ceremonies, subsistence, and commerce. The tribes within the range of the two Snake River species addressed in this plan include the Nez Perce, the Confederated Tribes of the Umatilla Indian Reservation (the Walla Walla, Cayuse and Umatilla Tribes), the Shoshone-Paiute Tribes and the Shoshone-Bannock Tribes.

A complex history of treaties, executive orders, legislation and court decisions have cumulated in the recognition of the tribes as co-managers who share management responsibilities and rights for fisheries in the Columbia Basin. Many Northwest Indian tribes have treaties reserving their right to fish in usual and accustomed fishing places, including areas covered by this recovery plan. These Columbia and Snake basin treaty tribes are co-managers of salmon stocks and participate in management decisions, including those related to hatchery production and harvest. Some other tribes in the Columbia Basin, whose reservations were created by Executive Order, do not have treaty reserved rights but do have a trust relationship with the federal government and an interest in salmon and steelhead management, including harvest and hatchery production. Other tribes, while not asserting treaty reserved rights, do fish for subsistence and ceremonial purposes in areas covered by this plan, in compliance with agreements with the state of Oregon.

The NMFS Regional Administrator, in testimony before the U.S. Senate Indian Affairs Committee (Lohn 2003), emphasized the importance of this co-manager relationship: "We have repeatedly stressed to the region's leaders, tribal and non-tribal, the importance of our co-management and trust relationship to the tribes. NMFS enjoys a positive working relationship with our Pacific Northwest tribal partners. We view the relationship as crucial to the region's future success in recovery of listed salmon."

Native American treaty-reserved fishing rights in the Columbia Basin are under the continuing jurisdiction of the U.S. District Court for the District of Oregon in the case *United States v. Oregon*, No. 68-513 (filed in 1968). In *U.S. v. Oregon*, the Court affirmed that certain treaties reserved for the tribes up to 50 percent of the harvestable surplus of fish destined to pass through their usual and accustomed fishing areas. The *U.S. v. Oregon* process affects the allocation of harvest among various fisheries and thus affects how fisheries are managed in the Columbia and Snake Rivers.

Restoring and sustaining a sufficient abundance of salmon and steelhead for harvest is important in fulfilling tribal fishing aspirations. It is NMFS' policy to promote restoration of salmon and steelhead runs sufficient for tribal harvest. This policy is described in a July 21, 1998 letter from Terry D. Garcia, Assistant Secretary for Oceans and Atmosphere, U.S. Department of Commerce, to Mr. Ted Strong, Executive Director of the Columbia River Inter-Tribal Fish Commission. This letter states that recovery "must achieve two goals: (1) the recovery and delisting of salmonids listed under the provisions of the ESA, and (2) the restoration of salmonid populations over time, to a level to provide a sustainable harvest sufficient to allow for the meaningful exercise of tribal fishing rights."

Thus, it is appropriate for recovery plans to acknowledge tribal harvest goals. Where tribal harvest goals can only be met through hatchery production, recovery plans will identify strategies and actions to ensure the hatchery production is consistent with recovery of naturally spawning populations.

2 ▪ Biological Structure and Viability

This chapter presents biological background information that will aid the reader in understanding the limiting factor and threats analyses, recovery criteria and goals, and recovery strategies that are part of this ESU-level recovery plan. Specifically, the chapter describes basic concepts in salmonid biology (i.e., biological structure, population viability, and critical habitat), presents biological criteria the ICTRT developed for assessing the viability of Interior Columbia River salmon and steelhead, and briefly summarizes methods and benchmarks the ICTRT recommends for evaluating individual population status. Recovery goals in the management unit plans and NMFS' criteria for delisting the Snake River species are both based on the work of the ICTRT. (See Chapter 3 for recovery goals and delisting criteria.)

2.1 Salmonid Biological Structure

Recovery planning for salmon and steelhead focuses on a hierarchical biological structure that extends from the species level to a level below the population. This structure reflects a species' homing propensity (their tendency to return to the locations where they originated), distribution across the landscape, and the diverse genetic, life history, and morphological characteristics that have evolved over generations and contributed significantly to its long-term persistence.

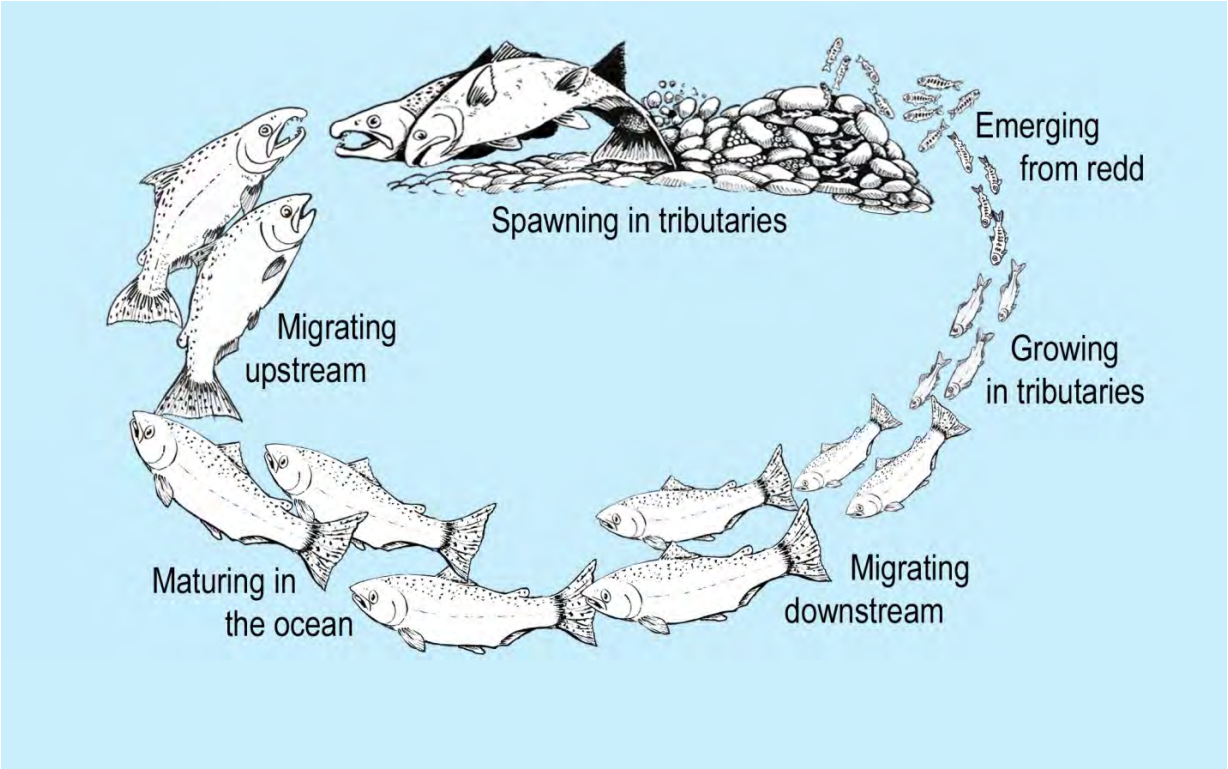


Figure 2-1 Anadromous Salmon and Steelhead Life Cycle.

Historically, a salmon ESU or steelhead DPS typically contained multiple populations connected by some small degree of genetic exchange that reflected the geography of the river basins in which they spawned. Thus, the overall biological structure of the ESU or DPS is hierarchical, and spawners in the same area of the same stream share more characteristics than they do with those in the next stream over. Fish whose natal streams are separated by hundreds of miles generally have less genetic similarity. The ESU or DPS is essentially a metapopulation defined as a group of populations connected by limited exchange of migrants. Recovery planning efforts focus on this biologically based hierarchy, which reflects the degree of connectivity between the fish at each geographic and conceptual level.

Two levels in the hierarchy, the evolutionarily significant unit (ESU) or distinct population segment (DPS) and the independent population, were formally defined for listing, delisting and recovery planning purposes. The ICTRT identified an additional level in the hierarchy between the population and ESU/DPS levels, which they call a major population group (MPG) (McClure et al. 2003). These three levels in the hierarchy are described below.

- **Evolutionarily Significant Unit & Distinctive Population Segments:** Two criteria define an ESU of salmon listed under the ESA: 1) it must be substantially reproductively isolated from other conspecific units, and 2) it must represent an important component of the evolutionary legacy of the species (Waples et al. 1991). Two similar, but slightly different, criteria define a DPS of steelhead listed under the ESA: 1) discreteness of the population segment in relation to the remainder of the species to which it belongs, and 2) significance of the population segment to the species to which it belongs. ESUs and DPSs may contain multiple populations that are connected by some degree of migration, and hence may have a broad geographic range across watersheds, river basins, and political jurisdictions.

- **Major Population Groups:** Within an ESU/DPS, independent populations can be grouped into larger aggregates that share similar genetic, geographic, and/or habitat characteristics (McClure et al. 2003). These "major groupings" are groupings of populations that are isolated from one another over a longer time scale than that defining the individual populations, but which retain some degree of connectivity greater than that between different ESUs or DPSs. The ICTRT defines this level in the hierarchy as Major Populations Groups (MPGs). These MPGs are analogous to “strata” as defined by the Lower Columbia-Upper Willamette TRT and “geographic regions” described by the Puget Sound TRT.

- **Independent Populations:** McElhany et al. (2000) defined an independent population as: “…a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season. For our purposes, not interbreeding to a ‘substantial degree’ means that two groups are considered to be independent populations if they are isolated to such an extent that exchanges of individuals among the populations do not substantially affect the population dynamics or extinction risk of the independent populations over a 100-year time frame.”

The independent populations exhibit different population attributes that influence their abundance, productivity, spatial structure and diversity. Independent populations are the units that will be combined to form alternative recovery scenarios for MPGs and ESU viability ─ and, ultimately, are the objects of recovery efforts.

Figure 2-2 shows the relationship between the three levels.

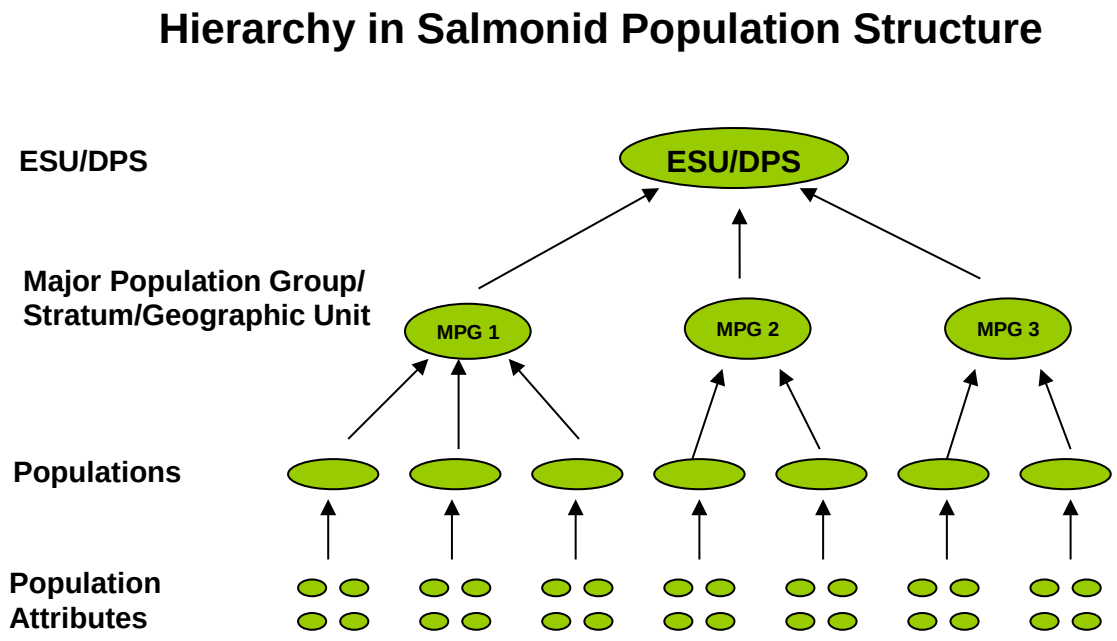


Figure 2-2. Hierarchical levels of salmonid species structure as defined by the TRTs for ESU/DPS recovery planning.

2.1.1 Population Structure Adopted for Recovery Planning

NMFS adopted the ESU/DPS, Major Population Group, and population structure defined by the ICTRT for purposes of Snake River spring/summer Chinook salmon and steelhead recovery planning. NMFS and the ICTRT identified the population groups of Snake River spring/summer Chinook salmon and steelhead based on geography, migration rates, genetic attributes, life history patterns, phenotypic characteristics, population dynamics, and environmental and habitat characteristics (Myers et al. 2006), as well as an understanding of the characteristics of viable salmonid populations (McElhany et al. 2000).

Snake River Spring/Summer Chinook Populations

The ICTRT identified five MPGs in the Snake River spring/summer Chinook ESU: Upper Salmon River, Middle Fork Salmon River, South Fork Salmon River, Grande Ronde/Imnaha Rivers, and Lower Snake River (ICTRT 2008). Together, as shown in Figure 2-3, the five MPGs

in the ESU contain 28 extant independent populations. They also contain two functionally extirpated populations and two extirpated populations (ICTRT 2008).[4]

Figure 2-3. Major Population Groups and Populations of Snake River Basin Spring/Summer Chinook. *** extirpated populations ** functionally extirpated populations.**

Snake River Steelhead Populations

The ICTRT identified six historical MPGs in the Snake River steelhead DPS ─ Clearwater River, Salmon River, Grande Ronde River, Imnaha River, Lower Snake River, Hells Canyon Tributaries (ICTRT 2008). Figure 2-4 shows these major population groups. The historical Hells Canyon MPG is now extirpated; construction of Hells Canyon Dam blocked passage of anadromous fish to historical habitat in the Snake River and tributaries upstream of the dam. Together, the five extant MPGs in the DPS support 24 extant independent populations (ICTRT 2008).

[4] Extirpated populations are considered to be locally extinct. The ICTRT considers extirpated populations to be those that are entirely cut off from anadromy. Functionally extirpated populations are those where there are not enough fish or habitat in suitable condition to support a fully functional population.

Figure 2-4. Major Population Groups and Populations of Snake River Basin Steelhead.
* extirpated populations ** functionally extirpated populations.
[Need separate 'bubble' for Imnaha River MPG.]

2.2 Viable Salmonid Populations

Viability is a key concept within the context of the Endangered Species Act. As described in NMFS' technical memorandum, *Viable Salmon Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000), a viable salmonid ESU or DPS is naturally self-sustaining over the long term. A viable salmonid population has a negligible risk of extinction over a 100-year timeframe (McElhany et al. 2000). NMFS scientists describe a viable salmonid population (VSP) in terms of four parameters: abundance, population productivity or growth rate, population spatial structure, and life history and genetic diversity. These parameters are closely associated, such that improvements in one parameter typically cause, or are related to, improvements in another parameter. For example, improvements in productivity might depend on increased diversity or habitat quality, and be accompanied by increased abundance and spatial structure.

2.2.1 Abundance and Productivity

Abundance refers to the number of spawners (adults on the spawning ground), averaged over a period sufficient to account for year-to-year fluctuations that are due to natural environmental variation. The ICTRT often uses a recent 10- or 12-year geometric mean of natural spawners as a measure of current abundance.

The productivity of a population (the average number of surviving offspring per parent) is a measure of the population's ability to sustain itself. Productivity can be measured as spawner-to-

spawner ratios (returns per spawner or recruits per spawner, meaning adult progeny to parent), annual population growth rate, or trends in abundance. Population-specific estimates of abundance and productivity are derived from time series of annual estimates, which typically are subject to a high degree of annual variability and sampling-induced uncertainties. The ICTRT recommends estimating current intrinsic productivity using spawner-to-spawner return pairs from low to moderate escapements over a recent 20-year period.

Abundance and productivity are linked. Populations with low productivity can still persist if they are sufficiently large, and small populations can persist if they are sufficiently productive. A viable population needs sufficient abundance to maintain genetic health and to respond to normal environmental variation, and sufficient productivity to enable the population to quickly rebound from periods of poor ocean conditions or freshwater perturbations.

The VSP guidelines for abundance recommend that a viable population should 1) be large enough to have a high probability of surviving environmental variation observed in the past and expected in the future, 2) be resilient to environmental and anthropogenic disturbances, 3) maintain genetic diversity, and 4) provide ecosystem functions (McElhany et al. 2000). Factors suggesting that a population is at a critically low size include decreased reproductive success because individuals cannot efficiently find mates, fixation of harmful genetic mutations or reduced fitness as a result of inbreeding, and random demographic effects, such as if the variation in individual reproduction becomes important.

Productivity guidelines for viability are reached when a population's productivity is such that abundance can be maintained above the viable level, viability is independent of hatchery subsidy, viability is maintained even during sequences of poor environmental conditions, declines in abundance are not sustained, life history traits are not in flux, and conclusions about a population's productivity are independent of uncertainty in parameter estimates (McElhany 2000).

Viability guidelines suggest that abundance should be high enough that 1) declines to critically low levels would be unlikely, assuming recent historical patterns of environmental variability and intrinsic productivity; 2) compensatory processes provide resilience to the effects of short-term perturbations; and 3) subpopulation structure is maintained (e.g., multiple spawning tributaries, spawning patches, life history patterns) (ICTRT 2005).

2.2.2 Spatial Structure and Diversity

Considerations of spatial structure and diversity are combined in the evaluation of a salmonid population's status because they often overlap. A population's spatial structure is made up of both the geographic distribution of individuals in the population and the processes that generate that distribution (McElhany et al. 2000). Spatial structure refers to the amount of habitat available, the organization and connectivity of habitat patches, and the relatedness and exchange rates of adjacent populations. Spatial structure influences the viability of salmon and steelhead because populations with restricted distribution and few spawning areas are at a higher risk of extinction as a result of catastrophic environmental events, such as a landslide, than are populations with more widespread and complex spatial structures. A population with a complex spatial structure, including multiple spawning areas, experiences more natural exchange of gene

flow and life history characteristics. (However, excessive exchange of migrants above historical levels can impede the process of local adaptation.).

Diversity refers to the distribution of life history, behavioral, and physiological traits within and among populations. Some traits are completely genetically based, while others, including nearly all morphological, behavioral, and life history traits, vary as a result of a combination of genetic and environmental factors (McElhany et al. 2000).

Like spatial structure, population-level diversity is important for long-term persistence of salmon and steelhead. Populations exhibiting greater diversity are generally more resilient to short-term and long-term environmental changes. Phenotypic diversity, which includes variation in morphology and life history traits, allows more diverse populations to use a wider array of environments, and protects populations against short-term temporal and spatial environmental changes. Underlying genetic diversity provides the ability to survive long-term environmental changes.

Because neither the precise role that diversity plays in salmonid population viability nor the relationship of spatial processes to viability is completely understood, the ICTRT adopted the principle from McElhany et al. (2000) that historical spatial structure and diversity should be taken as a "default benchmark," on the assumption that historical, natural populations did survive many environmental changes and therefore must have had adequate spatial structure and diversity.

McElhany et al. (2000) also offers spatial structure and diversity guidelines for viable salmonid populations. Spatial structure guidelines are reached when the number of habitat patches is stable or increasing, stray rates are stable, marginally suitable habitat patches are preserved, refuge source populations are preserved, and uncertainty is taken into account. Diversity guidelines are reached when variation in life history, morphological, and genetic traits is maintained; natural dispersal processes are maintained; ecological variation is maintained; and the effects of uncertainty are considered.

For all four of the viable salmonid population parameters, the guidelines recommend that population-specific status evaluations, goals, and criteria take into account the level of scientific uncertainty about how an individual parameter relates to a population's viability (McElhany 2000).

2.3 ICTRT Biological Viability Criteria and Approach

One of the main tasks that NMFS assigned to the ICTRT for recovery planning was to recommend biologically based viability criteria for application to Interior Columbia species of salmon and steelhead listed under the ESA. Viability criteria identify characteristics and conditions that, when met, will describe viable populations and viable species. The viability criteria also identify the metrics and thresholds that may be used to determine the status of a population and the viability risk. Thus, the biological viability criteria provided an important foundation for use in determining recovery goals and delisting criteria for Snake River spring/summer Chinook salmon and steelhead.

The ICTRT's biological viability criteria are consistent with guidance contained in the NMFS Technical Memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000). This memorandum provides general direction for setting viability objectives at the species and component population levels. Viable Salmonid Population (VSP) guidelines provided by McElhany et al. (2000) address four major considerations: abundance, productivity, spatial structure, and diversity.

Consistent with NMFS' guidance, the ICTRT's biological viability criteria define characteristics that describe viability at the ESU/DPS, MPG and population levels. They are designed to assess risk for abundance/productivity and spatial structure/diversity at the population level. These assessments are then "rolled up" to arrive at composites for the MPG and ESU levels. The criteria reflect the best available science and consist of a combination of general statements and metrics that characterize viability.

The viability criteria are summarized below and outlined in more detail in the ICTRT's draft technical report, *Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs* (ICTRT 2007). The report is available at: http://www.nwfsc.noaa.gov/trt/col/trt_viability.cfm. The three management units describe how the criteria were used to informed decisions during the recovery planning process.

2.3.1 ESU- and DPS-Level Viability Criteria

The ESU/DPS-level viability criterion focuses on ensuring the preservation of basic historical metapopulation processes needed to maintain a viable ESU or DPS in the face of long-term ecological and evolutionary processes. These characteristics include 1) genetic exchange across populations within an ESU/DPS over a long time frame; 2) the opportunity for neighboring populations to serve as source areas in the event of local population extirpations; and 3) populations distributed within an ESU/DPS so that they are not all susceptible to a specific localized catastrophic event.

The ESU/DPS viability criterion targets major population group viability. It recognizes that since MPGs are geographically and genetically cohesive groups of populations, they are critical components of ESU/DPS-level spatial structure and diversity. Having all MPGs within an ESU or DPS at low risk provides the greatest probability of persistence of any ESU/DPS.

ESU/DPS Viability Criterion (ICTRT 2007)

All extant MPGs and any extirpated MPGs critical for proper functioning of the ESU or DPS should be at low risk.

The ICTRT viability criteria allow for some flexibility in which populations will be targeted for a particular recovery level to achieve a viable ESU/DPS. The ICTRT recognized that in addition to some extant populations being in better shape than others, there are often one or more extirpated populations within an ESU/DPS. The ICTRT recommended that extirpated populations be included in the total number of populations in the ESU or DPS (for calculating

minimum number of populations in the MPG), but that the initial focus of recovery efforts be put on extant populations, with scoping efforts for re-introductions of extirpated populations conducted concurrently.

2.3.2 MPG-Level Viability Criteria

The ICTRT's MPG-level criteria are designed to ensure robust functioning of metapopulation processes and provide resilience in case of catastrophic loss of one or more populations. The criteria take into account the level of risk associated with the MPG's component populations. They assume that MPG viability depends on the number, spatial arrangement, and diversity associated with its component populations.

MPG-Level Viability Criteria (ICTRT 2007)

The following five criteria should be met for an MPG to be regarded as at low risk (Viable):

1. At least one-half of the populations historically within the MPG (with a minimum of two populations) should meet viability standards.
2. At least one population should be classified as "Highly Viable."
3. Viable populations within an MPG should include some populations classified (based on historical intrinsic potential) as "Very Large," "Large," or "Intermediate" generally reflecting the proportions historically present within the MPG. In particular, Very Large and Large populations should be at or above their composite historical fraction within each MPG.
4. All major life history strategies (e.g., spring and summer run timing) that were present historically within the MPG should be represented in populations meeting viability requirements.
5. Remaining MPG populations should be maintained with sufficient abundance, productivity, spatial structure, and diversity to provide for ecological functions and to preserve options for ESU/DPS recovery.

The MPG-level criteria follow NMFS' recommendations (McElhany et al. 2000) that the presence of viable populations in each extant MPG and some number of highly viable populations distributed throughout the ESU or DPS should result in sustainable production across a substantial range of environmental conditions. This distribution would preserve a high level of diversity within the ESU or DPS, and would promote long-term evolutionary potential for adaptation to changing conditions. The presence of multiple, relatively nearby, highly viable, viable, and maintained populations acts as protection against long-term impacts of localized catastrophic loss by serving as a source of re-colonization. These criteria are consistent with recommendations for other ESUs in the Pacific Northwest (e.g., McElhany et al. 2006, Ruckelshaus et al. 2002) (ICTRT 2007).

2.3.3 Population-Level Viability Criteria

The ICTRT population-level criteria define the viability status of the individual populations that make up a MPG and an ESU/DPS. The ICTRT's criteria describe a viable population based on the four VSP parameters (abundance, productivity, spatial structure, and diversity). As discussed in Section 2.2, these parameters are important indicators of population extinction risk — or,

conversely, a population's probability of persistence. The ICTRT grouped the population-level criteria into two categories: measures addressing abundance and productivity, and measures addressing spatial structure/diversity considerations.

Abundance and Productivity

Abundance refers to the average number of spawners in a population over a generation or more. Productivity, or population growth rate, refers to the performance of the population over time in terms of recruits produced per spawner. Together, these two parameters drive extinction risk.

The ICTRT used a quantitative tool, called a 'viability curve' for evaluating the abundance and productivity (A/P) of a population. A viability curve describes those combinations of abundance and productivity corresponding to a particular extinction risk. The ICTRT developed different viability curves corresponding to a range of extinction risks over a 100-year period: less than 1 percent (very low) risk, 1−5 percent (low) risk, 6−25 percent (moderate) risk, and greater than 25 percent (high) risk. The ICTRT targeted population-level recovery strategies to achieve less than a 5 percent (low) risk of extinction in a 100-year period. This is consistent with the VSP guidelines and conservation literature (McElhany et al. 2000; NRC 1996; ICTRT 2007). The ICTRT considers a population with less than 5 percent risk of extinction in 100 years to be Viable, and a population with a less than 1 percent risk of extinction during the period to be Highly Viable.

The ICTRT (2007) also identified and incorporated 'minimum abundance thresholds' for four different population size categories (basic, intermediate, large and very large) into the viability curves developed for the Interior Columbia populations. The minimum abundance thresholds reflect the viable salmonid principles provided by McElhany et al. (2000), as well as estimates of the relative amount of historical spawning and rearing habitat associated with each population. They represent the number of spawners needed for a population of the given size category to achieve the 5 percent (low) risk level at a given productivity. The ICTRT established a minimum abundance threshold of 500 individual spawners for the small Basic size population. For populations that cover a larger geographic area, the ICTRT identified higher minimum abundance levels that would be necessary to meet the full range of VSP criteria. The minimum abundance thresholds for the Snake River spring/summer Chinook salmon and steelhead populations are shown in Table 2-1 (Chinook) and Table 2-2 (steelhead). For spring/summer Chinook, abundance thresholds are 500, 750, 1000, and 2000 for population sizes of Basic, Intermediate, Large, and Very Large, respectively, with productivity of 2.21, 1.76, 1.58, and 1.34, respectively. For steelhead, abundance thresholds are 500, 1000, 1500 and 2500 for population sizes of Basic, Intermediate, Large, and Very Large, respectively, with productivity of 1.27, 1.14, 1.10, and 1.08, respectively.

Table 2-1. Abundance and Productivity Thresholds for Snake River Spring/Summer Chinook (ICTRT 2007)

MPG	Population	Population Size	Abundance Threshold	Productivity Threshold
Grande Ronde/Imnaha MPG	Wenaha	Intermediate	750	1.76
	Minam	Intermediate	750	1.76
	Catherine Creek	Large	750	1.76
	Lookingglass	_	_	_
	Lostine/Wallowa	Large	1,000	1.58
	Up. Grande Ronde	Large	1,000	1.58
	Imnaha	Intermediate	1,000	1.58
	Big Sheep Creek	Basic	500	2.21
Lower Snake River MPG	Tucannon River	Intermediate	750	1.76
	Asotin Creek	Basic	500	2.21
South Fork Salmon River MPG	Little Salmon River	Intermediate	500	2.21
	Secesh River	Intermediate	750	1.76
	South Fork Salmon	Large	1,000	1.58
	EF South Fork Salmon	Large	1,000	1.58
Middle Fork Salmon River MPG	Chamberlain Cr	Intermediate	500	2.21
	Big Creek	Large	1,000	1.58
	Lower MF Salmon	Basic	500	2.21
	Camas Creek	Basic	500	2.21
	Loon Creek	Basic	500	2.21
	Upper MF Salmon	Intermediate	750	1.76
	Sulphur Creek	Basic	500	2.21
	Bear Valley Creek	Intermediate	750	1.76
	Marsh Creek	Basic	500	2.21
Upper Salmon River MPG	North Fork Salmon	Basic	500	2.21
	Lemhi River	Very Large	2,000	1.34
	Lower Salmon River	Very Large	2,000	1.34
	Pahsimeroi River	Large	1,000	1.58
	East Fork Salmon	Large	1,000	1.58
	Yankee Fork Salmon	Basic	500	2.21
	Valley Creek	Basic	500	2.21
	Upper Salmon River	Large	1,000	1.58
	Panther Creek	Intermediate	750	1.76

Table 2-2. Abundance and Productivity Thresholds for Snake River Steelhead (ICTRT 2007)

MPG	*Population*	*Population Size*	Abundance Threshold	Productivity Threshold
Grande Ronde River MPG	*Joseph Creek*	Basic	500	1.27
	Wallowa	Intermediate	1000	1.14
	Upper Grande Ronde	Large	1500	1.10
	Lower Grande Ronde	Intermediate	1000	1.14
Imnaha River MPG	*Imnaha*	Intermediate	1000	1.14
Lower Snake River MPG	*Tucannon R.*	Intermediate	1000	1.14
	Asotin Cr.	Basic	500	1.27
Clearwater River MPG	*Lower Mainstem*	Large	1,500	1.10
	North Fork	Large	-	-
	Lolo Creek	Basic	500	1.27
	Lochsa River	Intermediate	1,000	1.14
	Selway River	Intermediate	1,000	1.14
	South Fork	Intermediate	1,000	1.14
Salmon River MPG	*Little Salmon R.*	Basic	500	1.27

	South Fork Salmon R.	Intermediate	1,000	1.14
	Secesh R.	Basic	500	1.27
	Chamberlain Creek	Basic	500	1.27
	L. Middle Fork Salmon	Intermediate	1,000	1.14
	U. Middle Fork Salmon	Intermediate	1,000	1.14
	Panther Creek	Basic	500	1.27
	North Fork Salmon R	Basic	500	1.27
	Lemhi River	Intermediate	1,000	1.14
	Pahsimeroi River	Intermediate	1,000	1.14
	East Fork Salmon	Intermediate	1,000	1.14
	Upper Salmon River	Intermediate	1,000	1.14
	Lower Hells Canyon tribs	Below Basic	--	--
Hells Canyon Tributaries* MPG	Powder River	--	--	--
	Burnt River	--	--	--
	Weiser River	--	--	--

* The historical Hells Canyon Tributaries MPG contained three independent populations above the site of Hells Canyon Dam. All three populations are now extirpated. Steelhead are present in the tributaries below Hells Canyon Dam; however, the ICTRT does not consider any of these tributaries (or all combined) to be large enough to support an independent population. The MPG is not expected to contribute to DPS recovery.

Spatial Structure and Diversity

The spatial structure and diversity criteria are specific to each population, and based on historical spatial distribution and diversity, to the extent these can be known or inferred. The ICTRT cautions that there is a good deal of uncertainty in assessing the status of spatial structure and diversity in a population (ICTRT 2007; McElhany et al. 2000).

The ICTRT identified two primary goals, or biological or ecological objectives, that spatial structure and diversity criteria should achieve:

- Maintaining natural rates and levels of spatially mediated processes. This goal serves (1) to minimize the likelihood that populations will be lost due to local catastrophe, (2) to maintain natural rates of recolonization within the population and between populations, and (3) to maintain other population functions that depend on the spatial arrangement of the population.
- Maintaining natural patterns of variation. This goal serves to ensure that populations can withstand environmental variation in the short and long terms (ICTRT 2007).

Integrating the Four VSP Parameters

The ICTRT integrated all four VSP parameters using a simple matrix approach (Figure 2-3). The abundance and productivity risk level combined the abundance and productivity VSP criteria using a viability curve. The spatial structure and diversity risk level integrated across 12 measures of spatial structure and diversity. The overall viability rating for a population was determined using two guiding principles. First, the VSP concept (McElhany et al. 2000) provides a 5 percent risk criterion to define a Viable population. Therefore, any population that scored moderate or high risk in the A/P criteria would not meet the recommended viable standards. In addition, any population that scored high risk in the SS/D criteria would not be considered viable. Second, populations with a very low risk rating for abundance and productivity and at least a low risk rating for spatial structure and diversity would be considered "Highly Viable." Populations with a low risk rating for abundance and productivity and a moderate rating for

spatial structure and diversity would be considered "Viable." This integration approach places greater emphasis on the abundance and productivity criteria. These individual ratings were then integrated to determine the viability of major population groups within an ESU. The assessments of individual MPGs were aggregated to assess the ESU as a whole (ICTRT 2007).

Abundance / Productivity Rating	Spatial Structure / Diversity Rating: Very Low	Low	Moderate	High
Very Low (<1%)	Highly Viable	Highly Viable	Viable	Maintained
Low (<5%)	Viable	Viable	Viable	Maintained
Moderate (<25%)	Maintained	Maintained	Maintained	High Risk
High	High Risk	High Risk	High Risk	High Risk

Figure 2-3. Matrix used to assess population viability across VSP criteria. Percentages for abundance and productivity scores represent the probability of extinction in a 100-year time period (ICTRT 2007).

2.4 Critical Habitat

The ESA requires the federal government to designate critical habitat for any species it lists under the ESA. The ESA defines critical habitat as occupied areas that contain physical or biological features that are essential for the conservation of the species and that may require special management or protection, and unoccupied areas that are essential for conservation. Critical habitat designations must be based on the best scientific information available, in an open public process, within specific timeframes. The designations are one factor to consider during the identification and prioritization of recovery actions in recovery plans.

A critical habitat designation applies only when federal funding, permits, or projects are involved. Under section 7 of the ESA, all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat. Before critical habitat is designated, careful consideration must be given to its economic impacts, impacts on national security, and other relevant impacts. The Secretary of Commerce may exclude an area from critical habitat if the benefits of exclusion outweigh the benefits of designation, unless excluding the area will result in the extinction of the species concerned. A critical habitat designation does not set up a preserve or refuge, and critical habitat requirements do not apply to citizens engaged in activities on private land that do not involve a federal agency.

In determining which areas should be critical habitat, NMFS identified the geographic areas occupied by the species and the physical or biological features essential for the conservation of the species. For all salmon ESUs and steelhead DPSs this includes sites and habitat components that support one or more life stages: examples include 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, (3) areas for growth and development to adulthood, and 4) adult

migration corridors. NMFS also identified features associated with these types of sites that play an essential role in maintaining habitat health. These features also describe the habitat factors associated with viability for all ESUs and DPSs (although the specific habitat requirements for each ESU and DPS differ by life history type and life stage). Table 2-3 summarizes the physical and biological features considered essential for anadromous salmon and steelhead.

Table 2-3. Types of sites and essential physical and biological features designated as PCEs for anadromous salmonids, and the life stage each PCE supports (Bambrick 2004).

Site	Essential Physical and Biological Features	ESU/DPS Life Stage
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover[a]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover	Juvenile and adult mobility and survival
Estuarine areas	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological transitions between salt and freshwater
	Natural cover, forage[b] and water quantity	Growth and maturation
Nearshore marine areas	Free of obstruction, water quality and quantity, natural cover,[a] and forage[b]	Growth and maturation, survival
Offshore marine areas	Water quality and forage[b]	Growth and maturation

[a] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.

Critical habitat for Snake River spring/summer Chinook was designated on December 28, 1993 (58 FR 68543) and revised slightly on October 25, 1999 (64 FR 57399). Critical habitat was designated for Snake River steelhead on September 2, 2005 (70 FR 52630).

Designated critical habitat for the Snake River spring/summer Chinook salmon ESU and steelhead DPS includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake Rivers, and all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam (NMFS 1999). Critical habitat also includes river reaches presently or historically accessible (except those above impassable natural falls and Dworshak and Hells Canyon dams). The lower Columbia River corridor is among the areas of high conservation value to these species because it connects every population with the ocean and is used by rearing/migrating juveniles and migrating adults.

Maps of the critical habitat areas are available at http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/CH-Maps.cfm and in the Federal Register notices, which also contain legal descriptions of the critical habitat areas.

NMFS recognizes that salmon habitat is dynamic and that current understanding of areas important for conservation will likely change as recovery planning sheds light on areas that can and should be protected and restored. NMFS will update the critical habitat designations as needed based on information developed during recovery plan implementation.

3 ▪ Recovery Goals and Delisting Criteria

This chapter provides an overview of the recovery goals in the management unit plans and the delisting criteria NMFS will use in future reviews of the status of the Snake River spring/summer Chinook salmon ESU and steelhead DPS to determine whether delisting is warranted. This discussion is supplemented by additional detail at the species level in Chapters 5 and 6.

Management unit plans can incorporate two types of recovery goals. These include biological recovery goals that are intended to be consistent with delisting, and "broad sense" goals that go beyond the requirements for delisting under the ESA to address other legislative mandates or social, economic and ecological values. The biological components of management unit plan recovery goals rely heavily on the biological viability criteria developed by the TRTs.

The formal delisting criteria are determined by NMFS and must meet ESA requirements. The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria which, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). These criteria are of two kinds: biological viability criteria, which deal with population or demographic parameters, and threats criteria, which relate to the five listing factors detailed in the ESA (see Sections 1.1 and 3.3 of this Plan). The threats criteria define the conditions under which the listing factors, or threats, can be considered to be addressed or mitigated. Together, the biological viability and threats criteria make up the "objective, measurable criteria" required under section 4(f)(1)(B) for the delisting decision.

Delisting criteria may include both technical and policy considerations, such as acceptable risk levels at the population, MPG, and ESU/DPS scales. They are based on the best available scientific information (including the ICTRT's biological viability criteria) and incorporate the most current understanding of the ESU/DPS and the threats it faces. As this recovery plan is implemented, additional information will likely become available that improves our understanding of the status of the populations and ESU/DPS, and the threats. Information may also become available to increase our certainty about how the threats influence the status of the populations and ESU/DPS, and whether the threats have been abated. If appropriate, NMFS will review and revise delisting criteria during its future 5-year status reviews of the ESU/DPS based on this new information.

NMFS has ultimate responsibility for final recovery plans and delisting decisions, and must take into account all relevant information, including, but not limited to, biological and policy considerations developed in the recovery planning process.

3.1 Management Unit Plan Recovery Goals

Snake River spring/summer Chinook and steelhead spawn in Oregon, Washington and Idaho, and are covered under three management unit plans. Each management unit plan includes broad, conceptual statements of purpose, as well as biological goals that local planners believe are

consistent with delisting.[5] The Oregon and Washington management unit plans also include goals that go beyond delisting to provide for other socio-economic values. The biological goals are identified at the population level but also have been coordinated among management unit plans to produce MPG- and ESU/DPS-level recovery scenarios. These recovery scenarios and their corresponding population-level biological goals are an important linkage between the management unit plans and the NMFS delisting criteria.

3.1.1 Management Unit Plan Purposes and Broad Sense Recovery Goals

Each management unit plan includes broad, conceptual statements of purpose for the recovery of their Snake River spring/summer Chinook salmon and steelhead populations. Generally, most of the planning entities and citizen groups agree that while delisting salmon and steelhead is an important goal, ultimately the "broad-sense" goal is to have thriving, abundant fish populations sufficient for harvest in perpetuity by all citizens as well as sufficient to meet federal treaty obligations. The Oregon and Washington management unit plans include goals that go beyond delisting to provide for other socio-economic values. Such goals have not yet been identified for the Idaho management unit plan.

Northeast Oregon Management Unit Plan

The broad sense goal for the salmon and steelhead populations in the northeast Oregon management unit was defined during a series of workshops held by the Oregon Snake River Stakeholders Group, which includes local representatives of communities, agricultural water users, land managers, and industry and environmental interests. The management unit plan describes a goal for the northeast Oregon populations that goes beyond delisting.

> *The naturally spawning Snake River Chinook and steelhead populations are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) throughout historical habitats so that they provide significant ecological, social, cultural, and economic benefits.*

To achieve benefits for current and future generations, the northeast Oregon plan seeks first to restore Snake River Chinook salmon and steelhead populations in Oregon subbasins to the point where their protection under the ESA is no longer needed. When this is achieved, efforts will move beyond the minimum steps necessary to delist the species to provide for other legislative mandates or social, economic, and ecological values.

Southeast Washington Management Unit Plan

The southeast Washington management unit plan states that the ultimate goal of the fish restoration effort is to create conditions allowing the establishment of salmonid populations that are both viable, harvestable, and of sufficient abundance to meet other socio-economic goals. Thus, delisting the salmonid populations is only the first step on the road to restoring populations within the management unit. The Snake River Salmon Recovery Board developed a vision statement — based largely on statements from the Lower Snake River Mainstem, Tucannon

[5] Section 3.2 discusses NMFS' view of the management unit plans' recovery goals.

River, Asotin Creek, and Walla Walla River subbasin plans — that describes broad sense goals for the Board's recovery plan for the southeast Washington management unit.

> *Develop and maintain a healthy ecosystem that contributes to the rebuilding of key fish populations by providing abundant, productive, and diverse populations of aquatic species that support the social, cultural, and economic well-being of the communities both within and outside the recovery region.*

The vision statement includes: 1) meeting recovery goals established by NMFS for listed populations of anadromous fish species, 2) achieving sustainable harvests of key species within the recovery region and the Columbia River, and 3) realizing these objectives while recognizing that local culture and economies (agriculture, urban development, logging, power production, recreation, and other activities) are beneficial to the health of the human environment within the recovery region.

Idaho Management Unit Plan

The Idaho management unit plan does not identify broad sense goals that reach beyond achieving population levels that support delisting. Instead, the Idaho management unit plan focuses on improving the viability of the two species to the point that ESA protection is no longer required.

3.1.2 Management Unit Plan Biological Recovery Goals

Recovery planners at the management unit level largely followed the ICTRT's guidelines in assessing the viability of Snake River spring/summer Chinook salmon and steelhead populations, MPGs, and ESUs/DPS for the purposes of setting recovery goals. The plans adopted the ICTRT's definition of a viable ESU or DPS. All the management unit plans also adopted the ICTRT's criteria described in Section 2.3. In addition, the management unit planners relied heavily on the ICTRT's guidelines regarding abundance and productivity, spatial structure, and diversity in setting viability goals for individual populations. Detail on methodologies can be found in the individual management unit plans. Chapters 6 and 7 present population-specific goals, such as abundance and productivity targets.

The primary goal of the management unit plans is recovery of the populations and MPGs to the point that the Snake River spring/summer Chinook salmon ESU and Snake River steelhead DPS can be delisted. The management unit plans lay out steps to meet the biological viability criteria, threats criteria, and other requirements that may be set by NMFS for delisting.

3.2 Recovery Scenarios for ESU and DPS

The target statuses for populations within an ESU or DPS are referred to collectively as the "recovery scenario" for the ESU or DPS. The ICTRT recommends that all MPGs in an ESU/DPS should be viable before the ESU or DPS is considered at low risk of extinction. However, the ICTRT recognizes that a variety of recovery scenarios may lead to a viable ESU/DPS. These various recovery scenarios may reflect different combinations of viable populations and policy choices regarding acceptable risk levels.

Compatible with the ICTRT criteria, an ESU or DPS recovery scenario will likely have some populations meeting viability standards close to each other AND some populations meeting viability standards relatively distant from each other. The major objectives of the ICTRT's ESU/DPS- and MPG-level viability criteria are to ensure preservation of basic historical metapopulation processes. This includes: 1) genetic exchange across populations within an ESU or DPS over a long timeframe; 2) the opportunity for neighboring populations to serve as source areas in the event of local population extinctions; and 3) distribution of populations throughout an ESU or DPS so that they are not all susceptible to a specific localized catastrophic event (McElhany et al. 2000; ICTRT 2007).

The ICTRT incorporated the viability criteria into viable recovery scenarios for each Snake River MPG. The criteria, which are explained in Section 2.3, ICTRT Biological Viability Criteria and Approach, should be met for a MPG to be considered Viable, or low risk, and thus contribute to the larger objective of ESU or DPS viability. These criteria are:

- At least one-half the populations historically present (minimum of two populations) should meet viability criteria (5% or less risk of extinction over 100 years).
- At least one population should be highly viable (less than 1% risk of extinction).
- Viable populations within a MPG should include some populations classified as "Very Large'" or "Large," and "Intermediate" reflecting proportions historically present.
- All major life history strategies historically present should be represented among the populations that meet viability criteria.
- Remaining populations within an MPG should be maintained (25% or less risk of extinction) with sufficient abundance, productivity, spatial structure and diversity to provide for ecological functions and to preserve options for ESU or DPS recovery.
- For MPGs with only one population, this population must be highly viable (less than 1% risk of extinction).

For each Snake River MPG, the ICTRT offered a detailed discussion of possible recovery scenarios that would allow each ESU or DPS to meet the viability criteria (ICTRT 2008). The ICTRT selected these combinations of target viability levels based on the populations' unique characteristics, such as run timing, population size, or genetics; major production areas in the MPG; and spatial distribution of the populations.

Although the ICTRT criteria provide that at least one population in each MPG should reach Highly Viable status, in most cases the team did not indicate which population that should be, because of the uncertainties of any population's response to recovery efforts. The ICTRT cautioned against prematurely closing off the options for any population.

Further, while not all populations in an MPG need to meet TRT viability criteria under most viable-MPG scenarios, the ICTRT strongly advised planners to attempt to improve more than the minimum number of populations to reach Viable status. There are two primary reasons for this: First, based on current population dynamic theory, the TRT has recommended that all extant populations be maintained with sufficient productivity that the overall MPG productivity does

not fall below replacement (i.e. the less robust areas should not serve as significant population sinks). Thus, it would be highly risky to allow the status of any population to degrade. In fact, many populations will need to be improved from their current status to meet "maintained" status. Second, although the possible population sets suggested by the ICTRT would meet TRT viability criteria for the ESUs, achieving recovery will likely require attempting recovery in more than those populations, because of the uncertainty of success of recovery efforts. A low-risk strategy will thus target more populations than the minimum for viability (ICTRT 2008).

While the management unit plans have adopted the ICTRT recovery scenarios, there are still choices to be made in designing recovery strategies, actions, and implementation plans. Where the ICTRT noted options, management unit planners have made decisions based on best available science concerning how to proceed and whether to target one population or another for Viable or Highly Viable status.

3.2.1 Recovery Scenario for Snake River Spring/Summer Chinook Salmon ESU

Table 3-1. Recovery Scenarios: Application of ICTRT Viability Criteria to Snake River Spring/Summer Chinook MPGs: Options for Viability (ICTRT 2007; NMFS 2011).

MPG & Population	Size Category	Adult Life History Type	Role in Viability Scenario	Considerations
Lower Snake Spring/Summer Chinook MPG: Applying ICTRT viability criteria, for this MPG to be viable, two populations should be Viable, and one Highly Viable. Initial recovery efforts should focus on the extant population. Scoping efforts for potential reintroduction should be conducted as recovery planning progresses.				
Tucannon River	Intermediate	Spring	Highly Viable	
Asotin Creek (functionally extirpated[6])	Basic	Spring	Consider for reintroduction as recovery efforts progress	ICTRT recommends that initial recovery efforts focus on extant populations, with scoping efforts for reintroduction conducted concurrently.
Grande Ronde/Imnaha Spring/Summer Chinook MPG: Applying ICTRT viability criteria, for this MPG to be viable at least four populations should meet viability criteria, with at least one Highly Viable; the rest should meet Maintained status. The Imnaha River population has a unique life history strategy and should meet the viability criteria. The Lostine/Wallowa River population and at least one from each of the following pairs: Catherine Creek or Upper Grande Ronde (both Large size), and Minam or Wenaha (both Intermediate size) should meet viability criteria. Distributing Viable "Large" populations throughout the subbasin is preferable to having them clumped or contiguous. Hatchery supplementation programs are ongoing in the Imnaha, Wallowa-Lostine, Catherine Creek and Upper Grande Ronde populations.				
Wenaha River	Intermediate	Spring	Option: Either Wenaha or Minam should be Viable or Highly Viable. The other should be Maintained.	Wenaha R. is most downstream, providing connectivity with other MPGs. Minam R. and Wenaha R. populations have little spatial structure or diversity impairment. They may be candidates for high viability status. Wenaha R. and Minam R. populations are currently the most unaffected by hatchery fish.
Minam River	Intermediate	Spring	Option: Either Wenaha or Minam should be Viable or Highly Viable. The other should be Maintained.	Minam R. and Wenaha R. populations have little spatial structure or diversity impairment. They may be candidates for high viability status. Wenaha R. and Minam R. populations are currently the most unaffected by hatchery fish.
Lostine/Wallowa Rivers	Large	Spring	Option: Viable or Highly Viable	
Lookingglass Creek (functionally extirpated)	Basic	Spring	Consider for reintroduction as recovery efforts progress	ICTRT recommends that initial recovery efforts focus on extant populations, with scoping efforts for re-introduction conducted concurrently.
Catherine Creek	Large	Spring	Option: Either Catherine Creek or Upper Grande Ronde should be Viable or Highly Viable. The other should be Maintained.	
Upper Grande Ronde	Large	Spring	Option: Either Catherine Creek or Upper Grande Ronde should be Viable or Highly Viable. The other should be Maintained.	
Imnaha River	Intermediate	Spring/Summer	Option: Viable or Highly Viable	There is the potential for Imnaha to be isolated.
Big Sheep Creek (functionally extirpated)	Basic	Spring	Consider for reintroduction as recovery efforts progress	ICTRT recommends that initial recovery efforts focus on extant populations, with scoping efforts for re-introduction conducted concurrently.

[6] The ICTRT considers extirpated populations to be those that are entirely cut off from anadromy. Functionally extirpated populations are those of which there are so few remaining numbers that there are not enough fish or habitat in suitable condition to support a fully functional population.

MPG & Population	Size Category	Adult Life History Type	Role in Viability Scenario	Considerations
South Fork Salmon River Spring/Summer Chinook MPG: Applying ICTRT viability criteria, for this MPG to be viable, at least two populations should meet viability criteria and one should be Highly Viable; the rest should be Maintained MPG-level criteria require that the Little Salmon River population meet viability criteria because it is the only population in the MPG with spring/summer life history; however, the ICTRT recommends that recovery efforts focus on populations in the South Fork drainage because of the Little Salmon population's small size and high level of potential hatchery integration. Since two of the populations are classified as Large and two are classified as Intermediate, at least one population from each size class or the two Large populations must achieve viability.				
Little Salmon River (includes Rapid River)	Intermediate	Spring/Summer	Need for Viable status lessened because of minor amount of spring-run production and location outside main drainage	Only population with spring/summer life history. Size category is driven by small, adjunct tributaries, which are where the spring life history is represented in the population. If these fish are a result of hatchery production or not representative of the historical condition, it is less importance to maintain that life history. The population is greatly influenced by Rapid River Hatchery production and releases.
South Fork Salmon River	Large	Summer	Option: Viable or Highly Viable	Considered first choice for viability to achieve large-size requirement.
Secesh River	Intermediate	Summer	Viable or Highly Viable	No supplementation and satisfies intermediate-size requirement for MPG.
East Fork South Fork Salmon River	Large	Summer	Option: Viable or Maintained	Ongoing supplementation exists in this population (Johnson Creek).
Middle Fork Salmon River Spring/Summer Chinook MPG: Applying ICTRT viability criteria, for this MPG to be viable, at least five populations should meet viability criteria, with one meeting Highly Viable status; remaining populations should be Maintained. Several populations have potential to achieve Highly Viable status because of high quality habitat. Big Creek should meet viability criteria as the only Large population. Two of the three Intermediate populations should meet viability criteria.				
Middle Fork Salmon below Indian Creek	Basic	Spring/Summer	Maintained	
Big Creek	Large	Spring/Summer	Need for Viable status: Viable or Highly Viable	The only Large population in this MPG. Supports spring and summer run fish.
Camas Creek	Basic	Spring	Viable or Maintained	
Loon Creek	Basic	Spring/Summer	Option: Viable or Highly Viable.	Targeted for viable status because of geographic distribution in MPG and historic production potential.
Middle Fork Salmon above Indian Creek	Intermediate	Spring	Option: Viable or Maintained	Upper Middle Fork mainstem is composed of a number of small tributaries (rather than a core, contiguous spawning area).
Sulphur Creek	Basic	Spring	Maintained	
Bear Valley Elk Creek	Intermediate	Spring	Option: Viable or Highly Viable	Targeted for viability because of historical production potential and opportunity.
Marsh Creek	Basic	Spring	Option: Viable or Highly Viable	Targeted for viable status because of geographic distribution in MPG and historic production potential.
Chamberlain Creek	Intermediate	Spring	Option: Viable or Highly Viable	Significant geographic position provides connectivity between MPGs. Population has unique, apparently persistent genetic characteristics.
Upper Salmon River Spring/Summer Chinook MPG: Applying ICTRT viability criteria, for this MPG to be viable, at least five populations should meet viability criteria and at least one should be Highly Viable; the rest should be Maintained. At least three Large or Very Large populations should meet viability criteria. One Intermediate or larger population should meet viability criteria.				
North Fork Salmon River	Basic	Spring	Maintained	The most downstream population. However, relatively few data are available, and there have been substantial anthropogenic effects on population and habitat.
Panther Creek (extirpated)	Intermediate	Spring		Extirpated, but the only Intermediate population. A large population could be substituted for this population to meet viability criteria.
Lemhi River	Very Large	Spring	Option: Viable or Highly Viable	Lemhi historically may have had summer Chinook production. Lemhi provides important connectivity to other MPGs, as a large, downstream

MPG & Population	Size Category	Adult Life History Type	Role in Viability Scenario	Considerations
				population; needs to be viable to provide proportional representation of class size.
Salmon River mainstem, below Redfish Lake	Very Large	Spring/Summer	Maintained	
Pahsimeroi River	Large	Spring	Needs to meet viability criteria: Viable or Highly Viable	The only extant population in this MPG with summer life history.
East Fork Salmon River	Large	Spring/Summer	Option: Viable or Highly Viable	
Yankee Fork	Basic	Spring	Maintained	Currently occupied by non-native stock.
Valley Creek	Basic	Spring	Option: Viable or Highly Viable	Historically had larger production than most Basic populations.
Upper Salmon River mainstem, above Redfish Lake	Large	Spring	Option: Viable or Highly Viable	Upper Salmon mainstem population is at the geographic end of the ESU and MPG. Population provides proportional representation of class size.

3.2.2 Recovery Scenario for Snake River Steelhead DPS

Table 3-2. Recovery Scenarios: Application of ICTRT Viability Criteria to Snake River Steelhead MPGs: Options for Viability (ICTRT 2007; NMFS 2011).

MPG & Population	Size Category	Adult Life History Type	Role in Viability Scenario	Considerations
Lower Snake River Steelhead MPG: Applying ICTRT viability criteria, for this MPG to be viable, two populations should be Viable and one should be Highly Viable.				
Tucannon River	Intermediate	A-Run	Option: Viable or Highly Viable	
Asotin Creek	Basic	A-Run	Option: Viable or Highly Viable	
Clearwater River Steelhead MPG: Applying ICTRT viability criteria, for this MPG to be viable at least three populations should be Viable and one of these should be Highly Viable; the rest should meet criteria for Maintained. Since NF Clearwater population is extirpated, Lower Clearwater populations, as only Large or Very Large population, should meet viability criteria. At least two of three Intermediate populations should meet viability criteria (Viable or Highly Viable). At least one A-run and one B-run population should meet viability criteria.				
Lower Clearwater	Large	A-Run	Viable or Highly Viable	The only extant Large population; also the only A-run population.
South Fork Clearwater	Intermediate	B-Run	Option: Viable or Maintained	High degree of hatchery influence.
North Fork Clearwater	Large		Not part of recovery scenario.	Population is extirpated.
Lolo Creek	Basic	A & B-Run	Option: Viable or Highly Viable	Initially believed to be the only population representing both A- and B-run life histories; however, recent data indicates that more populations also express both life history types.
Selway River	Intermediate	B-Run	Option: Viable or Maintained	Very little hatchery influence. Much of habitat in wilderness protection.
Lochsa River	Intermediate	B-Run	Option: Viable or Highly Viable	Very little hatchery influence. Much of habitat in wilderness protection. Area accessible for data collection using current monitoring programs.
Grande Ronde River Steelhead MPG: Applying ICTRT viability criteria, for this MPG to be viable at least two populations should be Viable, with one Highly Viable; the rest should meet criteria for Maintained. The Upper Grande Ronde mainstem is the only Large population and needs to be part of the viability scenario.				
Lower Grande Ronde mainstem	Intermediate	A-Run	Option: Viable or Maintained	Lower Grande Ronde population receives hatchery releases. The population would contribute to spatial structure in the lower MPG.
Joseph Creek	Basic	A-Run	Option: Viable, Highly Viable or Maintained	Joseph Creek population has the least hatchery influence. The population would contribute to spatial structure in the lower MPG. Population is at viable status and may be a candidate for High Viability status.
Wallowa River	Intermediate	A-Run	Maintained	Wallowa includes multiple core areas and some unique habitat characteristics (e.g. Eagle Cap), but supports a hatchery (with little straying)
Upper Grande Ronde mainstem	Large	A-Run	Viable or Highly Viable.	This is the only Large population in the MPG. Currently receives no hatchery releases.
Imnaha River Steelhead MPG: Applying ICTRT viability criteria, for this MPG to be viable, the MPG's one population should meet Highly Viable criteria.				
Imnaha River	Intermediate	A-Run	Highly Viable	Only population in MPG

MPG & Population	Size Category	Adult Life History Type	Role in Viability Scenario	Considerations
Salmon River Steelhead MPG: Applying ICTRT viability criteria, for this MPG to be viable at least six of the twelve populations should meet viability criteria, with at least one Highly Viable; the rest should meet Maintained criteria. At least four of the Intermediate populations should meet viability criteria. At least two of the six Viable populations should be B-run. Spatial structure should be a strong consideration in this large MPG. Populations meeting viability criteria should spread across Upper Salmon, Middle Fork, and South Fork and Lower Salmon. A-run populations should also be represented since they made up two-thirds of the total populations in this MPG. Where possible, maintaining the distribution of A and B run populations would most closely mirror historical (lower-risk) conditions.				
Little Salmon and Rapid Rivers	Intermediate	A-Run	Viable or Maintained	Population has some hatchery influence, which tends to be out-of-MPG (Dworshak B, Hells Canyon A). There has been little monitoring of the population except Rapid River.
South Fork Salmon River	Intermediate	B-Run	Viable or Highly Viable	One of four B-run populations. No hatchery influence or effects. Relatively natural river system characteristics. Located at the downstream end of the MPG and would provide geographic distribution of viable populations
Secesh River	Basic	B-Run	Viable or Maintained	Genetically distinct and has historic B-run production potential. No hatchery influence or effects. Relatively natural river system characteristics.
Lower Middle Fork Tributaries	Intermediate	B-Run	Viable or Highly Viable	B-run population with very little hatchery influence. Relatively natural system within the wilderness boundaries.
Upper Middle Fork Salmon River	Intermediate	B-Run	Viable or Highly Viable.	Very little hatchery influence. Geographic separation from other targeted populations. Relatively natural river system within wilderness boundaries.
Chamberlain Creek	Basic	A-Run	Viable or Highly Viable	A-run life history strategy with very little hatchery influence. Relatively natural river system characteristics. Population provides connectivity between populations in the South Fork, Middle Fork, and Upper Salmon River drainages
Panther Creek	Basic	A-Run	Viable or Maintained	Some hatchery influence, likely from out-of-MPG. Watershed is federally owned and could become very productive. Fewer water withdrawals than others in MPG do.
North Fork Salmon River	Basic	A-Run	Viable or Maintained	Some hatchery influence from out-of-MPG stock.
Lemhi River	Intermediate	A-Run	Viable or Maintained	Population has some hatchery influence from out-of-MPG. There has been little monitoring of the population.
Pahsimeroi River	Intermediate	A-Run	Viable or Maintained	Population has some hatchery influence from out-of-MPG. There has been little monitoring of the population. Active hatchery supplementation.
East Fork Salmon River	Intermediate	A-Run	Viable or Maintained	Population has hatchery influence, with some from out-of-MPG. There has been little monitoring of the population.
Upper Salmon River	Intermediate	A-Run	Viable or Maintained	Population has some hatchery influence, from out-of-MPG. There has been little monitoring of the population.
Hells Canyon Steelhead MPG: This MPG is not part of the Snake River steelhead DPS recovery scenario. With the possible exception of several small tributaries below Hells Canyon Dam, this MPG is largely extirpated. Fish that currently occupy the small tributaries below the dam may be the only remnants of this MPG. A key research need is to determine whether these are remnants or hatchery strays.				
Tributaries below Hells Canyon Dam				Tributaries do not appear (separate or combined) to be large enough to support an independent population.
Powder River (extirpated)				
Burnt River (extirpated)				
Weiser River (extirpated)				

3.3 NMFS Delisting Criteria and Decisions

The requirement for determining that a species no longer requires the protection of the ESA is that the species is no longer in danger of extinction or likely to become endangered within the foreseeable future, based on evaluation of the listing factors specified in ESA section 4(a)(1). To remove the Snake River spring/summer Chinook salmon ESU and Snake River steelhead DPS from the Federal List of Endangered and Threatened Wildlife and Plants, NMFS must determine that the ESU or DPS, as evaluated under the ESA listing factors, is no longer likely to become endangered.

The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria that, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12; 50 CFR 223.102 and 224.101). The biological and threats criteria in this plan, taken together, meet this statutory requirement.

3.3.1 Biological Criteria

NMFS has considered the ICTRT's biological viability criteria (ICTRT 2007), the principles presented in the Viable Salmonid Populations paper (McElhany et al. 2000), the recovery scenarios (summarized in Tables 3-1 and 3-2), population-level information and goals in the management unit plans, and the best available information on population and ESU/DPS status and new advances in risk evaluation methodologies. NMFS has concluded that the ICTRT's criteria adequately describe the characteristics of an ESU that meet or exceed the requirement for determining that a species no longer needs the protection of the ESA. These criteria provide a framework within which to evaluate specific recovery scenarios. NMFS has evaluated the management unit plan recovery scenarios (summarized in Tables 3-1 and 3-2 of this recovery plan) and population-level abundance, productivity goals (see Chapters 6 and 7) and has concluded that they also adequately describe the characteristics of an ESU that no longer needs the protections of the ESA. NMFS endorses the recovery scenarios and population-level goals in the management unit plans (summarized here in Tables 3-1 and 3-2 and Sections 6.2 and 7.2) as one of multiple possible scenarios consistent with delisting.

NMFS therefore proposes the following biological criteria for the listed ESU and DPS:

1. All MPGs critical for proper functioning of the ESU should be at low risk and have a high probability of persistence.
   Low risk or extinction, or high probability of persistence, is defined as:
   a. At least one-half the populations historically present (minimum of two populations) should meet viability criteria (5% or less risk of extinction over 100 years).
   b. At least one population should be highly viable (less than 1% risk of extinction).
   c. Viable populations within a MPG should include some populations classified as Very Large or Large, and Intermediate reflecting proportions historically present.
   d. All major life history strategies historically present should be represented among the populations that meet viability criteria.

e. Remaining populations within an MPG should be maintained (6 to 25% risk of extinction) with sufficient abundance, productivity, spatial structure and diversity to provide for ecological functions and to preserve options for ESU or DPS recovery.

f. For MPGs with only one population, this population must be highly viable (less than 1% risk of extinction).

The recovery scenarios in Tables 3-1 and 3-2 are consistent with these biological criteria.

3.3.2 Threat Criteria

In addition to a species achieving a certain biological status to be considered for reclassification or delisting, the threats to a listed species must have been ameliorated so as not to limit attainment of its desired biological status. Section 4(a)(1) of the ESA organizes NMFS' consideration of threats into five factors:

A. The present or threatened destruction, modification, or curtailment of the species' habitat or range
B. Over-utilization for commercial, recreational, scientific, or educational purposes
C. Disease or predation
D. Inadequacy of existing regulatory mechanisms
E. Other natural or human-made factors affecting the species' continued existence

These factors may not all be equally important in securing the continuing recovery of a particular ESU, and each ESU faces a different set of threats. It also is possible that current perceived threats will become insignificant in the future as a result of changes in the natural environment or changes in the way threats affect the entire life cycle of salmon and steelhead.

NMFS will use the listing factor criteria below in determining whether an ESU or DPS has recovered to the point that it no longer requires the protections of the ESA:

A: The present or threatened destruction, modification, or curtailment of a species' habitat or range:

To determine that the ESU/DPS is recovered, threats to habitat should be addressed as outlined below:

1. Passage obstructions (e.g., dams and culverts) are removed or modified to improve survival and restore access to historically accessible habitat where necessary to support recovery goals.
2. Flow conditions that support adequate rearing, spawning, and migration are achieved through management of mainstem and tributary irrigation and hydropower operations, and through increased efficiency and conservation in other consumptive water uses such as municipal supply.
3. Sufficient instream flows are protected to provide for steelhead in appropriate life stages.
4. Forest management practices that protect watershed and stream functions are implemented on federal, state, tribal, and private lands.

5. Agricultural practices, including grazing, are managed in a manner that protects and restores riparian areas, floodplains, and stream channels, and protects water quality from sediment, pesticide, herbicide, and fertilizer runoff.
6. Urban and rural development, including land use conversion from agriculture and forestland to residential uses, does not reduce water quality or quantity, or impair natural stream conditions so as to impede achieving recovery goals.
7. The effects of toxic contaminants on salmonid fitness and survival are understood and are sufficiently limited so as not to affect recovery.
8. Channel function, including vegetated riparian areas, canopy cover, stream-bank stability, off-channel and side-channel habitats, natural substrate and sediment processes, and channel complexity are restored to provide adequate rearing and spawning habitat.
9. Floodplain function and the availability of floodplain habitats for salmon are restored to a degree sufficient to support a Viable ESU/DPS. This restoration should include connectedness between river and floodplain and the restoration of impaired sediment delivery processes.

B: Over-utilization for commercial, recreational, scientific or educational purposes

To determine that the ESU/DPS is recovered, any utilization for commercial, recreational, scientific, or educational purposes should be managed as outlined below:

1. Fishery management plans are in place that (a) accurately account for total fishery mortality (i.e., both landed catch and non-landed mortalities) and constrain mortality rates to levels that are consistent with recovery; and (b) are implemented in such a way as to avoid deleterious genetic effects on populations or negative effects on the distribution of populations.
2. Federal, tribal and state rules and regulations are effectively enforced.
3. Technical tools accurately assess the effects of the harvest regimes so that harvest objectives are met but not exceeded.
4. Handling of fish is minimized to reduce indirect mortalities associated with educational or scientific programs, while recognizing that monitoring, research, and education are key actions for conservation of the species.
5. Routine construction and maintenance practices are managed to reduce or eliminate mortality of listed species.

C: Disease or predation

To determine that the ESU/DPS is recovered, any disease or predation that threatens its continued existence should be addressed as outlined below:

1. Hatchery operations do not subject targeted populations to deleterious diseases and parasites and do not result in increased predation rates of wild fish.
2. Predation by avian predators is managed in a way that allows for recovery of salmon and steelhead populations.
3. The northern pikeminnow is managed to reduce predation on the targeted populations.

4. Populations of introduced exotic predators such as smallmouth bass, walleye and catfish are managed such that competition or predation does not impede recovery.
5. Predation of all Snake River species below Bonneville Dam by marine mammals does not impede achieving recovery.
6. Physiological stress and physical injury that may cause disease or increase susceptibility to pathogens during rearing or migration is reduced during critical low flow periods (e.g. low water years) or poor passage conditions (e.g. at diversion dams or bypasses).

D: The inadequacy of existing regulatory mechanisms

1. To determine that the ESU/DPS is recovered, any inadequacy of existing regulatory mechanisms that threatens its continued existence should be addressed as outlined below:
2. Adequate resources, priorities, regulatory frameworks, and coordination mechanisms are established and/or maintained for effective enforcement of land and water use regulations that protect and restore habitats, including water quality and water quantity, and for the effective management of fisheries.
3. Habitat conditions and watershed functions are protected through land-use planning that guides human population growth and development.
4. Habitat conditions and watershed function are protected through regulations that govern resource extraction such as timber harvest and gravel mining.
5. Habitat conditions and watershed functions are protected through land protection agreements as appropriate, where existing policy or regulations do not provide adequate protection.
6. Regulatory, control, and education measures to prevent additional exotic plant and animal species invasions are in place.
7. Sufficient priority instream water rights for fish habitat are in place.

E: Other natural or human-made factors affecting [the species'] continued existence

To determine that the ESU/DPS is recovered, other natural and manmade threats to its continued existence should be addressed as outlined below:

1. Hatchery programs are being operated in a manner that is consistent with individual watershed and region-wide recovery approaches; appropriate criteria are being used for integration of hatchery steelhead populations and extant natural populations inhabiting watersheds where the hatchery fish return.
2. Hatcheries operate using appropriate ecological, genetic, and demographic risk containment measures for (1) hatchery-origin adults returning to natural spawning areas, (2) release of hatchery juveniles, (3) handling of natural-origin adults at hatchery facilities, (4) withdrawal of water for hatchery use, (5) discharge of hatchery effluent, and (6) maintenance of fish health during their propagation in the hatchery.
3. Monitoring and Evaluation plans are implemented to measure population status, hatchery effectiveness, and ecological, genetic, and demographic risk containment measures.

4. Nutrient enrichment programs are implemented where it is determined that nutrient limitations are a significant limiting factor for steelhead production and that nutrient enrichment will not impair water quality.

3.3.3 Delisting Decision

In accordance with our responsibilities under section 4(c)(2) of the Act, NMFS will conduct reviews of Snake River Spring Summer Chinook and Snake River Steelhead every 5 years to evaluate the status of the species and determine whether the ESUs should be removed from the list or changed in status. NMFS will base such evaluations on the best scientific information available at that time and take into account the following:

- The biological recovery criteria (ICTRT 2007c) and listing factor (threats) criteria described above.
- The management programs in place to address the threats.
- Principles presented in the Viable Salmonid Populations paper (McElhany et al. 2000).
- Best available information on population and ESU/DPS status and new advances in risk evaluation methodologies.
- Other considerations, including: the number and status of extant spawning groups; the status of the major spawning groups; linkages and connectivity among groups; the diversity of life history and phenotypes expressed; and considerations regarding catastrophic risk.

3.4 Achieving Broad Sense Goals after Delisting

NMFS is supportive of the broad sense recovery goals in the management unit plans and believes that the most expeditious way to achieve them is by achieving viability of natural populations and delisting. Upon delisting, NMFS will work with co-managers and local stakeholders, using our non-ESA authorities, to pursue broad sense recovery goals while continuing to maintain robust natural populations.

4 ▪ Current Status Assessment

This chapter summarizes the current status of the Snake River spring/summer Chinook salmon ESU and steelhead DPS, and their MPGs and populations, based on ICTRT viability assessment results (ICTRT 2007 and 2008, updated in 2010). It also describes the gaps between current status and desired status. The ICTRT assessed the current status of each population using the biological criteria and assigned a current viability rating. The chapter also summarizes findings from several NMFS publications, including the Northwest Fisheries Science Center's: *Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act* (Ford 2011) and NMFS' *5-Year Review: Summary and Evaluation of Snake River Sockeye, Snake River Spring-Summer Chinook, Snake River Fall-Run Chinook and Snake River Steelhead* (NMFS 2011). The management unit plans for the northeast Oregon, southeast Washington, and Idaho populations provide more information on population status.

4.1 Current Status of Snake River Spring/Summer Chinook Salmon ESU

This section describes the current status of the Snake River spring/summer Chinook ESU. Section 4.1.1 summarizes the viability assessment results for independent populations in each MPG. Section 4.1.2 discusses the gap between the current and desired status.

4.1.1 Current Status

Currently, all 28 of the extant spring/summer Chinook salmon populations in the Snake River spring/summer Chinook salmon ESU are rated at high risk of extinction, with a low probability of persistence within 100 years[7]. As a result, all five of the MPGs comprised by these populations also fail to achieve the ICTRT's criteria for viability (Ford 2011).

Low abundance and poor productivity remain the primary obstacles to viability for all of the Snake River spring/summer Chinook salmon populations. Most of the populations also exhibit reduced spatial structure and diversity. Although natural spawning abundance has increased in recent years for some populations, it persists, for all populations, well below the minimum natural-origin abundance thresholds set by the ICTRT (Ford 2011). Thus, relatively low natural production rates and spawning levels below minimum abundance thresholds remain a major concern across the ESU. The ability of populations to be self sustaining through normal periods of relatively low ocean survival continues to be uncertain.

Recent conclusions regarding the status of the Snake River spring/summer Chinook salmon ESUs five MPGs are summarized below from the *Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act* (Ford 2011) and *5-Year Review: Summary &*

[7] As described in Section 2.3, the ICTRT recommended methods for evaluating the status of salmon and steelhead populations in the Interior Columbia domain. The ICTRT's approach is based on evaluating the population parameters of abundance, productivity, spatial structure, and diversity and then integrating these assessments into an overall assessment of population risk and persistence probability. Management unit recovery planners and the ICTRT followed this approach to assess the current status of the populations. Information from these assessments is summarized here. It is consistent with conclusions of the Northwest Fisheries Science Center in its *Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act* (Ford 2011).

Evaluation of Snake River Sockeye, Snake River Spring-Summer Chinook, Snake River Fall-Run Chinook and Snake River Steelhead (NMFS 2011). The three management unit plans describe the status of the populations.

Lower Snake River MPG

Abundance and productivity remain the major concern for the Tucannon River population, the only extant population in this MPG. Natural spawning abundance (10-year geometric mean) for the population has increased but persists well below the minimum abundance threshold. Poor natural productivity continues to be a major concern for the population. The Asotin Creek population is functionally extirpated, and it is uncertain whether the population is critical to the functioning of the MPG.

Grande Ronde/Imnaha Rivers MPG

All populations in this MPG are rated at high risk. The Wenaha, Lostine/Wallowa and Minam River populations have shown substantial increases in natural abundance in recent years, although each population lingers below their respective minimum abundance thresholds. The Catherine Creek and Upper Grande Ronde populations each remain in a critically depressed state. Geometric mean productivity estimates continue to be relatively low for all populations in the MPG. The Upper Grande Ronde population is rated at high risk for spatial structure/diversity. The remaining populations are rated at moderate risk.

South Fork Salmon River MPG

Natural spawning abundance has increased for the South Fork Salmon, East Fork South Fork Salmon, and Secesh River populations, and productivity estimates for the three populations are generally higher than estimates for populations in other Snake River spring/summer Chinook salmon MPGs. Viability ratings based on combined estimates for abundance and productivity linger at high risk, although survival/capacity gaps relative to moderate and low risk are smaller than for other ESU populations. Spatial structure/diversity risks are currently rated moderate for the South Fork Salmon population (relatively high proportion of hatchery spawners) and low for the Secesh River and East Fork South Fork populations. Insufficient data hinders efforts to determine the status of the Little Salmon River population.

Middle Fork Salmon River MPG

All nine populations in this MPG remain at high risk for abundance/productivity. Natural-origin abundance and productivity continue to be extremely low for the populations. As in the previous ICTRT assessment, abundance/productivity estimates for Bear Valley Creek and Chamberlain Creek (limited data series) are the closest to meeting viability minimums among the populations. Spatial structure/diversity risk ratings for Middle Fork populations are generally moderate, largely driven by moderate ratings for genetic structure assigned by the ICTRT because of uncertainty arising from the lack of direct samples from within the component populations.

Upper Salmon River MPG

All eight extant populations in the Upper Salmon River MPG remain at high risk for abundance/productivity. Abundance and productivity estimates for most of the populations persist at very low levels relative to viability objectives. The Upper Salmon mainstem population

has the highest abundance/productivity of the populations. Spatial structure and diversity ratings vary considerably across the MPG. Four of the eight populations (North Fork Salmon River, Upper Salmon lower mainstem, Valley Creek and Upper Salmon mainstem) are rated at low or moderate risk for overall spatial structure/diversity and could achieve viable status with improved abundance and productivity. The high spatial structure/diversity risk rating for the Lemhi population is driven by a substantial loss of access to tributary spawning and rearing habitats and the associated reduction in life history diversity. High spatial structure/diversity ratings for the Pahsimeroi, East Fork Upper Salmon and Yankee Fork populations reflect a combination of habitat loss and diversity concerns related to low natural abundance combined with chronically high proportions of hatchery spawners in natural areas.

4.1.2 Gap between Current and Desired Status

Table 4-1 shows the current and desired status for each Snake River spring/summer Chinook salmon population. Management unit recovery planners coordinated with NMFS in making decisions about the desired status for each population, taking into consideration opportunities for improvement in view of historical production, current habitat conditions and potential, and the desire to accommodate objectives such as maintaining harvest opportunities.

Table 4-1. Snake River Spring/Summer Chinook ESU Recovery Strategy and Current and Desired Population Status.

Major Population Group	Population	Contribution to Recovery	Current Status	Desired Status
Lower Snake MPG	Tucannon River	Primary	High Risk	Highly Viable
	Asotin Creek	Consider reintroduction	Functionally extirpated	
Grande Ronde/ Imnaha MPG	Wenaha River	Primary	High Risk	Viable or Highly Viable
	Minam River	Primary	High Risk	Viable or Highly Viable
	Lostine/Wallowa Rivers	Primary	High Risk	Viable or Highly Viable
	Lookingglass Creek	Consider reintroduction	Functionally extirpated	
	Catherine Creek	Primary	High Risk	Viable or Highly Viable
	Upper Grande Ronde	Supporting	High Risk	Viable of Maintained
	Imnaha River	Primary	High Risk	Viable or Highly Viable
	Big Sheep Creek	Consider reintroduction	Functionally extirpated	
South Fork Salmon River MPG	Secesh River	Primary	High Risk	Highly Viable
	EF South Fork Salmon	Supporting	High Risk	Viable or Maintained
	South Fork Salmon	Primary	High Risk	Viable
	Little Salmon River	Supporting	High Risk	Maintained
Middle Fork Salmon River MPG	L. Middle Fork Salmon	Supporting	High Risk	Maintained
	Big Creek	Primary	High Risk	Highly Viable
	Camas Creek	Supporting	High Risk	Maintained
	Loon Creek	Primary	High Risk	Viable
	U. Middle Fork Salmon	Supporting	High Risk	Maintained
	Sulphur Creek	Supporting	High Risk	Maintained
	Bear Valley Elk Creek	Primary	High Risk	Viable
	Marsh Creek	Primary	High Risk	Viable
	Chamberlain Creek	Primary	High Risk	Viable
Upper Salmon River MPG	North Fork Salmon River	Supporting	High Risk	Maintained
	Lemhi River	Primary	High Risk	Viable
	U. Salmon River, L. main	Supporting	High Risk	Maintained
	Pahsimeroi River	Primary	High Risk	Viable
	East Fork Salmon River	Primary	High Risk	Viable
	Yankee Fork	Supporting	High Risk	Maintained
	Valley Creek	Primary	High Risk	Viable
	U. Salmon River, U. main	Primary	High Risk	Highly Viable
	Panther Creek	Consider reintroduction	Extirpated	

Very large improvements will be needed to bridge the gap between the current status and desired status for many of the populations to support recovery of the Snake River spring/summer Chinook salmon ESU. Currently all of the populations are rated at high risk, with a low probability of persistence in 100 years. For most populations, meeting recovery objectives will require improvements in all viable salmonid population parameters: abundance, productivity, spatial structure, and diversity. Targeted populations for each MPG recovery strategy will need to decrease their abundance/productivity risk to reach their desired status, whether it is highly viable with very low (<1%) risk, viable with low (1-5%) risk, or maintained with moderate (6-25%) risk. The current spatial structure/diversity risk for many of the populations will also need to improve for many of the populations to meet their desired status. Improvements in all of these areas will increase the ability of the target populations to become self-sustaining through normal periods of fluctuating ocean survival and future habitat transformations posed by climate change.

At this time, no single population is targeted for highly viable status in the Grande Ronde/Imnaha MPG. While the ICTRT has determined that the Minam and Catherine Creek populations would require the least improvement in survival to achieve this status, all the populations are currently at high risk and it is unclear how they will respond individually to recovery efforts. Future monitoring results showing changes in population performance will be used to determine which population(s) in the MPG can best achieve highly viable status. This approach also applies for the other MPGs. The populations targeted for viable and highly viable status may change in any of the MPGs depending on how the populations — all currently rated at high risk — respond to recovery efforts.

4.2 Current Status of Snake River Steelhead DPS

This section describes the current status of the Snake River steelhead DPS. Section 4.2.1 summarizes the viability assessment results for independent populations in each MPG. Section 4.2.2 discusses the gap between the current and desired status.

4.2.1 Current Status

Currently, population specific estimates of annual abundance exist for 2 of the 24 extant populations in the Snake River steelhead DPS. Both of these populations (Joseph Creek and Upper Grande Ronde River) are part of the Grande Ronde River MPG. Consequently, much uncertainty remains regarding the viability status of many of the other populations. No MPGs in the Snake River steelhead DPS are currently considered viable (Ford 2011; NMFS 2011). Adult abundance data series are currently limited to aggregate estimates of abundance at Lower Granite Dam (both A-run and B-run), estimates for the two Grande Ronde MPG populations, and index area and weir counts for subsections of several other populations. The ICTRT used these various sources of information to estimate abundance for the different Snake River steelhead populations.

Overall, results from the ICTRT's latest assessment show that while the level of natural production in the two populations with full data series (Joseph Creek and Upper Grande Ronde River) and the Asotin Creek index reaches is encouraging, the status of most populations in the Snake River steelhead DPS remains highly uncertain (Ford 2011). For the populations without

specific adult abundance time series data, population-level natural-origin abundance and productivity inferred from the aggregate estimates of abundance at Lower Granite Dam, along with the juvenile indices available for some specific areas, indicate that many of the steelhead populations are likely below the minimum combinations defined by the ICTRT viability criteria. A great deal of uncertainty also remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites. The review found little evidence for substantial change in DPS viability relative to the previous BRT and ICTRT reviews (Ford 2011). The ICTRT considers obtaining annual estimates of population-level spawning abundance and hatchery/wild proportions as one of the highest priority opportunities for improved assessments for Snake River steelhead, as well as other Interior Basin ESUs/DPSs (ICTRT 2010).

Recent conclusions regarding the status of the Snake River steelhead DPS's five extant MPGs are summarized below from the *Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act* (Ford 2011) and *5-Year Review: Summary & Evaluation of Snake River Sockeye, Snake River Spring-Summer Chinook, Snake River Fall-Run Chinook and Snake River Steelhead* (NMFS 2011). The three management unit plans describe the status of the populations.

Lower Snake River MPG

Currently, the ICTRT considers the Tucannon River steelhead population's overall viability at high risk and the Asotin Creek population at moderate risk due to uncertainty regarding natural spawning abundance and productivity. Information from the Snake River Salmon Recovery Board indicates that spawner escapement in the Asotin Creek population core area (within Asotin Creek subbasin) exceeded 500 spawners in 2000 and 2005; however, these estimates are of insufficient duration to demonstrate with certainty that the population is functioning above the minimum threshold (NMFS 2011). Spatial structure and diversity are currently rated moderate for the two populations.

Grande Ronde River MPG

Population-level abundance data for this MPG include longer-term estimates for two MPG populations (Joseph Creek and Upper Grande River) and more recent natural spawner abundance estimates for the two other populations (Lower Grande Ronde and Wallowa). The data indicates that the Joseph Creek steelhead population's overall viability rating remains as highly viable, with abundance/productivity and spatial structure/diversity rated at low risk. Data for the Upper Grande River population indicate that while it has experienced an increase in natural-origin abundance in recent years, it retains a rating of maintained, with abundance/productivity and spatial structure/diversity rated at moderate risk (NMFS 2011). Recent estimates of mean adult abundance for the Lower Grande Ronde and Wallowa populations suggest that the populations may rate at low risk for abundance; however, additional information is needed to confirm these low risk ratings. Because of the lack of adequate data, the ICTRT has not given the Lower Grande Ronde population an overall viability rating. The ICTRT rated the Wallowa populations at high risk, although there is uncertainty associated with this rating. Hatchery strays are rare in all the populations, comprising less than 5 percent of the spawners in all cases, (NMFS 2011).

Imnaha River MPG

The Imnaha River population is the only population within the Imnaha River MPG. Efforts to estimate abundance for this population remain difficult due to a lack of data. Currently, the only long-term estimates for the population are estimates for abundance and productivity within a six-mile section of Camp Creek, which represents a small portion of the overall spawning area. The ICTRT currently rates the Imnaha River population at moderate risk for abundance and productivity based on this uncertainty in abundance. Spatial structure and diversity for the steelhead population are also rated moderate risk. Limited available information indicates that the incidence of hatchery fish mixing with the natural population is low (less than 10 percent of the spawners), but more information is needed to confirm this. Overall, available data, while limited, indicates that the population meets the criteria for a maintained population; however, this does not meet the criteria for a viable MPG because the population needs to be highly viable for the MPG to be viable.

Clearwater River MPG

Four of the five steelhead populations in the Clearwater River MPG have an overall viability rating of high risk (South Fork Clearwater, Lolo Creek, Selway River and Lochsa River). The Lower Mainstem Clearwater River has an uncertain overall viability rating of moderate risk. The ratings reflect a lack of data on natural spawning abundance to determine abundance and productivity for the five steelhead populations. Because of the insufficient data, the populations rate at high risk for abundance/productivity, with the exception of the Lower Mainstem Clearwater populations, which rates as at moderate risk. Spatial structure and diversity risks for the steelhead populations rate as low for the Lower Mainstem Clearwater, Selway River, and the Lochsa River. The South Fork Clearwater River and Lolo Creek have moderate risk ratings for spatial structure and diversity (NMFS 2011).

Salmon River MPG

Data on natural spawning abundance remains insufficient to determine productivity for all 12 steelhead populations in this MPG. The ICTRT rated six of the populations (South Fork Salmon River, Secesh River, Chamberlain Creek, Lower Middle Fork Salmon River, Upper Middle Fork Salmon River and Panther Creek) at high risk with low overall viability status. The remaining six populations (Little Salmon, North Fork Salmon, Lemhi, Pahsimeroi, East Fork Salmon, and Upper Mainstem Salmon) are rated at moderate risk with an overall status of maintained.

4.2.2 Gap between Current and Desired Status

Table 4-2 shows the current and desired status for each Snake River steelhead population. Management unit recovery planners coordinated with NMFS in making decisions about the desired status for each population, taking into consideration opportunities for improvement in view of historical production, current habitat conditions and potential, and the desire to accommodate objectives such as maintaining harvest opportunities.

Table 4-2. Snake River Steelhead DPS Recovery Strategy and Gaps between Current and Desired Population Status.

MPG	Population	Contribution to Recovery	Current Status	Target Status
Lower Snake River MPG	Tucannon River	Primary	High Risk	Viable or Highly Viable
	Asotin Creek	Primary	Moderate Risk	Viable or Highly Viable
Grande Ronde River MPG[1]	Lower Grande Ronde	Primary	Unclear	Viable or Highly Viable
	Joseph Creek	Primary	Very Low Risk	Viable or Highly Viable
	Wallowa River	Primary	High Risk	Viable or Highly Viable
	Upper Grande Ronde	Primary	Moderate Risk	Viable or Highly Viable
Imnaha River MPG	Imnaha River	Primary	Moderate Risk	Highly Viable
Clearwater River MPG	L. Main Clearwater River	Primary	Moderate Risk	Viable
	SF Clearwater	Supporting	High Risk	Maintained
	Lolo Creek	Supporting	High Risk	Maintained
	Selway River	Primary	High Risk	Viable
	Lochsa River	Primary	High Risk	Highly Viable
	NF Clearwater River	Consider reintroduction	Extirpated	
Salmon River MPG	Little Salmon River	Supporting	Moderate Risk	Maintained
	South Fork Salmon River	Primary	High Risk	Viable
	Secesh River	Supporting	High Risk	Maintained
	L. Middle Fork Salmon	Primary	High Risk	Highly Viable
	U. Middle Fork Salmon	Primary	High Risk	Viable
	Chamberlain Creek	Primary	High Risk	Viable
	North Fork Salmon River	Supporting	Moderate Risk	Maintained
	Lemhi River	Primary	Moderate Risk	Viable
	Pahsimeroi River	Supporting	Moderate Risk	Maintained
	East Fork Salmon River	Supporting	Moderate Risk	Maintained
	U. main Salmon River	Supporting	Moderate Risk	Maintained
	Panther Creek	Primary	High Risk	Viable
Hells Canyon MPG	Hells Canyon Tributaries	Consider reintroduction	Extirpated	

[1]At this time, no single population is targeted for highly viable status in the Grande Ronde steelhead MPG.

The viability ratings for the populations in the Snake River steelhead DPS do not currently meet the ICTRT viability criteria for the DPS. Because of the high-risk population ratings, remaining uncertainty regarding the viability status of many of the populations, and the overall lack of population date, none of the MPGs are currently considered to be viable. The gap between the current and desired status for most steelhead populations in the DPS remains unclear because of the lack of population-specific abundance data. The ICTRT (2010) identified obtaining annual estimates of population-level spawning abundance and hatchery/wild proportions as among the highest priority opportunities for improved assessments of the populations. Results from ongoing and planned efforts to generate annual estimates of spawning escapement based on adult PIT tag detections and other studies should improve our understanding of current status for many of the populations and efforts needed to achieve desired levels.

5 ▪ Regional Limiting Factors and Recovery Strategies

The reasons for a species' decline are generally described in terms of limiting factors and threats. Limiting factors are the biological, physical or chemical conditions and associated ecological processes and interactions that limit a species' viability. Threats are human activities or natural events, such as floodplain development or drought, that cause or contribute to limiting factors. A single limiting factor may be caused by one or more threats. Likewise, a single threat may cause or contribute to more than one limiting factor and may affect more than one life stage. In addition, the impact of past threats may continue to contribute to current limiting factors through legacy effects. For example, current high water temperature could be the result of earlier riparian practices that removed vegetation from stream banks so the stream is no longer shaded. Or, the effects of previous fishery harvest practices may be evident in the relatively small number of life history strategies that currently exist among salmon and steelhead. Designing effective recovery strategies and actions requires an understanding of the range and impact of limiting factors and threats affecting the species, across its entire life cycle.

This chapter evaluates limiting factors and threats at the regional scale and identifies regional strategies to address them and achieve recovery. The regional strategies are general approaches that either will benefit several species or can be applied in ways that target the specific needs of each species. Chapters 6 and 7 supplement the regional strategies with complementary strategies that provide greater specificity at the species and MPG levels. The regional strategies also highlight the need for domain-scale coordination to implement effective recovery strategies in tributary habitat, estuary habitat, hydropower, hatcheries, harvest, and ecological interactions. Coordination needs are further discussed in Chapter 10, Implementation and Coordination.

> Limiting factors are the biological and physical conditions that limit a species' viability (e.g. high water temperature).
>
> Threats are the human activities or natural processes that cause the limiting factors.
>
> The term "threats" carries a negative connotation; however, they are often legitimate and necessary activities that at times may have unintended negative consequences on fish populations. These activities can be managed to minimize or eliminate the negative impacts.

5.1 Tributary Habitat

5.1.1 Limiting Factors and Threats

The alteration of tributary habitats due to past and/or present land use remains a concern for Snake River spring/summer Chinook and steelhead populations. Both fish species spend long periods of their lives in tributary habitats to the Snake River systems and are very sensitive to changes in their freshwater ecosystems. Stream systems that are outside of areas protected by wilderness designations — such as the Grande Ronde and Imnaha Rivers in northeast Oregon, the Tucannon River in southeast Washington, and the South Fork Salmon River drainage in Idaho — particularly display scars from past, and sometimes ongoing, land use practices. Impaired habitat conditions in the areas generally stem from combined development and land use

activities over the past two hundred years, primarily in the early and mid 1900s. These threats include agricultural, forestry and grazing practices, dams and other barriers, water withdrawals, roads and channel manipulations. While the term "threats" carries a negative connotation, many of these are legitimate and necessary land use activities. The activities can be managed to minimize or eliminate negative impacts on fish populations.

Four interrelated limiting factors primarily reduce the viability of the Snake River spring/summer Chinook and steelhead populations: excess fine sediment, water quality (primarily temperature), water quantity (primarily low summer flows), and habitat quantity/diversity (primarily limited pools and large wood). Sediment levels are above historic levels throughout the area, except in wilderness area watersheds. Summer water temperatures are elevated in many stream reaches across the Snake River basin. Summer flows, often limited naturally, are lower than they were historically due to water withdrawals and land management practices. Salmon and steelhead often cannot survive in warmer streams unless they can find pools that have an influx of cool water from springs or seepage through gravels. Large wood and pool habitat in streams across the area are reduced relative to historic levels. Many stream reaches suffer from impaired riparian conditions and loss of floodplain connectivity, which contribute significantly to the above conditions.

5.1.2 Regional Strategy for Tributary Habitat

Protecting existing high quality and good quality tributary habitat, and restoring impaired habitats will specifically benefit Chinook salmon and steelhead in the spawning and rearing life stages. Improved spawning and rearing means that more fish will reproduce, more juveniles will survive to migrate, and consequently more adults will return to the area.

The freshwater habitat strategy is in line with findings from recent studies, which show that restoration planning that carefully integrates watershed processes is more likely to succeed in restoring depleted salmonid populations (Roni et al. 2008; Beechie et al. 2003). The strategy aims to improve tributary spawning and rearing conditions by restoring watershed processes, as well as by directly restoring degraded habitat. Together, actions will improve instream, riparian and upland habitat conditions; provide fish passage and floodplain connectivity; and address water quality and flow concerns.

The recovery plan proposes a hierarchy for implementation that aims to increase the success and cost effectiveness of habitat restoration efforts. Under this hierarchy, the first priority is to assess, protect and maintain good quality habitat and the processes that create and maintain it. The next priorities are to reconnect isolated habitat and restore various biological processes. Directly restoring impaired habitat becomes a lower priority because it is often more costly and only a short-term fix, compared to restoring the processes that create properly functioning habitat. However, some direct actions, such as placing large woody debris in carefully chosen areas, may be a high priority because they initiate biological processes that are likely to continue naturally if done together with protecting and restoring ecological processes for the long term.

The strategy intends to build on the many conservation efforts that are already helping to protect, conserve, and restore habitats on public and private lands in northeast Oregon, southeast Washington and Idaho. Recovery projects throughout the Snake River basin include: 1) land

acquisitions to protect existing high-quality habitat, 2) improved fish passage and increased access to high quality habitat, 3) riparian vegetation restoration through fencing and planting, 4) instream habitat improvements, and 5) screening of irrigation diversions. Many of these projects are being accomplished through coordination between water and land managers, private landowners, public interest groups and others using a variety of funding sources. NMFS will coordinate with the various partners to prioritize and implement tributary habitat actions for recovery of the spring/summer Chinook salmon and steelhead populations.

Table 5-1. Regional approach to address tributary habitat-related factors limiting recovery of Snake River spring/summer Chinook and steelhead populations.

Tributary Habitat		
Limiting Factors	Strategies	Types of Actions
Impairment of tributary habitat-forming processes and functions (loss of channel structure and complexity, floodplain connectivity, riparian vegetation, and LWD recruitment)	Protect and conserve natural ecological processes that support the population/MPG viability	Protect highest quality habitats through acquisition and conservation. Maintain current wilderness protection. Adopt and manage Cooperative Agreements. Conserve rare and unique functioning habitats. Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.
Loss of historical habitat because of blocked or impaired fish passage (dams, culverts, unscreened diversions)	Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	Remove or replace barriers blocking passage, such as dams, road culverts, irrigation structures and hatchery weirs. Provide screening at irrigation diversions. Replace screens that do not meet criteria.
Reduced floodplain connectivity and function (off-channel habitat, side channels, connected hypotheic zone)	Maintain and restore floodplain connectivity and function.	Reconnect side channels and off-channel habitats. Restore wet meadows. Reconnect floodplain to channel.
Reduced channel structure and complexity (loss of spawning and rearing habitat, LWD, pools)	Restore channel structure and complexity and maintain properly functioning conditions.	Place stable wood and other large debris in streambeds. Stabilize stream banks. Restore natural channel form.
Impaired riparian condition (native riparian vegetative communities, LWD recruitment)	Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	Restore natural riparian vegetative communities. Develop grazing strategies that promote riparian recovery.
Altered hydrology (low flow, scouring peak flows due to impaired watershed conditions, streamflow alterations and/or withdrawals for irrigation and other uses)	Restore natural hydrograph to provide sufficient flow during critical periods.	Implement water conservation measures. Improve irrigation conveyance and efficiency. Lease or acquire water rights and convert to instream.
Degraded water quality (high temperatures, nutrients, pesticides and other chemicals)	Improve degraded water quality and maintain unimpaired water quality.	Reduce chemical pollution inputs. Apply BMPs to animal feeding operations. Restore natural functions and processes through remediation actions.
Altered sediment routing excess fine sediment and runoff patterns due to upland management activities.	Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	Upgrade or remove problem forest roads. Restore native upland plant communities. Employ BMPs to forest practices, livestock grazing, road management and agricultural practices.

5.2 Estuary and Plume Habitat

5.2.1 Limiting Factors and Threats

Habitat conditions in the Columbia River estuary and plume are important to the survival of all Columbia Basin salmon and steelhead during critical rearing, migration, and saltwater acclimation periods in their life cycle. The estuary and plume provide salmon and steelhead with a food-rich environment where they undergo the physiological changes needed to make the transition to and from saltwater and achieve the growth needed to bolster their marine survival (NMFS 2011a; LCFRB 2010a).

Spring and summer Chinook salmon and steelhead, as well as other stream-type salmonids, appear to move more quickly through the estuary than ocean-type salmonids, such as fall Chinook salmon, and spend more time in plume habitats. The plume—a unique low-salinity, high-productivity environment that extends well into the ocean—provides feeding opportunities for spring Chinook salmon and steelhead to achieve growth and gradually acclimate to saltwater. The species typically make more use of the plume and use mostly deeper, main channel estuarine habitats rather than shallow vegetated wetlands (NMFS 2011a). Nevertheless, feeding and refuge areas in the estuary may still be important for these species while they are moving through the estuary (LCFRB 2010a).

The cumulative impacts of past and current land use (including dredging, filling, diking, and channelization) and alterations to the Columbia River flow regimes have reduced the quality and quantity of estuarine and plume habitat. The amount and accessibility of in-channel, off-channel, and plume habitat have been reduced as a result of habitat conversion for agricultural, urban, and industrial uses, hydro regulation and flood control, channelization, and higher bank full elevations, which have been facilitated by diking, dredging, and filling. Access to up to 77 percent of historical tidal swamps and many other peripheral wetlands has been eliminated, and the surface area of the estuary has decreased by approximately 20 percent over the past 200 years (Fresh et al. 2005).

The quality of the habitat available to salmon and steelhead in the estuary also has been compromised. Water temperatures above the upper thermal tolerance range for salmon and steelhead occur earlier and more often (NMFS 2011a) and are likely to continue to climb due to climate change (Independent Scientific Advisory Board 2007a, as cited in NMFS 2011a). Further, construction of revetments, disposal of dredged material, removal of large wood, and reductions in flow in the estuary have altered the diet of juvenile salmon in the estuary by eliminating much of the vegetated wetlands that historically supplied insect prey for juvenile salmonids and macrodetrital inputs to the estuarine food web. The shift in diet has been compounded by increased microdetrital inputs to the estuary; microdetrital inputs originate in decaying phytoplankton delivered from upstream reservoirs and nutrient inputs from urban, industrial, and agricultural development. The microdetrital-based food web may be less efficient for salmon and steelhead and favor other fish species in the estuary, such as American shad. It is likely that estuarine food web dynamics are being further altered by the presence of native and exotic fish, introduced invertebrates, invasive plant species, and thousands of over-water and instream structures, which alter habitat in their immediate vicinity. These and other changes in

habitat have left the estuary and plume in a degraded state compared to historical conditions (NMFS 2011a).

5.2.2 Regional Strategy for Estuary Habitat

Juvenile spring/summer Chinook and summer steelhead pass through the estuary on their way to the ocean. They are stream-type fish, and generally prefer deeper estuarine waters. Thus, the characteristics of the deeper estuarine channels, and the Columbia River plume, are important in determining the survival of these species. Actions that affect the estuary and plume, decrease exposure to toxicants, and decrease predation (especially Caspian tern predation) should improve the abundance/productivity and diversity of the Snake River spring/summer Chinook ESU and steelhead DPS.

The Estuary Module (NMFS 2011a) identifies management actions that will improve estuary and plume conditions for all salmonid. In general, estuary habitat strategies focus on providing adequate off-channel and intertidal habitats, such as tidal swamp and marsh; restoring habitat complexity in areas modified by agricultural or rural residential use; decreasing exposure to toxic contaminants; and lowering late summer and fall water temperatures. Over the long term the strategies will help restore hydrologic, sediment, and riparian processes that structure habitat in the estuary. Table 5-2 shows the types of actions to be implemented to improve habitat conditions in the Columbia River estuary and plume.

Table 5-2.Regional approach to address estuarine/plume habitat-related factors limiting recovery of Snake River spring/summer Chinook and steelhead populations.

Estuarine and Plume Habitat		
Limiting Factors	Strategies	Types of Actions
Degraded estuarine and near shore marine habitat reduces refugia available to juvenile steelhead in Columbia River estuary and plume as they prepare for ocean life.	Restore degraded estuarine and plume habitats and associated ecological processes.	Protect/restore riparian areas. Remove pile dikes. Protect remaining high-quality off-channel habitat. Breach or lower dikes and levees. Identify and reduce sources of pollutants. Monitor and restore contaminated sites. Adjust the timing, magnitude and frequency of flows.

5.3 Hydropower System and Fish Passage

5.3.1 Limiting Factors and Threats

Hydropower limiting factors and threats include those related to reservoirs and structures (including passage and habitat access impacts) and those related to flow modifications. Specific limiting factors that impact viability include mortality and delayed upstream passage (adults), direct and indirect mortality on downstream migrants (juveniles), alteration of the hydrograph (mainstem and estuary flow regime), depletion of historically available nutrients, and degraded rearing and food resources for both presmolts and smolts in the Columbia River. These limiting factors and threats are summarized below.

The Columbia Basin contains more than 450 dams, which are managed for hydropower, flood control, and other uses. Together these dams provide active storage of 42 million acre-feet of

water, with dams in Canada accounting for about half of the total storage (NPCC 2001, as cited in NMFS 2011a). Within the United States, a number of large multi-purpose hydroelectric projects operate as a coordinated system in the Columbia Basin as part of the Federal Columbia River Power System (FCRPS). Three U.S. government agencies – the Bonneville Power Administration, U.S. Army Corps of Engineers and Bureau of Reclamation, also called, collectively, the "action agencies" – collaborate to run the FCRPS under various congressional authorities, as a coordinated system for power production and flood control. The FCRPS provides about 60 percent of the Northwest's hydroelectric generating capacity and the dams supply irrigation water to more than a million acres of land in Washington, Oregon, Idaho and Montana. The Columbia River also supports barge navigation from the Pacific Ocean to Lewiston, Idaho, 465 miles inland.

The Columbia and Snake River hydro system remains a primary threat to the viability of Snake River spring/summer Chinook salmon and steelhead. The fish must pass eight large mainstem dams on their journey to the ocean and back: four federal dams on the lower Snake River mainstem (Lower Granite, Lower Monumental, Ice Harbor and Little Goose) and four federal dams on the lower Columbia River mainstem (McNary, The Dalles, John Day and Bonneville). The hydroelectric projects have converted much of the once free-flowing migratory river corridor into a stair-step series of slow pools. Today, median travel times for yearling Chinook from the Snake River to Bonneville Dam range from 14 days to 31 days depending on flow conditions, an increase of 40 to 50 percent over travel times measured in 1966 when fish encountered only four mainstem dams (Williams et al. 2005).

Passing the dams during their migrations remains a risky venture for juvenile and adult salmon and steelhead. A substantial proportion of juvenile salmon and steelhead can be killed while migrating through the dams, both directly through collisions with structures and abrupt pressure changes during passage through turbines and spillways, and indirectly, through non-fatal injury and disorientation that leave fish more susceptible to predation and disease, resulting in delayed mortality (NMFS 2008). Operational improvements and passage route configuration changes at dams in recent years have reduced juvenile mortality and injury rates. The dams also cause mortality and delayed upstream passage of adults retuning to natal streams.

The water impoundment and dam operations also affect downstream hydrologic conditions and water quality characteristics, vital for salmonid survival. Today, annual spring freshet flows through the Columbia River estuary are about one-half of the pre-development levels that flushed the estuary and carried smolts to sea. Water development also influences water temperatures through storage, diversion, and irrigation return flows. The Hydro Module (NMFS 2008) describes these impacts in detail and identifies actions to address them. The Hydro Module is available on the NMFS Web site: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Other-Documents.cfm.

Dam construction also blocked salmon and steelhead passage to thousands of miles of historical habitat in the Snake River basin. The Hells Canyon Dam complex on the Snake River cut off access to historical habitat in seven large tributaries for spring/summer Chinook salmon and steelhead (USBR 1997). Each of these seven tributaries — the Boise, Burnt, Malheur, Owyhee, Payette, Powder, and Weiser Rivers — provided hundreds of miles of spawning and rearing

habitat for spring/summer Chinook salmon and steelhead. Dworshak Dam, completed in 1969, blocked salmon and steelhead access to the North Fork Clearwater River. Many smaller dams, and temporary dams, have also been built without fish passage facilities and had the same effects, though on much smaller scales.

5.3.2 Regional Strategy for Hydropower System and Passage

Hydropower system strategies and actions address configurations and operations of the Columbia River hydropower system. They focus on improving juvenile and adult spring/summer Chinook salmon and steelhead passage and survival at particular mainstem Columbia and Snake River dams, and addressing flow and temperature issues. New fish passage structures installed at several mainstem Snake and Columbia River dams have proven to improve dam juvenile passage survival. These improvements include: a removal spillway weir at Lower Monumental Dam (2008), two temporary spillway weirs each at McNary Dam (2007) and John Day Dam (2008), an adjustable spillway weir and Little Goose Dam (2009), and a tailrace spillway wall at The Dalles Dam (2010). Evaluations of these structures shows that good progress is being made toward achievement of hydro performance standard levels of 96 percent for spring migrants and 93 percent for summer migrants (NMFS 2010).

Ongoing improvements to mainstem hydro operations, other actions identified in the 2008 FCRPS Biological Opinion and its 2010 Supplement (NMFS 2008f and 2010a), and further improvements for fish survival that result from the ongoing FCRPS collaborative process, represent the hydropower recovery strategy for all listed salmonids that migrate through the mainstem Columbia River, including Snake River spring/summer Chinook salmon and steelhead. Table 5-3 summarizes the strategies and actions being implemented to improve juvenile and adult salmon and steelhead survival through the Columbia and Snake hydropower system.

Table 5-3.Regional approach to address hydropower system constraints to recovery of Snake River spring/summer Chinook and steelhead populations.

Hydropower System		
Limiting Factors	Strategies	Types of Actions
Altered spring/summer Chinook and steelhead migration conditions and delayed passage due to hydrosystem development and operations in mainstem Columbia and Snake Rivers.	Operate the FCRPS to provide flows and water quality to improve juvenile and adult salmonid survival.	Draft storage reservoirs (Libby, Hungry Horse, Grand Coulee, and Dworshak) in attempt to meet seasonal and weekly flow objectives in the lower Columbia River during July and August. Pursue negotiations with Canada to provide 1 million acre feet of storage to augment summer flows. Meet Non-Treaty storage refill responsibilities and pursue a new long-term agreement on use of nontreaty space in Canadian reservoirs. Implement measures to improve flows during the lowest 20th percentile years. Implement water quality plans for Total Dissolved Gas and water temperatures in the mainstem Columbia and Snake Rivers to meet ESA and Clean Water Act responsibilities.
Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.	Modify Columbia and Snake River dams to maximize juvenile and adult survival.	Implement project specific configurations and operations at the eight mainstem dams on the lower Snake and Columbia rivers.

Hydropower System		
Limiting Factors	Strategies	Types of Actions
Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.	Implement spill and juvenile transportation improvements at Columbia and Snake River dams.	Provide spill to improve juvenile fish passage. Implement interim transportation program to improve survival of transported fish.
Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.	Operate and maintain juvenile and adult fish passage facilities at Corps mainstem projects to maintain biological performance.	Corps will operate juvenile and adult passage facilities year around with the regionally coordinate Fish Passage Plan.
Reduced survival of migrating kelts.	Develop and implement a kelt management plan.	BPA and Corps will prepare a Kelt Management Plan in coordination with NMFS.

5.4 Fisheries

5.4.1 Limiting Factors and Threats

Snake River spring/summer Chinook salmon and steelhead encounter fisheries in the ocean, Columbia River estuary, mainstem Columbia and Snake Rivers, and tributaries as they migrate from the ocean back to natal streams. Mortality and other indirect effects associated with the fisheries persist as a concern for all Snake River spring/summer Chinook salmon and steelhead populations. Direct effects are associated with immediate mortality as a result of fisheries. Immediate mortality results from fish that are caught and retained, or via fatal injury from trauma for a small number of fish that are killed immediately but not landed. Indirect effects include delayed mortality for fish that are caught and released, or captured by fishing gear but not landed. Other, indirect, fishery-related effects to Snake River spring/summer Chinook salmon and steelhead include reduced reproductive success when fish exposed to fishing pressure do not spawn successfully because of their exposure, and when released fish have reduced spawning success due to physical damage resulting from gear.

Direct and indirect effects associated with past and present fisheries continue to affect the abundance, productivity and diversity of all Snake River spring/summer Chinook salmon and steelhead populations. However, while harvest-related mortality in past fisheries contributed significantly to the populations' decline, the fisheries are now managed to restrict mortality of ESA-listed species. As a result, the current effects from all fisheries remain relatively low.

The largest harvest-related effects on Snake River spring/summer Chinook salmon and steelhead result from the implementation of tribal and nontribal mainstem Columbia River fisheries that target harvestable hatchery stocks migrating through Zones 1-6, an area extending from the river mouth to McNary Dam, and in the Snake River upstream to Lower Granite Dam. Mortality associated with tributaries fisheries also continues to occur in some areas. Mortality associated with ocean fisheries is rare for the species.

Fishery managers use complex management frameworks to restrict annual mortality rates on ESA-listed salmon and steelhead while meeting various harvest goals. States and tribes manage fisheries in the Columbia River estuary, mainstem Columbia River, Snake River, and tributaries to focus on different stocks and populations, and to meet various commercial, recreational and tribal needs. The different fisheries adhere to the guidelines and constraints of the Endangered

Species Act administered by NMFS, the Columbia River Compact, and management agreements negotiated between the parties to *U.S. v. Oregon*. Consequently, mortality rates on natural-origin Snake River spring/summer Chinook salmon and steelhead are influenced by a combination of laws, policies, and guidelines established to manage fisheries, and to control impacts on ESA-listed Columbia River salmonids. Negotiations between the different fishery co-managers in recent years have significantly reduced harvest-related mortality of natural-origin Snake River spring/summer Chinook salmon and steelhead.

5.4.2 Regional Strategy for Fisheries Management

Harvest strategies and actions aim to protect Snake River spring/summer Chinook and steelhead in the mainstem Columbia River, ocean and tributaries by maintaining low impact fisheries. Managers will continue to implement the abundance-based management framework for managing mainstem and tributary fisheries to limit ESA impacts on natural-origin Snake River spring/summer Chinook salmon and steelhead populations. Fishery opportunities will continue to be responsive to annual population abundance and recovery criteria, while remaining consistent with tribal trust responsibilities and formal agreements. Fisheries in the Columbia River mainstem will continue to comply with criteria developed through negotiation in *U.S. v. Oregon* to limit impacts on ESA-listed species. Tributary fisheries for Snake River spring/summer Chinook salmon will continue to be managed to support natural production and not reduce the likelihood of survival and recovery of the ESU.

The harvest strategy also calls to refine monitoring and research efforts. More and improved data are needed to monitor and manage population-specific impacts on natural-origin spring/summer Chinook salmon and steelhead, including remaining uncertainty regarding natural-origin spawning escapement and catch and release impacts in recreational fisheries. Table 5-4 shows the types of actions to be implemented to reduce potential risks from fisheries in the Columbia and Snake Rivers and tributaries.

Table 5-4. Regional approach to address fishery-related factors limiting recovery of Snake River spring/summer Chinook and steelhead populations.

Fishery Management		
Limiting Factors	Strategies	Types of Actions
Commercial, recreational and tribal fisheries in ocean, mainstem Columbia and Snake Rivers and tributaries reduce adult abundance and influence diversity.	Continue to manage to maintain current low impact fisheries and reduce harvest related adverse effects in those fisheries that have significant impacts.	Continue implementing fisheries in the mainstem Columbia that comply with management agreements developed under the jurisdiction of *U.S. v. Oregon* and associated biological opinions. Continue to manage tributary harvest and reduce adverse effects by implementing state and tribal fishery plans that have been reviewed and authorized under the ESA by NMFS. Develop population-specific sliding scales for harvest management based on natural-origin returns and designed to minimize impacts to natural-origin fish.
Questions remain regarding natural-origin spawning escapement levels and the impacts from catch and	Continue to refine monitoring and research efforts to gain more and improved data	Continue to implement and improve creel surveys and other fishery monitoring to assess and manage impacts on natural-origin returns.

Fishery Management		
Limiting Factors	Strategies	Types of Actions
release in recreational fisheries.	needed to reduce impacts on natural-origin returning fish.	Continue marking hatchery-origin juveniles that are for harvest mitigation. Consider implementation of genetic stock identification and PIT-tag studies to determine population-specific impacts from mainstem Columbia, Snake and tributary fisheries.

5.5 Hatcheries

5.5.1 Limiting Factors and Threats

Hatchery programs in the Snake River basin, and in the larger Columbia Basin, affect Snake River spring/summer Chinook salmon and steelhead. Hatchery programs can help preserve genetic resources, increase spatial distribution, and provide short-term demographic benefit in abundance in low return years. However, artificial propagation also poses risks to the productivity and genetic characteristics of the natural populations. Hatchery fish also affect natural populations by competing for limited food and habitat, and by transferring diseases. This section summarizes the effects of hatchery programs on Snake River spring/summer Chinook salmon and steelhead populations. The three management unit plans discuss hatchery-related limiting factors and threats to individual populations and MPGs, and present strategies and actions to address these factors.

Hatchery programs for many Snake River Chinook salmon and steelhead populations serve the dual purpose of providing fish for fisheries and supplemental spawners to help rebuild depressed natural populations. Most of the hatchery production for Snake River spring/summer Chinook salmon and steelhead was initiated under the Lower Snake River Compensation Program (LSRCP). This program is administered by the USFWS and was established as compensation for losses incurred as a result of the construction and operation of the four lower Snake River hydroelectric dams. Production under this initiative generally began in the mid-1980s. The Dworshak mitigation program also provides for artificial production of steelhead as compensation for the loss of access to the North Fork Clearwater. Dworshak Hatchery, completed in 1969, is the focus for that production. Small-scale natural stock supplementation studies and captive breeding efforts have been initiated in the Snake River basin since the mid-1990s.

Proper management of existing hatchery programs remains a concern for several Snake River spring/summer Chinook salmon and steelhead populations. The situation is complex, however, because several of the populations may have expired without the help of hatchery supplementation. Further, the existence of locally derived hatchery stocks may help natural populations bridge periods of adverse environmental conditions (as occurred in the 1990s).

Large releases of hatchery fish can pose risks to native-origin fish in the Snake River spring/summer Chinook salmon and steelhead MPGs. For example, approximately three million steelhead, all B-run, are released into the Salmon River and Clearwater MPGs, primarily for harvest augmentation. These are large releases of hatchery fish relative to the likely size of

natural production, so the cumulative program size poses risks. Further, many of the hatchery fish are released into areas that historically did not support B-run steelhead. Other potential problems include using out-of-MPG stocks and releasing fish in mainstem areas without proper acclimation, which increases the risk of straying.

Three major uncertainties exist regarding the effects of hatchery programs on natural populations: net demographic benefits, possible negative genetic effects, and ecological effects. As such, it is extremely important to collect information to understand what effect a hatchery program may have on either target or non-target populations so managers can understand and revise management practices to reduce negative effects, or fully benefit from positive impacts.

5.5.2 Regional Strategy for Hatchery Management

Hatchery programs for Snake River spring/summer Chinook salmon and steelhead have evolved as the status of the natural populations have changed, and new plans are now under development for every hatchery program in the Snake River basin. For example, many captive programs initiated during the 1990s to conserve Snake River spring/summer Chinook salmon genetic resources were terminated after the status of these fish improved. A comprehensive assessment of hatchery benefits and risks is now underway across the Snake River basin. The assessment is expected to result in operational refinements and changes that will benefit listed species and satisfy mitigation requirements.

This recovery plan identifies actions that support the recovery of viable natural-origin, self-sustaining populations of Snake River spring/summer Chinook salmon and steelhead. Recovery plan actions will help ensure that hatchery programs minimize demographic risks to the genetic and productive character of the natural-origin populations. The approach to recovery incorporates uncertainty with respect to population response and proceeds as a series of staged actions, many that are contingent on achieving measurable progress benchmarks.

Hatchery Genetic Management Plans (HGMP‘s) are being developed for each hatchery program, and will provide more detail on the components, facilities, and other aspects of these hatchery programs. HGMP‘s are coordinated by NMFS and developed by the operating entities to minimize hatchery impacts on ESA-listed species. NMFS uses the HGMP‘s as a basis for providing ESA coverage of hatchery operations through Section 7 consultations and Section 10 permits. Hatchery effects on the Chinook and steelhead populations and potential actions contributing to recovery are also discussed in NMFS’ Appendices C and D of the Supplemental Comprehensive Analysis of the FCRPS (NMFS 2008). Additional actions are being identified through the Hatchery Scientific Review Group’s work and in hatchery management plans. These hatchery reform proposals will be addressed and implemented through development of the HGMPs, section 7 consultations, and the *U.S. v. Oregon* process. Table 5-5 identifies the types of actions to be implemented to reduce risks associated with hatchery management and releases.

Table 5-5.Regional approach to address hatchery-related factors limiting recovery of Snake River spring/summer Chinook and steelhead populations.

Hatchery Management		
Limiting Factors	Strategies	Types of Actions
Potential divergence in genetic and phenotypic traits between hatchery and natural-origin populations.	Manage hatchery fish to support recovery of viable natural-origin, self-sustaining populations by minimizing influences on the productivity or genetic characteristics of natural-origin populations.	Use local-origin natural broodstock-based hatchery supplementation programs to reduce near-term demographic risks of Chinook salmon or steelhead population extinction. In long term, scale back reliance on hatchery programs to reduce demographic risks. Manage returning hatchery fish to minimize influences on the productivity and genetic characteristics of natural-origin spawners in affected populations. Address potential risks through HGMP development and consultation process.
Potential divergence in genetic and phenotypic traits between hatchery and natural-origin populations.	Reduce uncertainty in abundance and proportion of hatchery strays spawning naturally with the natural-origin populations.	Increase monitor to include estimates of adults returning to each population and to reduce uncertainty regarding hatchery strays and associated genetic risk. Limit straying of hatchery fish on spawning grounds through additional stream surveys and other methods. Ensure that actions taken to reduce hatchery straying associated risk are effective.
Competition for food and space	Evaluate ecological interactions and develop alternative release strategies if necessary.	Release strategies (life stage released, timing, etc.) Release numbers Release locations
Straying of out-of-DPS hatchery fish into natural spawning areas.	Reduce uncertainty regarding out-of-basin hatchery strays and associated genetic risks.	Increase monitoring efforts to restrict naturally spawning hatchery fish in some population areas.
Risk associated with reintroductions to historical habitat.	Manage efforts to restore natural production into historically utilized habitat to protect the viability of ESA-listed populations.	Evaluate feasibility of reestablishing naturally reproducing Chinook and populations into historical habitats in blocked areas.

5.6 Predation, Competition, Disease and Exposure to Toxics

5.6.1 Limiting Factors and Threats

Predation, competition, disease, and exposure to toxics all pose direct sources of mortality for Snake River spring/summer Chinook and steelhead.

Predation

Predation by pinnipeds, birds, and piscivorous fish in the mainstem Columbia River, while probably always a significant source of mortality for salmonids, has increased to the point that it is now a contributing factor limiting the viability of Snake River spring/summer Chinook salmon and steelhead. Ecosystem alterations attributable to hydropower dams and changes in the hydro system, and to modification of estuarine habitat, have increased predation on the populations. The number and/or predation effectiveness of Caspian terns, double-crested cormorants, and a

variety of gull species has increased due to habitat modification, particularly in the Columbia River estuary. The combined consumption of juvenile salmonids by Caspian terms and double-crested cormorants nesting on East Sand Island has been estimated to be between 7 and 16 million smolts annually (Collis et al. 2009). This represents approximately 10 percent of all the salmonid smolts that survive to the estuary in an average year (NMFS 2011a). Stream-type juvenile salmonids are most vulnerable to avian predation by Caspian terns because the juveniles use deep-water habitat channels that have relatively low turbidity and are close to island tern habitats.

Non-salmonid fish and marine mammals also prey on spring and summer Chinook salmon and steelhead. Northern pikeminnows congregate below Bonneville Dam and at hatchery release sites to feed on smolts. Introduced exotic fish species, such as smallmouth bass, Northern pikeminnow and walleye, thrive in the Bonneville, John Day, and lower Snake River reservoirs and prey on juvenile salmonids concentrated by the dams. Marine mammals (pinnipeds or sea lions) prey on migrating adult salmon and steelhead in the lower Columbia River and as they attempt to pass over Bonneville Dam (USACE 2007).

Predation also remains a concern in natal tributaries, including by Northern pikeminnow, small mouth bass, and non-native brook trout. The individual management unit plans discuss predation concerns in tributary reaches.

Competition

It is likely that competition between hatchery-origin fish and natural-origin fish is occurring in the Columbia River estuary, where food resources are limited and juvenile salmon and steelhead become concentrated on their way to the ocean (Fresh 1997). Competition may also occur among salmonids, and between salmonids and other fish, in the estuary. The intensity and magnitude of competition likely escalates when large numbers of salmonids inhabit the estuary at the same time and require similar habitat conditions and food. Habitat loss in the Columbia River estuary over the last century has concentrated salmon and steelhead into more limited and fragmented regions (Bottom et al. 2005), which may have increased competition. However, the impact of habitat loss on the Columbia River estuary's capacity to support juvenile salmon is unknown (Bottom et al. 2005).

Competition between natural-origin and hatchery-origin salmonids and/or other native or invasive species fish also remains a concern in natal tributaries. The individual management unit plans discuss competition concerns in tributary reaches.

Disease

A range of viruses, bacteria, fungi, and parasites, collectively known as pathogens, have significant effects on salmon and steelhead populations through mortality or reduced fitness (morbidity). A number of factors have increased the potential for Snake River spring/summer Chinook salmon and steelhead to contract diseases. Impoundments have increased summer water temperatures, creating conditions where levels of pathogens and severity of virulence of some pathogens are increased. Passage through the hydrosystem also delays and stresses salmonids, increasing their exposure and reducing their resistance to disease. Introduction of exotic species and between-basin transfer of native fish create opportunities for the introduction of new

pathogens, or for endemic pathogens to increase their range. Large-scale intensive hatchery culture provides conditions where pathogens could spread rapidly within the hatchery, and increases the risk of transfer of disease out of the hatchery through hatchery effluents and the release of infected fish. Changing environmental conditions have altered relationships between parasites and their hosts, potentially increasing the severity of parasitic infection. Handling and transport of fish at dams has led to fish being held at much higher densities than observed in the wild, increasing chances of disease transmission.

Exposure to Toxics

A variety of toxic contaminants have been found in water, sediments, and salmon tissue in the Columbia River estuary at concentrations above the estimated thresholds for health effects in juvenile salmon and steelhead. These contaminants include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), DDT, and copper (Lower Columbia River Estuary Partnership 2007). Pesticides in current use also have been detected in the estuary, along with emerging contaminants such as pharmaceuticals, personal care products, and brominated fire retardants (NMFS 2011a). Although the effects of emerging contaminants on salmon and steelhead are not well understood, these compounds appear to pose risks to salmonid development, health, and fitness through endocrine disruption, bioaccumulative toxicity, or other means. Toxic contaminants are widespread in the estuary, both geographically and in the food chain.

5.6.2 Regional Strategy for Predation, Competition, Disease and Toxics

Strategies and actions to address concerns presented by predation, competition, and toxics are discussed in the management unit plans, Estuary Module, FCRPS BiOp and this recovery plan. The documents also direct additional research, monitoring and evaluation activities to quantify the impacts of predation, competition, and toxics on Snake River spring/summer Chinook salmon and steelhead recovery efforts.

Since multiple factors cause disease in salmonids, it cannot be directly addressed by recovery actions except in specific instances of known causal factors. It is more likely that nearly all of the recommended recovery actions to increase the survival, abundance, and productivity of naturally produced salmon and steelhead will decrease the incidence of disease. Table 5-6 describes the regional strategy to monitor and address concerns related to predation, competition, disease and toxics.

Table 5-6.Regional approach to monitor and address concerns related to predation, competition, disease and toxics that could affect recovery of Snake River spring/summer Chinook and steelhead populations.

Limiting Factors	Strategies	Types of Actions
Predation and Competition		
Increased predation on salmon and steelhead due to degraded estuarine and plume habitats, and to hydrosystem development and operations.	Reduce predation and competition in the Columbia River mainstem, estuary and plume.	Reduce predation by pinnipeds Redistribute Caspian terns Redistribute cormorants
Competition between natural-origin and hatchery-origin salmonids, and/or other native or invasive species, for	Evaluate ecological interactions and develop alternative release strategies if necessary.	Release strategies (life stage released, timing, etc.) Release numbers Release locations

food and space.		Utilize fisheries
Disease		
Effects of disease reduce fish health and survival.	Reduce transmission and effects of disease	Release fish that have history of good health and are free of disease. Monitor for disease or pathogen presence in hatchery and naturally produced fish.
Toxics		
Exposure to toxics reduces fish health and survival.	Identify and reduce sources of pollutants.	Implement pesticide and fertilizer best management practices to reduce estuarine and upstream sources of toxic contaminants. Identify and reduce terrestrially and marine-based industrial, commercial, and public sources of pollutants. Restore or mitigate contaminated sites. Implement stormwater best management practices in cities and towns.

5.7 Climate Change

5.7.1 Limiting Factors and Threats

Likely changes in temperature, precipitation, wind patterns, ocean acidification, and sea level height have implications for survival of Snake River spring/summer Chinook salmon and steelhead in their freshwater, estuarine, and marine habitats. Details of the effects of climate change on Columbia River Basin salmon and steelhead are reviewed in ISAB (2007), NMFS (2010), and Mote and Salathé (2010) and summarized below.

Expected climate change impacts on freshwater habitat conditions for salmon and steelhead populations include:

a. Increases in water temperatures.
b. Decreases in snow pack causing a shift of peak flows from summer to spring, and a decrease in summer flow. Shifts in the timing of peak flows will likely result in changes in outmigration timing, changes in survival, changes in distribution, and changes in the availability of spawning and rearing habitats.
c. Peak flows will be flashier, likely resulting in channel scouring and increased risk of sedimentation.
d. Higher elevation areas will likely continue to provide habitat conditions within the biological tolerance of salmonids. However, lower and transitional areas will experience increasing temperatures reducing the available spawning and rearing habitats, altering distribution, and diminishing survival of fish migrating up to and from the higher elevation spawning areas.
e. Life history strategies may be altered (e.g., adoption of sub-yearling life history strategies by Snake River spring/summer Chinook salmon).

While the magnitude and timing of these resulting biological effects are poorly understood at present, and specific effects are likely to vary among populations, the biological consequences

are generally predicted to be negative, including changes in distribution, behavior, growth, migration characteristics and survival.

Climate change is also affecting the estuarine and marine environment, resulting in increasing sea temperatures, sea level height, and ocean acidity. These factors could further restrict available habitat, alter prey survival and productivity, and possibly alter salmon and steelhead migration patterns, growth, and survival.

5.7.2 Regional Strategy for Climate Change

All other threats and conditions remaining equal, future deterioration of water quality, water quantity, and/or physical habitat due to climate change is expected to cause a reduction in the number of naturally produced adult spring/summer Chinook and steelhead returning to populations across the ESU and DPS. This possibility further reinforces the importance of achieving survival improvements throughout the entire life cycle, and across different populations since neighboring populations with differences in habitat may show different responses to climate changes. Important elements of a regional strategy include:

- Conserve adequate habitat to support healthy fish populations and ecosystem functions in a changing climate.
- Manage species and maintain habitat diversity to protect ecosystem functions.
- Conduct studies to document climatic effects on freshwater, estuary and ocean productivity, and adjust actions accordingly through adaptive management.

In general, mitigating for climate-induced changes in hydrology and temperature in tributaries will involve many of the same approaches that are already ongoing and/or identified in the management unit plans. As climate and streams warm, tributary habitats will become increasingly important because they usually provide the cool waters for salmonids. Actions that help minimize increased water temperatures, increase stream flow during summer and autumn, and provide pools with cool water from springs would contribute to this end (ISAB 2007). Actions to reduce impacts from climate change in the Columbia River estuary and mainstem reaches also serve to reduce water temperatures and provide cool-water thermal refugia to support salmon and steelhead.

The Independent Scientific Advisory Board's recommendations for incorporating climate change considerations into restoration and recovery planning and recommended actions for reducing climate change impacts on Columbia Basin salmon and steelhead are specifically targeted to salmon and steelhead populations in the Pacific Northwest (ISAB 2007). NMFS incorporates the ISAB's recommendations by reference into this recovery plan. The management unit plans and Estuary Module contain actions that implement many of these strategies. These actions will continue to be evaluated during plan implementation and will be tailored as needed to address climate change impacts in the Snake River basin.

5.8 Key Information Needs

Much remains unknown about how different factors affect salmon and steelhead abundance, productivity and diversity throughout their life cycles. NMFS continues to work with other federal, state, and tribal management agencies and others to gain information needed to better understand how remaining uncertainties affect progress toward recovery and to target future actions most effectively. The following information is needed to conduct future effects analyses as recovery actions are implemented over time. The information will be used to evaluate the impact of recovery actions at the species level and across the salmon life cycle.

Ocean Productivity and Natural Variation

Global-scale processes in the ocean and atmosphere can regulate the productivity of marine, estuarine, and freshwater habitats of salmon and steelhead. Although managers cannot control these processes, natural variability must be understood to correctly interpret the response of salmon and steelhead to management actions. For example, assessing needed survival improvements based on spawner returns during periods of below average climatic and other background conditions has the effect of projecting these generally poor ocean conditions into the future. If more years were added to the analysis, representing better ocean conditions, estimated required survival increases would decrease. Additional research is needed to help understand the mechanisms of ocean and climatic survival conditions, and to help improve forecasting and relating fisheries management capabilities and ensure that Snake River spring/summer Chinook salmon and steelhead populations persist over the full range of environmental conditions they are likely to encounter.

Hydropower System

Ongoing studies continue to assess factors such as juvenile survival rates at each dam, seasonal trends in smolt to adult returns, and adult survival rates for different stocks. As recommended in NMFS' 2011 status review, additional research and monitoring is needed to gain a better understanding of smolt migration timing and mortality rates through the lower Snake and Columbia Rivers, including the effects of spring and summer spills. Investigations are also needed concerning factors that could contribute to latent mortality of fish passing through the hydro system.

Harvest

Ongoing fisheries management discussions are working toward abundance-based sliding-scale harvest rates for Snake River spring/summer Chinook salmon and steelhead. Gaining more fisheries data through pit tag detection and other studies will help managers better understand the sources of losses and improve harvest management. Information is also needed to improve estimates of harvest catch and release impacts.

Hatcheries

Uncertainties exist concerning hatchery effects on natural-origin salmon and steelhead populations. These uncertainties include the impact of hatchery releases on natural-origin population abundance, productivity, and genetic integrity. Importantly, they also include the ecological interactions that occur between hatchery and natural-origin ESA-listed fish in the tributary, mainstem, estuary and ocean environments. Additional research will help managers

assess demographic risk versus conservation benefit of hatchery supplementation, and the implications of hatchery programs.

The ICTRT has identified collecting population-specific estimates of annual abundance and obtaining information on the relative distribution of hatchery spawners at the population level as the main priorities for the Snake River steelhead DPS (ICTRT 2007). Because of this lack of information, the status of most of the populations in the DPS remains highly uncertain. Currently, estimates of population-specific spawning abundance are only available for two of the 24 extant populations of Snake River steelhead. Adult abundance data series are limited to aggregate estimates at Lower Granite Dam (total, A-run and B-run), estimates for two Grande Ronde populations (Joseph Creek and Upper Grande Ronde River), and index area or weir counts for subsections of several other populations. Information is also needed to determine where and to what extent unaccounted for hatchery steelhead are interacting with depressed ESA-listed populations, particularly in Idaho (Ford 2011).

At a larger scale, information is also needed to determine the factors contributing to lower or greater reproductive success rates for hatchery fish, and the effects of total hatchery production on the listed salmon and steelhead populations. The potential effect of total hatchery production in the Columbia and Snake Rivers on natural-origin fish is unknown at this time.

Reintroduction Opportunities

Research is ongoing to examine the risks and feasibility of reintroducing Chinook salmon and steelhead into historical habitats in blocked areas. Information is needed to determine the potential benefits of additional reintroductions, considerations under which reintroductions would be suitable, and potential alternative reintroduction strategies and techniques.

Predation, Competition and Disease

Other native species (competitors and predators), invasive species (competitors, predators and pathogens) and/or other populations (tradeoff among species) target salmon and steelhead populations and affect their viability. These threats are not restricted to direct predation. Instead, non-indigenous species and other native species can compete directly and indirectly with Snake River spring/summer Chinook salmon and steelhead for resources, significantly altering food webs and trophic structure, and potentially altering evolutionary trajectories (NMFS 2011). More information is needed to evaluate the effects of these threats on population and ESU/DPS viability.

Exposure to Toxics

Chemical contaminants are increasingly being recognized as a factor that has contributed to the decline of listed species (NMFS 2010). Recent scientific studies document the presence of elevated concentrations of bioaccumulative contaminants including polycholinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDTs), polycyclic aromatic hydrocarbons (PAHs) and polybrominated diphenylethers (PBDEs) in bodies or prey of juvenile salmon in the lower Columbia River (Johnson et al. 2007; LCREP2007; Sloan et al. 2010 as cited in NMFS 2010). Scientific information indicates that if chemical contaminates are affecting the survival and productivity of individual fish, the intrinsic productivity of affected populations also could be reduced. The toxic effects of various chemicals and pesticides could also indirectly affect

viability by reducing non-target insect species that are important food for juvenile salmonids. More information is needed to determine the role of these chemical contaminants in limiting salmon and steelhead population viability.

Climate Change

Current research is providing insights to potential future climate change impacts for the Pacific Northwest region. Although the values or severity of these changes may be uncertain, and their biological impacts on salmonids have yet to be demonstrated, there is general scientific agreement regarding the impacts already evident and expected trends. Additional information is needed to monitor changes to habitat conditions and increase our understanding of the likely impacts of these changes on salmonid populations. Data needs to be collected throughout the salmonid life cycle, including changes in freshwater conditions (snow pack), mainstem conditions (flow and temperature), and ocean conditions (temperature, acidity) on survival.

Interacting Strategies/Actions

It is unclear how strategies and actions implemented within each of the sectors (Harvest, Hatcheries, Hydropower, and Habitat) will interact to impact the environment and contribute to population, MPG and species recovery. In particular, a high level of uncertainty exists for the magnitude and response time of habitat actions. While significant habitat restoration and protection actions have been implemented to improve degraded habitat conditions and restore passage, we do not yet have evidence demonstrating that improvements in habitat conditions have led to improvements in population viability. Ongoing improvements in the monitoring, evaluation, and reporting of habitat metrics and fish population response will allow us to document the effectiveness of habitat restoration actions and progress toward the viability criteria for the ESU and DPS in the future. Generally, it takes one to five decades to demonstrate such increases in viability.

Information is also needed to better understand the degree of geographic concordance among populations, including similarities and differences in their responses to variability in freshwater and marine productivity, differing levels of habitat restoration across watersheds, and influences of total hatchery composition on the wild component of the species. This type of information will help us identify populations that are especially vulnerable to extinction due to spatial isolation.

5.9 Summary of Overall Recovery Strategy

No single factor, threat, or threat category accounts for the declines of Snake River spring/summer Chinook salmon and steelhead. Instead, the status of the ESU and DPS is the result of the cumulative impact of multiple limiting factors and threats. Although this chapter and the recovery analyses that follow highlight major recovery topics, factors, and actions, recovery of the ESU and DPS will be accomplished through improvements in every general threat category. Even small increments of improvement will play an important role. When the need for improvement for most ESUs is so large, the contribution of no population or threat reduction can be discounted.

6 ▪ Snake River Spring/Summer Chinook Salmon Recovery Analysis

This chapter describes the recovery analysis for the Snake River spring/summer Chinook salmon ESU. It provides specific information about the Snake River spring/summer Chinook salmon ESU, including the recovery strategies for the ESU and its major population groups, the expected effects of proposed actions, key information needs, and delisting criteria. The chapter builds on information presented in previous chapters. Chapter 3 describes the recovery goals, delisting criteria, and potential recovery scenarios for the Snake River spring/summer Chinook salmon ESU. Chapter 4 discusses the current status of the ESU and MPGs, and the gap that must be breached to achieve recovery. Chapter 5 summarizes the recovery issues, limiting factors and threats, and recovery strategies that apply at a regional level for the species.

Material presented in this chapter draws from the three management unit plans (northeast Oregon, southeast Washington and Idaho); several NMFS publications: the Supplemental Comprehensive Analysis of the 2008 Biological Opinion (NMFS 2008b), the ICTRT's 2010 Status Assessments of Snake River species; the Northwest Fisheries Science Center's 5-year Review (Ford 2011), the ICTRT's 2007 Viability Criteria document and 2007 "Gap" report, and the NMFS' *5-Year Review of Snake River sockeye, spring/summer Chinook, fall-run Chinook and steelhead* (NMFS 2011); and the three recovery planning modules.

6.1 Biological Background

6.1.1 Life History

Spring and summer Chinook salmon belong to the Chinook salmon family, which is one of eight species of Pacific salmonids in the genus *Oncorhynchus* and the largest of any salmonid. Historically, Chinook salmon ranged in North America from the Ventura River in southern California to Point Hope, Alaska, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia (Healey 1991). Chinook salmon have been reported in the Mackenzie River area of northern Canada (McPhail and Lindsey 1970).

Spring and summer Chinook salmon represent two of four different seasonal (i.e., spring, summer, fall, or winter) "races" or "runs" in the Chinook salmon migration from the ocean to fresh water. These runs reflect the timing of when adult Chinook salmon enter fresh water to begin their spawning migration. The runs differ in the degree of maturation at the time of river entry, the thermal regime and flow characteristics of their spawning site, and their actual time of spawning. Freshwater entry and spawning timing are generally related to local temperature and water flow regimes.

The different seasonal migration strategies among Chinook salmon reflect the evolution of two distinct life histories: a "stream-type" Chinook salmon resides in freshwater for a year or more following emergence; an "ocean-type" Chinook salmon migrates to the ocean predominantly within their first year. Snake River spring and summer Chinook salmon exhibit a stream-type life

history. This type of Chinook salmon exhibits different life history traits, geographic distribution, and genetic characteristics than the ocean-type of Chinook salmon.

Stream-type Chinook salmon generally migrate to the ocean as yearling, averaging 73-134 mm depending on the river system (some 2-year-old smolts have been identified). They undertake extensive offshore ocean migrations, traveling as far north as the Aleutian Islands and out into the open ocean, far from coastal waters. They typically rear two to three years in the ocean before beginning their migration back to their natal freshwater streams as spring- or summer-run fish. In comparison, salmon with an ocean-type life history commonly migrate to sea within the first three months of emergence, although they may spend up to a year in fresh water prior to emigration. Ocean-type Chinook salmon tend to use estuaries and coastal areas more extensively for juvenile rearing than do stream-type Chinook. They spend their ocean life in coastal waters, often migrating along the coastline before migrating back to their natal freshwater streams as spring-, summer-, fall-, late-fall- or winter-run fish.

Adult spring and summer Chinook salmon destined for the Snake River enter the Columbia River on their upstream spawning migration from February through March and arrive at their natal tributaries between June and August. Spawning occurs in August and September. The eggs that Snake River spring and summer Chinook salmon deposit in late summer and early fall then incubate over the following winter, and hatch in late winter and early spring. Juvenile spring and summer Chinook salmon rear in their natal streams throughout their first summer, overwinter, and migrate to sea in the spring of their second year of life. Depending on the tributary and the specific habitat conditions, the juveniles may migrate extensively from natal reaches into alternative summer rearing or overwintering areas. After reaching the ocean as smolts, the fish typically rear two to three years in the ocean before beginning their migration back to their natal freshwater streams in the spring or summer months. Snake River spring/summer Chinook salmon return from the ocean to spawn primarily as 4-year and 5-year-old fish. A small portion return as 3-year-old "jacks," which are primarily males (Good et al. 2005). The returning fish hold in deep mainstem and tributary pools until late summer, when they emigrate into tributary areas to spawn. Because of their long freshwater residency, these stream-type fish rely heavily on the conditions of their freshwater stream ecosystems.

[Insert figure 6-1. (Life cycle)]

6.1.2 Historical and Current Distribution

The Snake River spring/summer Chinook ESU includes all naturally spawned populations of spring/summer Chinook in the mainstem Snake River and the Tucannon River, Grand Ronde River, Imnaha River, and Salmon River subbasins. The Salmon River system contains especially productive habitats for spring and summer Chinook salmon, and may have once contributed more than 40 percent of the total return of spring/summer Chinook to the entire Columbia River (Fulton 1968). The South Fork and Middle Fork Salmon River currently support the bulk of natural production in the drainage. Two large tributaries entering above the confluence of the Middle Fork Salmon River, the Lemhi and Pahsimeroi Rivers, drain broad alluvial valleys and are believed to have historically supported substantial, relatively productive anadromous fish runs. Sunbeam Dam, built in 1910 on the mainstem Salmon River at the mouth of the Yankee Fork, seriously impeded the migration of anadromous fish to the upper Salmon River tributaries

and may have been a complete block in at least some years before its partial removal in 1934 (Waples et al. 1991b). Salmon and steelhead passage to the upper Salmon River tributaries was reestablished following the partial removal of the dam.

Historically, Snake River spring/summer Chinook also ranged into several areas that are no longer accessible (Figure 6-2). Habitat analyses and historical records of fish presence indicate that the Clearwater River basin and the area above Hells Canyon Dam, including the Owyhee, Malheur, and Powder Rivers, supported several additional anadromous populations (ICTRT 2008). No biological data, however, are available to assess the historical relationships among populations in the extirpated areas above the Hells Canyon Dam complex, including the potential that one or more additional ESUs may have existed (ICTRT 2007). Current runs to the Clearwater River also are not part of the Snake River spring/summer Chinook salmon ESU. Lewiston Dam, constructed on the lower Clearwater River in 1927, blocked salmon and steelhead passage until the early 1940s (Matthews and Waples 1991). Biologists have concluded that even if a few native salmon survived the hydropower dams on the Clearwater River, the massive outplantings of nonindigenous hatchery stocks to the Clearwater system since the late 1940s have presumably substantially altered, if not eliminated, the original gene pool (Matthews and Waples 1991).

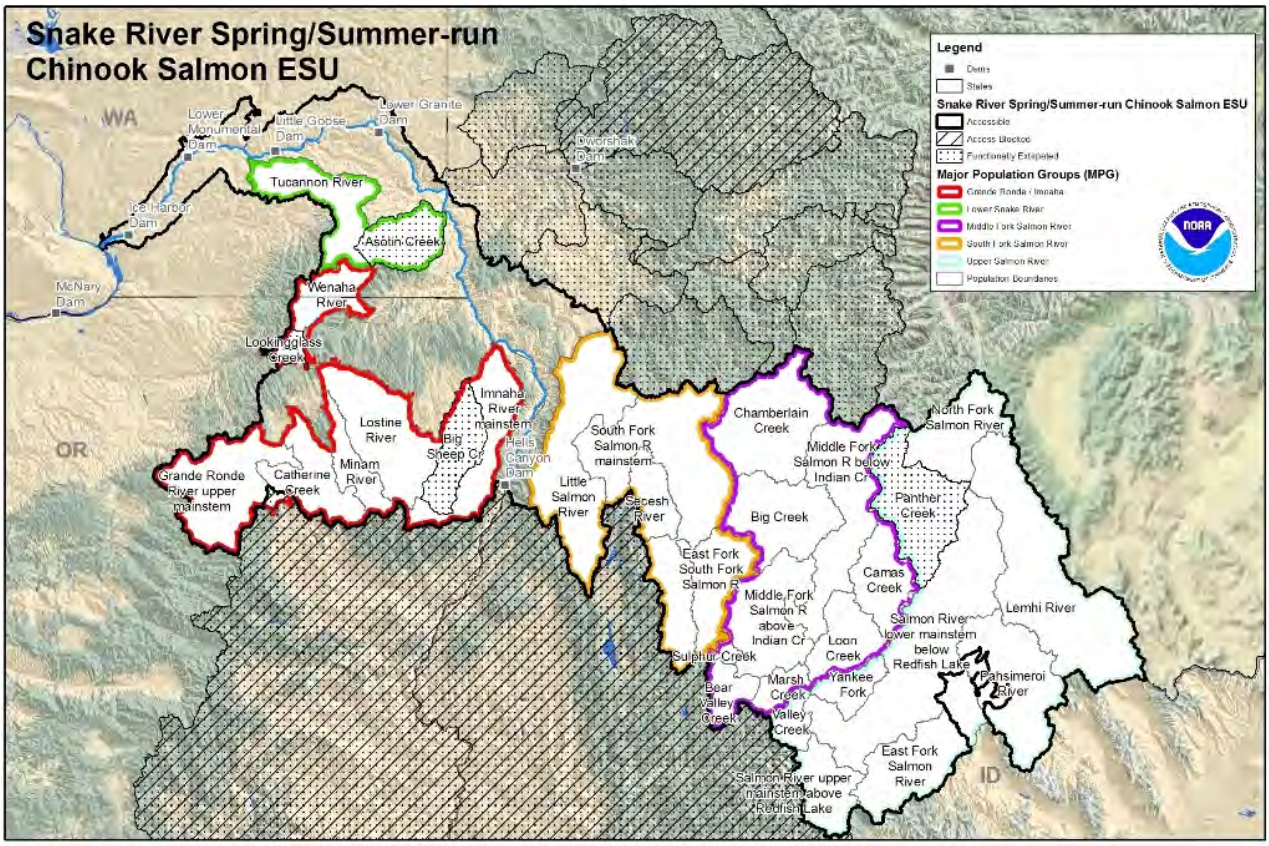


Figure 6-2. Snake River spring/summer Chinook ESU with populations and major population groups, as well as historical production areas above Hells Canyon Dam and in the Clearwater River drainage that may have supported additional MPGs (NMFS 2012).

Spring-run Chinook salmon return to natal reaches of major Snake River tributaries in mid-through late August; summer-run Snake River Chinook salmon spawn approximately one month later than spring-run fish. Summer-run Chinook salmon tend to spawn lower in the Snake River drainages, although their spawning areas often overlap with spring-run spawners. The returning spring and summer Chinook salmon tend to spawn in the extensive meanders through high-elevation meadowlands and the relatively steep lower sections that join the drainages to the mainstem Salmon River (Matthews and Waples 1991). The combination of relatively high summer water temperatures and the upland meadow habitat creates the potential for high juvenile productivity (Good et al. 2005).

6.2 ESU and MPG-Level Recovery Strategies and Adaptive Management

The path to recovery for Snake River spring/summer Chinook salmon requires that the biological and threats criteria for the ESU be met. According to these criteria, all major population groups that are critical for proper functioning of the ESU need to be at low risk and have a high probability of persistence before the ESU can be removed from the ESA's threatened and endangered species list. Achieving this goal will be a large task. This section describes the MPG-level strategies designed to bridge the gap between the current and desired status (described in Chapter 4) and support ESU recovery. Sections 6.2.1 through 6.2.5 summarize the MPG-level strategies designed to achieve viability at the MPG level and support delisting of the Snake River spring/summer Chinook salmon ESU. The recovery strategies target actions at the major population group and population levels. Targeting recovery efforts at these levels, and achieving viability for the populations and MPGs, will support recovery of the Snake River spring/summer Chinook ESU and steelhead DPS. The northeast Oregon, southeast Washington and Idaho management unit plans provide detailed discussions of the strategies summarized in this section.

The recovery strategy is designed to meet the recovery goal of ESA delisting and to be consistent with achieving broad sense goals that go beyond ESA delisting. Delisting goals and broad sense goals are provided in Chapter 3.

Insert: describe the overall recovery strategy

This recovery strategy depends on implementation of an adaptive management framework that implements site specific actions based on best available science, monitors to improve the science, and updates actions based on new knowledge. The ESA section 4(f) requires site specific actions "as may be necessary to achieve the plan's goals for conservation and survival of the species." There are two types of site specific actions in this plan: management actions and research, monitoring and evaluation actions. Management actions address the limiting factors and threats. Research, monitoring and evaluation actions address the information needed to evaluate the status of the species and the threats. Our hypothesis is that the management actions will be effective in improving survival; however, we have substantial uncertainties about whether they will be sufficient to achieve viability. Thus, this recovery plan depends on an adaptive management framework as follows:

1) Establish recovery goals and viability and threats criteria for delisting (Chapter 3).

2) Determine the species present status and the gaps between the present status and viability criteria. (Chapter 4).

3) Assess the threats and limiting factors in each of the major planning sectors that are contributing to the gaps between present status and viability criteria (Chapter 5). Also, assess the threats in the context of variable ocean conditions and emerging climate change.

4) Implement management actions (Chapter 6) that target the limiting factors and threats associated with each of the major planning sectors.

5) Implement research, monitoring and evaluation actions (Chapter 7) to evaluate the status of the species and the threats.

6) Address critical uncertainties. There are critical uncertainties about the species status, effects of ongoing and proposed actions, the role of the ocean and climate change, and the best opportunities for further improving survival to meet the viability criteria. These uncertainties are described and prioritized in the research, monitoring, and evaluation Chapter 7.

7) Establish a contingency process. We need to be prepared if the species' status does not continue to improve in a timely manner and also if there are significant declines in status. A contingency process should be established that sets intermediate goals and timeframes and also sets early warning indicators and significant decline triggers. As part of this process, additional actions should be developed that are "on the shelf," if needed, to address long term trends toward recovery and to prevent precipitous declines. The need for this contingency process is also addressed in the Implementation Chapter (Chapter 10).

8) Review progress and identify best opportunities for survival improvements. Regular major reviews of implementation progress, species response, and new information are needed. These progress reviews are addressed in the Implementation Chapter (Chapter 10).

9) Adjust actions according to progress reviews. The success of this recovery plan depends on an implementation structure that takes action in response to the results of progress reviews.

10) Repeat the adaptive management cycle. Adaptive management should be a continuous loop of action implementation, monitoring and evaluation, new information, assessment of information and updated actions.

6.2.1 Grande Ronde/Imnaha Rivers MPG

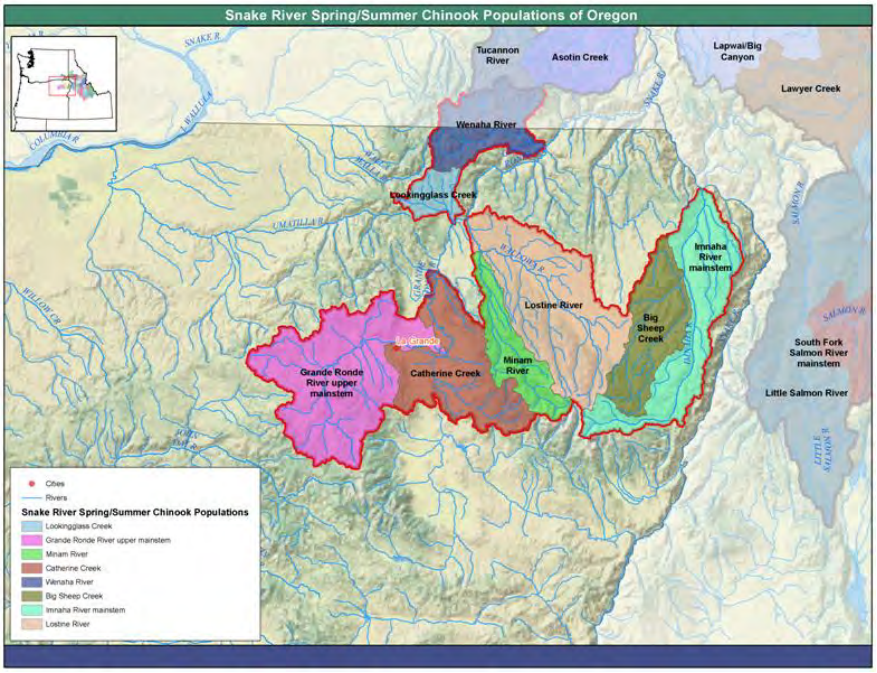
Current MPG Status

- The six extant populations in MPG are at high risk of extinction and non-viable in their current state.
- Two populations, Big Sheep and Lookingglass Creeks, are functionally extirpated.

Proposed MPG Recovery Strategy

- Achieve viable status (low risk) for the Imnaha, Lostine/Wallowa, Minam, Catherine, and Wenaha populations, with at least one highly viable (very low risk).
- Achieve at least "maintained" status (moderate risk) for Upper Grande Ronde population.
- Support reintroduction programs for Big Sheep and Lookingglass Creek populations.

MPG-Level Recovery Strategies



- Implement FCRPS BiOp actions to reduce mortalities associated with passage through mainstem Columbia and Snake River hydroelectric projects.
- Reduce mortalities during the outmigration from overwintering habitats to the mainstem Snake River, especially in the lower Grande Ronde River mainstem and key tributary production areas.
- Maintain current wilderness protection and protect pristine tributary habitat.
- Improve quantity and quality of winter rearing habitats, especially key overwintering areas in the Grande Ronde Valley, lower mainstem Grand Ronde River, and in tributary production areas.
- Protect and enhance spawning and summer rearing habitats in currently used reaches of the Grande Ronde River and key tributary production areas, and improve potential summer rearing habitat quantity and quality.
- Manage risks from mainstem Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries according to an abundance-based schedule.
- Implement hatchery programs so they will reduce short-term extinction risk and promote recovery.
- Monitor/evaluate effects of Lookingglass, Imnaha and Big Sheep Creek hatchery programs on extant populations. Manage returning hatchery fish to minimize effects of hatchery fish on natural-origin spawners in affected populations.
- Restrict naturally spawning hatchery fish in some population areas, while maintaining unrestricted natural spawning of hatchery fish in others.
- Utilize terminal fisheries to minimize the escapement of hatchery-origin fish in natural production areas.

6.2.2 Lower Snake River MPG

Current MPG Status

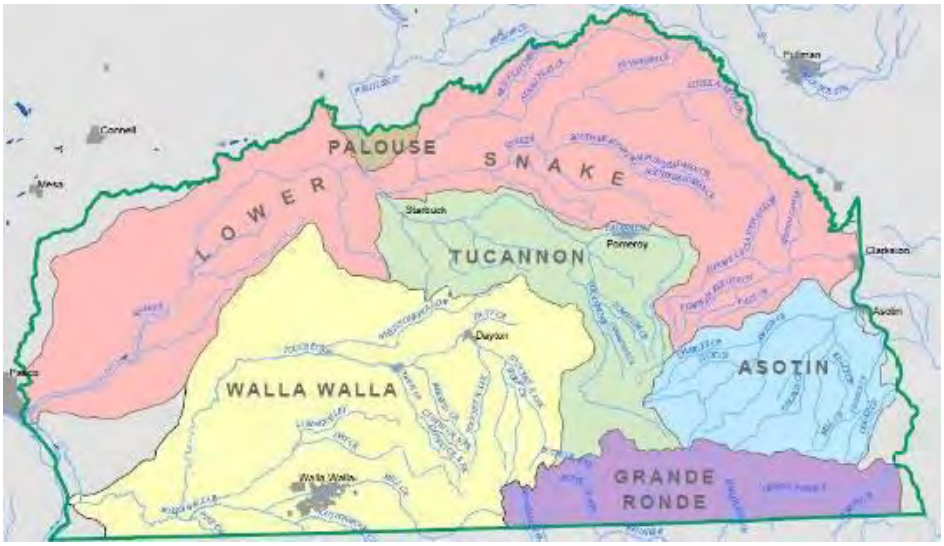
- The lone extant population, Tucannon River, remains at high risk of extinction and non-viable.
- The Asotin Creek population is functionally extirpated.

Proposed MPG Recovery Strategy

- Achieve Highly Viable status (very low risk) for the Tucannon River population.
- Focus initial recovery efforts on improving status of Tucannon River population, but support reintroduction program for Asotin Creek population.

MPG-Level Recovery Strategies

- Implement FCRPS BiOp actions to reduce mortalities associated with passage through the mainstem Columbia and Snake River hydroelectric projects.
- Protect, improve and increase summer rearing and overwintering habitat, especially in high potential reaches of the Tucannon River, Pataha Creek, and other tributaries by restoring riparian areas, reducing temperatures and embeddedness, and increasing recruitment of large wood.



- Manage risks from mainstem Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries according to an abundance-based schedule.
- Conduct research to determine the cause of straying of Tucannon natural- and hatchery-origin fish that continue upstream of Lower Granite Dam instead of migrating into the Tucannon River, and take actions to reduce straying.
- Consider using hatchery fish from Tucannon Hatchery program for possible reintroduction in Asotin Creek to reduce extinction risk and support recovery.
- Continue hatchery management practices that minimize impacts from hatchery releases on naturally produced fish.
- Utilize terminal fisheries to minimize the escapement of hatchery-origin fish and exotic predatory fish to natural production areas, and predation on spring Chinook salmon fry and subyearlings.

6.2.3 South Fork Salmon River MPG

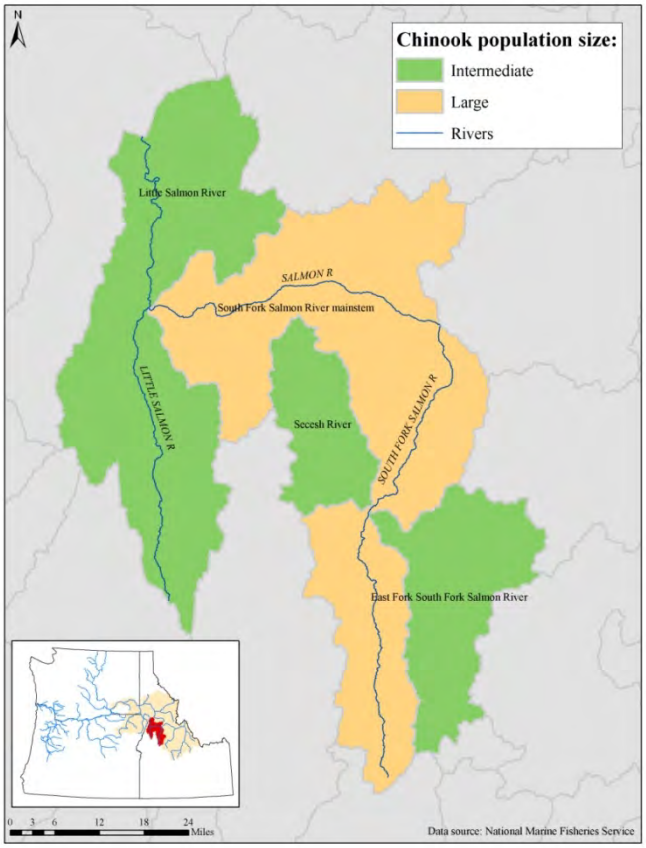
Current MPG Status

- All four populations in MPG remain at high risk of extinction and non-viable in their current state.

Proposed MPG Recovery Strategy

- Achieve highly viable status (very low risk) for the Secesh River population.
- Achieve at least viable status (low risk) for South Fork Salmon population.
- Achieve at least "maintained" status (moderate risk) for East Fork South Fork Salmon River and Little Salmon River populations.

MPG-Level Recovery Strategies



- Implement FCRPS BiOp actions to reduce mortalities associated with passage through the mainstem Columbia and Snake River hydroelectric projects.
- Reduce juvenile mortality during outmigration from rearing habitats through the mainstem Salmon River, Little Salmon River, and key tributary production areas.
- Maintain current wilderness protection and protect pristine tributary habitat.
- Provide/improve passage to and from areas with high intrinsic potential through barrier removal, screening, and other projects.
- Reduce and prevent sediment delivery to streams by improving road systems and riparian communities, and rehabilitating abandoned mine sites.
- Improve riparian and floodplain health and function by encouraging beaver activity and enhancing riparian communities.
- Manage risks from mainstem Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries according to an abundance-based schedule.
- Manage MPG for natural production in Secesh River and other areas where appropriate (e.g., upstream of weir on Little Salmon River).
- Monitor straying of retuning hatchery-origin fish to spawning grounds. Manage returning hatchery fish to minimize straying and effects of hatchery fish on natural-origin spawners in affected populations.
- Manage brook trout to reduce predation and competition with spring/summer Chinook salmon.

6.2.4 Middle Fork Salmon River MPG

Current MPG Status

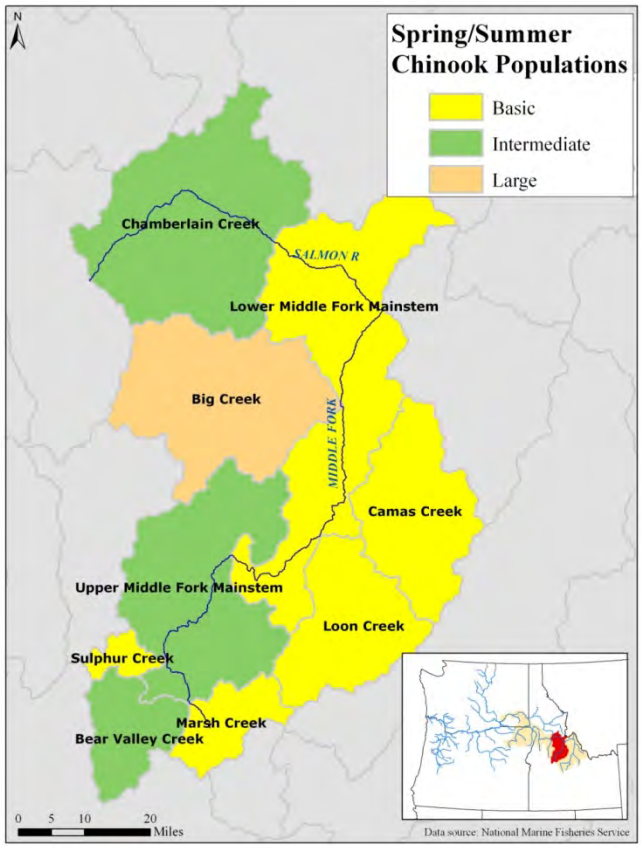
- All nine populations in MPG are extant but remain at high risk of extinction and non-viable in their current state.

Proposed MPG Recovery Strategy

- Achieve highly viable status (very low risk) for the Big Creek population.
- Achieve at least viable status (low risk) for Loon Creek, Bear Valley Creek, Marsh Creek, and Chamberlain Creek populations.
- Achieve at least "maintained" status (moderate risk) for Lower Middle Fork Salmon River, Camas Creek, Upper Middle Fork Salmon River and Sulphur Creek populations.

MPG-Level Recovery Strategies

- Implement FCRPS BiOp actions to reduce mortalities associated with passage through the mainstem Columbia and Snake River hydroelectric projects.
- Reduce juvenile mortality during outmigration from rearing habitats through the mainstem Salmon River.
- Maintain current wilderness protection and protect pristine tributary habitat.
- Provide/improve passage to and from areas with high intrinsic potential through barrier removal, screening, and other projects.
- Reduce and prevent sediment delivery to streams by rehabilitating abandoned mine sites and roads, and improving riparian areas.
- Improve riparian and floodplain health and function by encouraging beaver activity and enhancing riparian communities.
- Protect and improve instream flows to support fish production during critical periods.
- Investigate feasibility of increasing nutrients in areas where lack of nutrients may be limiting productivity.



- Manage risks from mainstem Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries according to an abundance-based schedule.
- Manage MPG for natural production. Monitor for straying hatchery-origin fish to minimize effects of hatchery fish on natural-origin spawners.
- Manage brook trout to reduce predation and competition with spring/summer Chinook salmon.

6.2.5 Upper Salmon River MPG

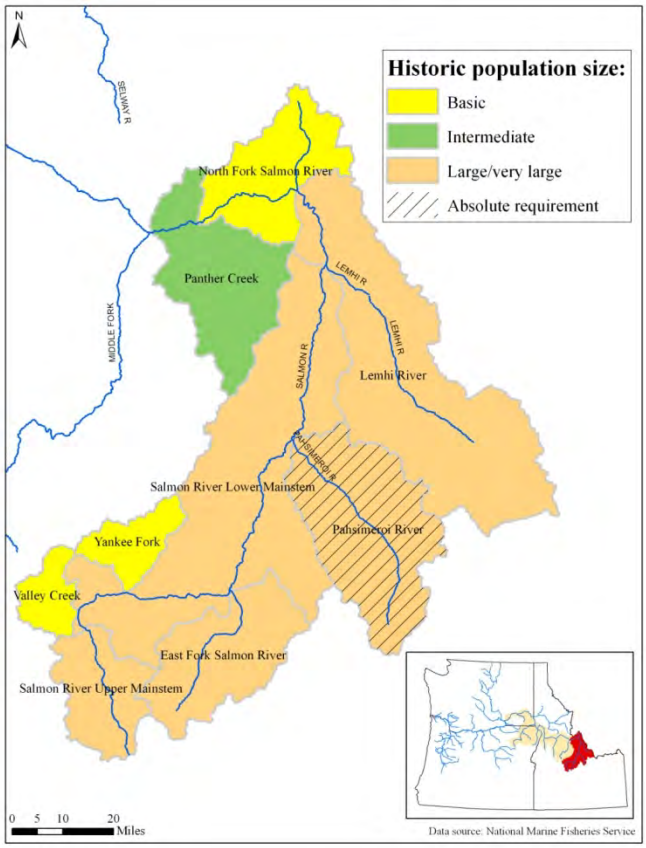
Current MPG Status

- Eight of MPG's nine populations are extant but remain at high risk of extinction and non-viable in their current state.
- The Panther Creek population is extirpated

Proposed MPG Recovery Strategy

- Achieve highly viable status (very low risk) for the Upper Salmon River Mainstem (above Redfish Lake Creek) population.
- Achieve at least viable status (low risk) for Lemhi, Pahsimeroi, East Fork Salmon River, and Valley Creek populations.
- Achieve at least "maintained" status (moderate risk) for North Fork Salmon, Upper Salmon River Mainstem (below Redfish Lake Creek), and Yankee Fork populations.
- Support reintroduction program for Panther Creek population.

MPG-Level Recovery Strategies



- Implement FCRPS BiOp actions to reduce mortalities associated with passage through the mainstem Columbia and Snake River hydroelectric projects.
- Reduce juvenile mortality during outmigration through the mainstem Salmon River.
- Maintain current wilderness protection and protect pristine tributary habitat.
- Protect and improve flows to support all spring/summer Chinook life stages.
- Provide/improve passage to and from areas with high intrinsic potential through barrier removal, screening, and other projects.
- Reduce sediment delivery to streams from roads, recreation sites and livestock grazing.
- Improve riparian conditions and floodplain function in select areas.
- Improve water quality in areas of high intrinsic potential by implementing TMDLs.
- Manage risks from mainstem Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries according to an abundance-based schedule.
- Manage populations in the North Fork Salmon, Upper Salmon Lower mainstem and East Fork Salmon Rivers, and Valley Creek for natural production. Monitor for straying hatchery-origin fish.
- Consider Yankee Fork and Dollar Creek hatchery programs for inclusion in the ESU.
- In all populations where artificial production is used, minimize associated ecological and genetic risks.
- Manage brook trout to reduce predation and competition with spring/summer Chinook salmon.

6.4 Key Information Needs

In addition to the types of key information needs that are common for both Snake River species, as identified in Chapter 5, several key information needs are specific to recovery of Snake River spring/summer Chinook salmon. The management unit plans for northeast Oregon, southeast Washington and Idaho discuss these key information needs in more detail.

Information on current population status

- What is the current status of each population in terms of abundance, productivity and distribution?
- What is the current status of life history, genotypic and phenotypic diversity for each population?
- Is reintroduction of Asotin Creek population needed to achieve Lower Snake River MPG viability? Should the population be considered as an expansion of the Tucannon population?

Information on effects of current threats across the life cycle

- How are current hatchery programs influencing abundance, productivity, spatial structure and diversity of the natural populations?
- What are the demographic risks versus the conservation benefits associated with sliding scale hatchery management actions?
- What are the effects of current harvest management strategies on the abundance, productivity and diversity of the natural populations?
- What are the effects of predation, competition and disease on abundance and productivity of the natural populations?
- What factors are reducing juvenile survival during outmigration through the lower Salmon River and Snake River to Lower Granite Dam?
- Why are Tucannon natural- and hatchery-origin spring Chinook salmon straying to areas upstream of Lower Granite Dam?

Information on recovery action effectiveness

As part of action implementation, three general types of key information need to be examined to determine action effectiveness:

- Can and will the proposed actions be implemented effectively?
- Will implementation of the proposed actions translate into the benefits expected?
- Will the benefits achieved by the actions allow the populations and MPGs to recover to desired levels where the species can be delisted?

Chapter 9 describes the approach that will be taken to gain this information. The research, monitoring and evaluation program is designed to assess the status of the listed species and their habitat, track progress toward achieving recovery goals, and provide information needed to

refine recovery strategies and actions through the process of adaptive management. Programs specific for each management unit are described in the three management unit plans.

6.5 Delisting Decision for Snake River Spring/Summer Chinook Salmon

The requirement for determining that a species no longer requires the protection of the ESA is that the species is no longer in danger of extinction or likely to become endangered within the foreseeable future, based on evaluation of the listing factors specified in ESA section 4(a)(1). To remove the Snake River spring/summer Chinook salmon ESU from the Federal List of Endangered and Threatened Wildlife and Plants (that is, to delist the ESU), NMFS must determine that the ESU, as evaluated under the ESA listing factors, is no longer likely to become endangered.

The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria that, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). The recovery criteria in this plan (both biological and threats criteria) meet this statutory requirement.

The ICTRT used the viability criteria to describe recovery scenarios for the Snake River spring/summer Chinook salmon ESU. As discussed in Chapter 3, if these scenarios (summarized in Table 3-1) were achieved, they would meet the ICTRT's MPG-level viability criteria and support delisting of the ESU. Using the recovery scenarios, NMFS worked with the recovery planners to design MPG-level recovery strategies for the Snake River spring/summer Chinook salmon ESU that target populations within the MPGs for viable and highly viable status based on available science concerning how best to achieve recovery. These MPG-level recovery strategies (summarized in Section 6.2) take into consideration opportunities for improvement in view of historical production, current habitat conditions and potential, as well as the desire to accommodate objectives such as maintaining harvest opportunities.

The recovery plan, and associated management unit plans, recognize that achieving desired status levels and recovering the Snake River spring and summer Chinook salmon ESU demands an all-H (Habitat, Hydro, Harvest, and Hatcheries) restoration approach — and that much uncertainty remains regarding how best to implement this approach and achieve ESU recovery. Thus, besides defining a strategic approach to address limiting factors and threats across all life stages, the plan lays out a research, monitoring and evaluation program (summarized in Chapter 9) to gain key information about the different populations and their habitats, track progress toward achieving recovery goals, and provide information to refine recovery efforts through the process of adaptive management. Further, information gained through future monitoring will also show changes in population performance and help planners determine which population(s) in an MPG can best achieve highly viable status. As a result, the populations targeted for viable and highly viable status in the MPGs, and the recovery actions, may change depending on how the populations respond to recovery efforts. The northeast Oregon, southeast Washington and Idaho management unit plans provide detailed discussions of the recovery strategies and the research, monitoring and evaluation program.

In accordance with our responsibilities under section 4(c)(2) of the Act, NMFS will conduct reviews of Snake River Spring Summer Chinook every 5 years to evaluate the status of the species and determine whether the ESU should be removed from the list or changed in status. NMFS will base such evaluations on the best scientific information available at that time and take into account the following:

- The biological recovery criteria (ICTRT 2007c) and listing factor (threats) criteria described above.
- The management programs in place to address the threats.
- Principles presented in the Viable Salmonid Populations paper (McElhany et al. 2000).
- Best available information on population and ESU/DPS status and new advances in risk evaluation methodologies.
- Other considerations, including: the number and status of extant spawning groups; the status of the major spawning groups; linkages and connectivity among groups; the diversity of life history and phenotypes expressed; and considerations regarding catastrophic risk.

7 ▪ Snake River Steelhead Recovery Analysis

This chapter describes the recovery analysis for the Snake River steelhead DPS. It provides specific information about the Snake River steelhead DPS, including the recovery strategies for the DPS and its major population groups, the expected effects of proposed actions, key information needs, and delisting criteria. The chapter builds on information presented in previous chapters. Chapter 3 describes the recovery goals, delisting criteria, and potential recovery scenarios for the Snake River steelhead DPS. Chapter 4 discusses the current status of the DPS and MPGs, and the gap that must be breached to achieve recovery. Chapter 5 summarizes the recovery issues, limiting factors and threats, and recovery strategies that apply at a regional level for the species.

The analysis draws from information presented in the three management unit plans and the following NMFS publications: the Supplemental Comprehensive Analysis of the 2008 Biological Opinion (NMFS 2008b); the ICTRT's 2010 Status Assessments of Snake River species; the Northwest Fisheries Science Center's 2005 updated status report (Good et al. 2005) and 2011 five-year review (Ford 2011); the ICTRT's 2007 Viability Criteria document and 2007 "Gap" report; NMFS' 5-Year review of Snake River sockeye, spring-summer Chinook salmon, fall-run Chinook salmon and steelhead (NMFS 2011); and the three recovery planning modules.

7.1 Biological Background

7.1.1 Life History

Steelhead are the anadromous form of the biological species *Oncorhynchus mykiss.* Their range extends from the Kamchatka Peninsula in Asia, east to Alaska, and south to southern California (NMFS 1999a), although the historical range of *O. mykiss* extended at least to the Mexico border (Busby et al. 1996).

O. mykiss may exhibit the most complex suite of life history traits of any species of Pacific salmonid. They can be anadromous or freshwater resident (and under some circumstances, apparently yield offspring of the opposite form). Steelhead, the anadromous form, can spend up to 7 years in freshwater prior to smoltification, then spend up to 3 years in salt water prior to first spawning. They can also spawn more than once (iteroparous) before death; however, it is rare for steelhead to spawn more than twice before dying and most that do so are females (Nickelson et al. 1992). All other species of *Oncorhynchus* except cutthroat trout (*O. clarki*) spawn once then die (semelparous). Steelhead, like other anadromous salmonids, are under the jurisdiction of NMFS, while the resident freshwater forms, including rainbow and redband trout, are under the jurisdiction of USFWS. Resident *O. mykiss* are also present in many of the drainages used by Snake River steelhead.

Snake River steelhead express a summer-run spawning migration strategies, one of the four seasonal steelhead migration strategies from the ocean to fresh water to begin their spawning migration (winter, spring, summer or fall). The runs differ in the degree of maturation at the time of river entry, the thermal regime and flow characteristics of their spawning site, and their actual

time of spawning. Summer-run steelhead enter freshwater in a sexually immature condition between May and October and requires several months to mature and spawn. For this reason they are also categorized as stream-maturing type, as opposed to ocean-maturing steelhead, such as winter-run steelhead, which enter freshwater between November and April with well-developed gonads and spawns shortly thereafter.

Inland steelhead of the Columbia River basin, especially in the Snake River subbasin, are also commonly grouped as either A-run or B-run steelhead. These designations are based on a bimodal migration of adult steelhead at Bonneville Dam (235 km from the mouth of the Columbia River) and differences in age (1- versus 2-ocean) and adult size observed among Snake River steelhead. Generally, A-run steelhead are smaller, have a shorter freshwater and ocean residence, and begin their upriver migration earlier in the year. B-run steelhead are larger, spend more time rearing in both fresh water and the ocean, and appear to begin their upriver migration later in the year. A-run steelhead are believed to occur throughout the steelhead-bearing streams of the Snake River basin and the inland Columbia River; B-run steelhead are thought to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon rivers (IDFG 1994). Steelhead populations discussed in this plan contain both A-run and B-run fish.

Snake River steelhead enter the Columbia River from late June to October. After holding over the winter, the steelhead spawn the following spring (typically from March to May) (Good et al. 2005). Emergence occurs by early June in low elevation streams and as late as mid July at higher elevations. Snake River steelhead usually smolt at age-2 or age-3 years. They typically reside in marine waters for one to three years before returning to their natal stream to spawn at 4 or 5 years of age.

[Insert figure 7-1. (Life cycle)]

7.1.2 Historical and Current Distribution

The Snake River steelhead DPS includes all naturally spawned populations of anadromous *O. mykiss* (steelhead) below natural and manmade impassable barriers in stream in the Snake River and its tributaries (62 FR 43937). It also includes steelhead from several artificial propagation programs: the Tucannon River, Dworshak National Fish Hatchery, Lolo Creek, North Fork Clearwater River, East Fork Salmon River, and the Little Sheep Creek/Imnaha River Hatchery steelhead hatchery programs (71FR 834).

Snake River steelhead are known to spawn and rear in all tributaries used by Snake River spring/summer Chinook, as well as many additional tributaries, some of which are much smaller than those used by spring/summer Chinook. They are genetically differentiated from other Interior Columbia steelhead populations, as they spawn and rear at higher altitudes (typically 1,000–2,000 m above sea level), and after longer freshwater migrations (up to 1,500 km) (Busby et al. 1996). B-run steelhead are believed to be more prevalent in higher elevation drainages. Like steelhead in other areas, these fish exhibit a wide range of life-history strategies, including varying times of freshwater rearing or ocean residence, or elimination of an ocean residence altogether. They occupy habitat that is considerably warmer and drier (on an annual basis) than

other steelhead DPSs. With the exception of the Tucannon River and some small tributaries to the mainstem Snake River, the tributary habitat used by Snake River steelhead lies above Lower Granite Dam.

Major groupings of populations and subpopulations can be found in the Grande Ronde River system, the Imnaha River drainage, the Clearwater River drainage, the South Fork Salmon River, the smaller mainstem tributaries before the confluence of the mainstem Snake River, the Middle Fork Salmon River, the Lemhi and Pahsimeroi Rivers, and the upper Salmon River tributaries (Good et al. 2005). The ICTRT recognizes 24 extant steelhead populations within this DPS, organized into five major population groups (ICTRT 2003). As shown in Figure 7-2, the five steelhead MPGs with extant populations are: Lower Snake River MPG (2 populations); the Grande Ronde MPG (4 populations); the Imnaha River MPG (1 population); the Clearwater River MPG (5 extant populations, 1 extirpated); and the Salmon River MPG (12 populations). Historically, Snake River steelhead also spawned and rearing in areas above the Hells Canyon complex on the Snake River and in the North Fork Clearwater River. Steelhead are currently blocked from historical habitat in these areas. The ICTRT has identified one historical MPG for the area above the Hells Canyon complex, which does not have any extant independent populations. Small tributaries entering the mainstem Snake River below Hells Canyon Dam likely were historically part of the Hells Canyon MPG, with a core area currently cut off from anadromous access.

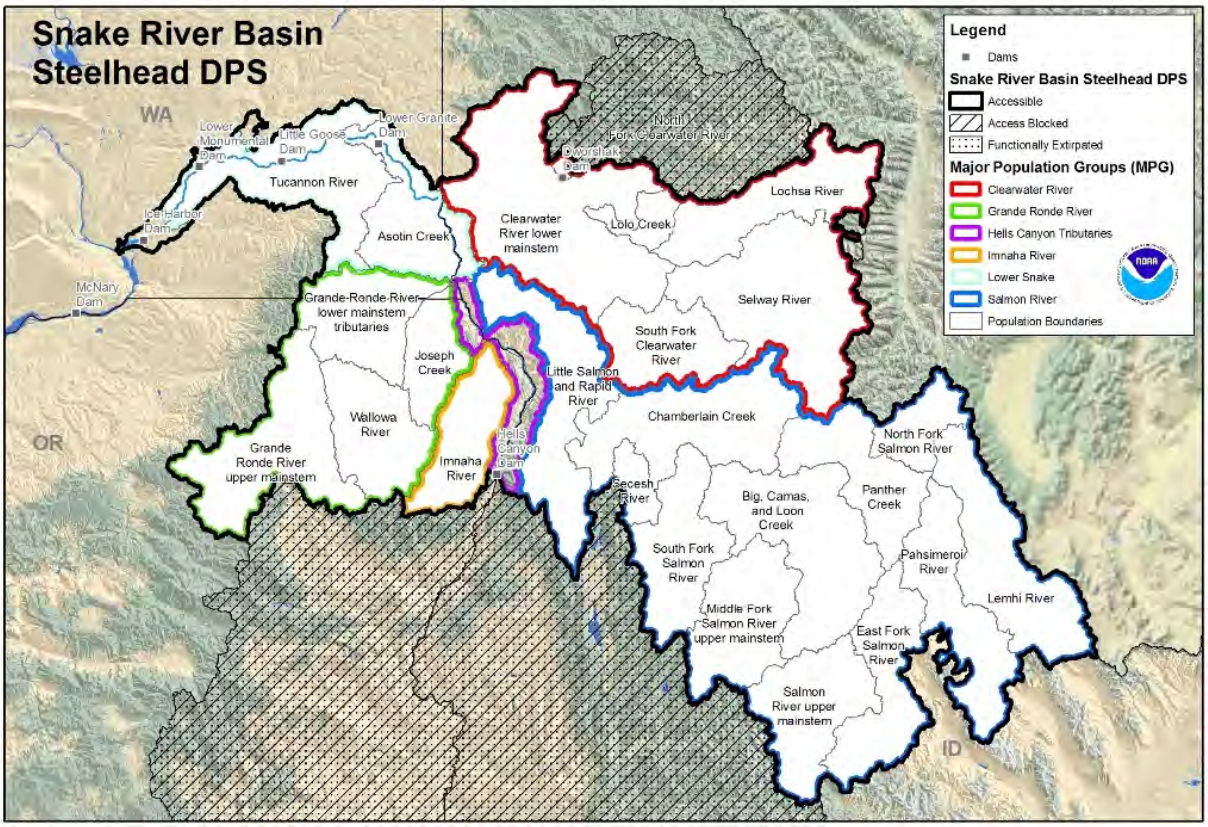


Figure 7-2. Snake River steelhead DPS with populations and major population groups, as well as historical production areas above Hells Canyon Dam and in the Clearwater River drainage that may have supported additional MPGs (NMFS 2012).

7.2 DPS and MPG-Level Recovery Strategies and Adaptive Management

The path to recovery for Snake River steelhead requires that the biological and threats criteria for the DPS be met. According to these criteria, all major population groups that are critical for proper functioning of the DPS need to be at low risk and have a high probability of persistence before the DPS can be removed from the ESA's threatened and endangered species list. Achieving this goal will be a large task.

This section describes the MPG-level strategies designed to bridge the gap between the current and desired status (described in Chapter 4) and support recovery of the Snake River steelhead DPS. Sections 7.2.1 through 7.2.5 summarize the MPG-level strategies designed to achieve viability for the MPGs and support delisting of the Snake River steelhead DPS. The recovery strategies target actions at the major population group and population levels. Targeting recovery efforts at these levels, and achieving viability for the populations and MPGs, will support recovery of the Snake River steelhead DPS. The management unit plans provide detailed discussions of the strategies summarized in this section.

Research, monitoring, evaluation and adaptive management play an important role in the recovery of the Snake River steelhead DPS. Currently, there is a high degree of uncertainty regarding the current status of most of the populations, as well as how much improvement will be needed to achieve viability targets for the populations. Research and monitoring will provided needed information about the populations and their responses to various recovery efforts.

In addition, recovery planners continue to examining steelhead production opportunities in the historical Hells Canyon Tributaries MPG and North Fork Clearwater drainage, which were once important production areas for Snake River steelhead. Currently, the small tributaries entering the mainstem Snake River below Hells Canyon Dam support a small number of steelhead; however, none of the tributaries (nor all combined) appear to be large enough to support an independent population. While reestablishing populations in areas above Hells Canyon Dam and in the North Fork Clearwater drainage is not needed for DPS recovery, it will provide a safety net for DPS viability and support broader goals to provide for other socio-economic values.

The recovery strategy is designed to meet the recovery goal of ESA delisting and to be consistent with achieving broad sense goals that go beyond ESA delisting. Delisting goals and broad sense goals are provided in Chapter 3.

This recovery strategy depends on implementation of an adaptive management framework that implements site specific actions based on best available science, monitors to improve the science, and updates actions based on new knowledge. The ESA section 4(f) requires site specific actions "as may be necessary to achieve the plan's goals for conservation and survival of the species." There are two types of site specific actions in this plan: management actions and research, monitoring and evaluation actions. Management actions address the limiting factors and threats. Research, monitoring and evaluation actions address the information needed to evaluate the status of the species and the threats. Our hypothesis is that the management actions will be effective in improving survival; however, we have substantial uncertainties about

whether they will be sufficient to achieve viability. Thus, this recovery plan depends on an adaptive management framework as follows:

1) Establish recovery goals and viability and threats criteria for delisting (Chapter 3).

2) Determine the species present status and the gaps between the present status and viability criteria. (Chapter 4).

3) Assess the threats and limiting factors in each of the major planning sectors that are contributing to the gaps between present status and viability criteria (Chapter 5). Also, assess the threats in the context of variable ocean conditions and emerging climate change.

4) Implement management actions (Chapter 6) that target the limiting factors and threats associated with each of the major planning sectors.

5) Implement research, monitoring and evaluation actions (Chapter 7) to evaluate the status of the species and the threats.

6) Address critical uncertainties. There are critical uncertainties about the species status, effects of ongoing and proposed actions, the role of the ocean and climate change, and the best opportunities for further improving survival to meet the viability criteria. These uncertainties are described and prioritized in the research, monitoring, and evaluation Chapter 7.

7) Establish a contingency process. We need to be prepared if the species' status does not continue to improve in a timely manner and also if there are significant declines in status. A contingency process should be established that sets intermediate goals and timeframes and also sets early warning indicators and significant decline triggers. As part of this process, additional actions should be developed that are "on the shelf," if needed, to address long term trends toward recovery and to prevent precipitous declines. The need for this contingency process is also addressed in the Implementation Chapter (Chapter 10).

8) Review progress and identify best opportunities for survival improvements. Regular major reviews of implementation progress, species response, and new information are needed. These progress reviews are addressed in the Implementation Chapter (Chapter 10).

9) Adjust actions according to progress reviews. The success of this recovery plan depends on an implementation structure that takes action in response to the results of progress reviews.

10) Repeat the adaptive management cycle. Adaptive management should be a continuous loop of action implementation, monitoring and evaluation, new information, assessment of information and updated actions.

7.2.1 Grande Ronde River MPG

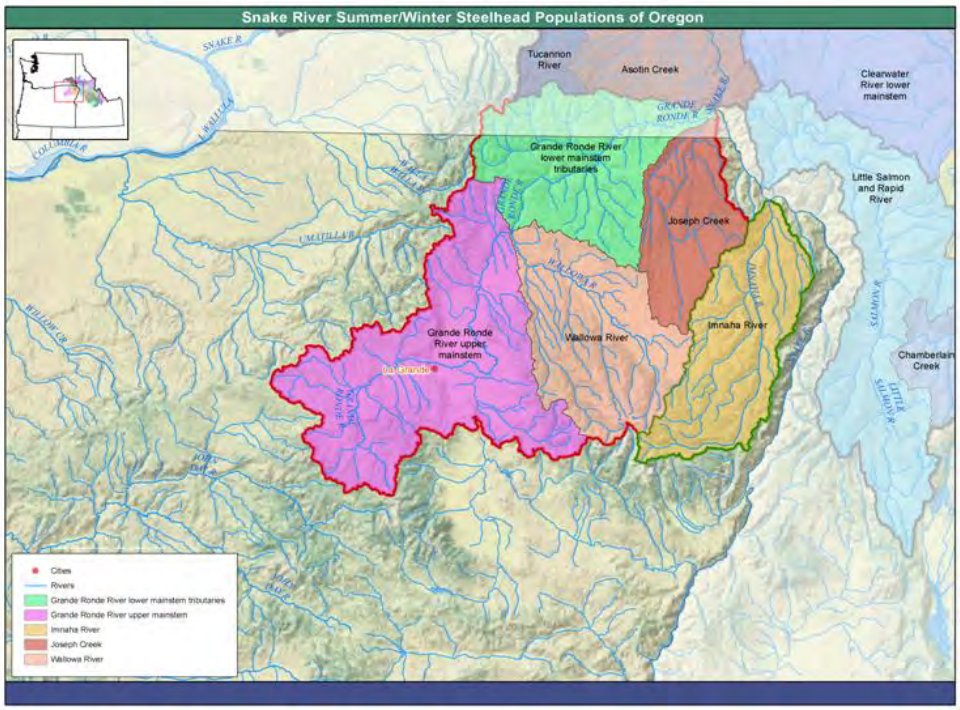
Current MPG Status

- One population, Joseph Creek, is at very low risk of extinction and considered Highly Viable.
- The Upper Grande Ronde population is at moderate risk and rated at Maintained status. The Wallowa population is at high risk. Both populations are considered non-viable in their current state.
- The Lower Grande Ronde population is at Low or Moderate risk of extinction and non-viable in its current state.

Proposed MPG Recovery Strategy

- Achieve at least Viable status (low risk) for at least two steelhead populations in the MPG, with at least one populations at Highly Viable status (very low risk).
- Achieve at least Maintained status (moderate risk) for the remaining populations.

MPG-Level Recovery Strategies



- Implement FCRPS BiOp actions to reduce mortalities associated with passage through the mainstem Columbia and Snake River hydroelectric projects.
- Reduce mortalities during the outmigration from overwintering habitats to the mainstem Snake River.
- Maintain current wilderness protection. Protect and conserve pristine tributary habitat.
- Increase streamflows in the mainstem Grande Ronde River to improve habitat for summer parr.
- Reduce mortalities during the outmigration from overwintering habitats to the mainstem Snake River – with special emphasis on the Grande Ronde mainstem.
- Improve winter rearing habitats in the lower mainstem Grande Ronde and tributary production areas.
- Improve summer rearing habitats in the mainstem Grande Ronde River and tributary production areas.
- Enhance spawning and eggs and alevin survival by reducing sediment in spawning gravels in tributaries.
- Manage risks from Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries through updated Fisheries Management Evaluation Plans and Tribal Resource Management Plans, and according to an abundance-based schedule.
- Maintain a segregated-type hatchery program. Manage releases of hatchery smolts so returning hatchery adults home to localized areas and do not interact to a substantial degree with the natural-origin population.

7.2.2 Imnaha River MPG

Current MPG Status

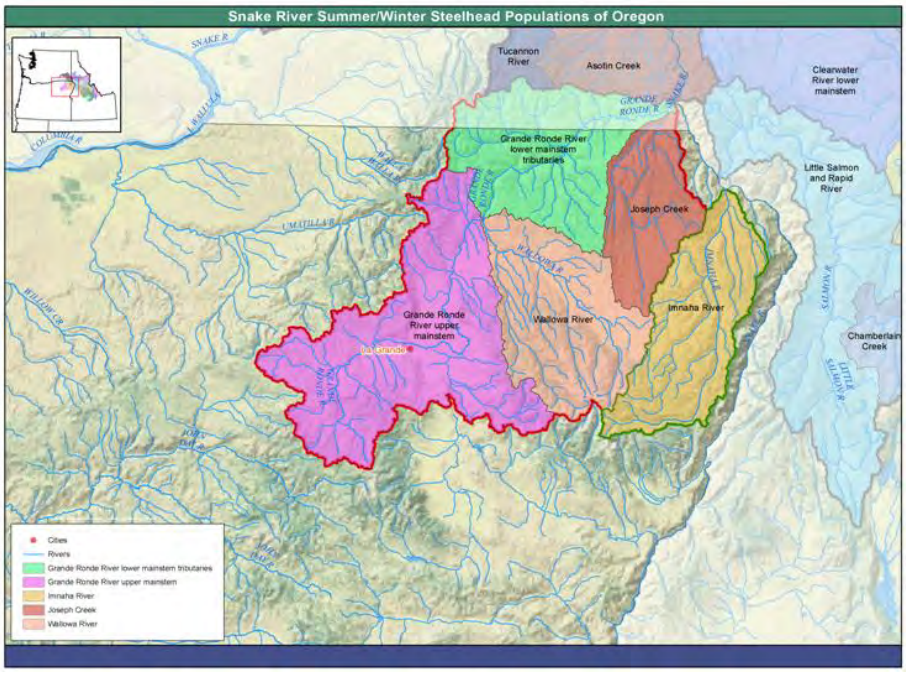
- The Imnaha River steelhead population is the only population located in this MPG.
- The population is rated at moderate risk of extinction and is non-viable in its current state.

Proposed MPG Recovery Strategy

- The Imnaha River population must attain High Viability status (very low risk) for the MPG to achieve viable status and support delisting of the Snake River steelhead DPS.

MPG-Level Recovery Strategy

- Collect and analyze population-specific data to accurately determine population status.
- Implement FCRPS BiOp actions to reduce mortalities associated with passage through the mainstem Columbia and Snake River hydroelectric projects.
- Reduce mortalities during the outmigration from overwintering habitats to the mainstem Snake River.
- Maintain current wilderness protection.
- Protect and conserve pristine tributary habitat.
- Restore tributary habitat conditions, especially for steelhead spawners and juvenile rearing.
- Manage the Little Sheep Creek hatchery program to minimize genetic and ecological impacts on natural-origin spawning fish.
- Manage risks from mainstem Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries through updated Fisheries Management Evaluation Plans and Tribal Resource Management Plans, and according to an abundance-based schedule.



7.2.3 Lower Snake River MPG

Current MPG Status

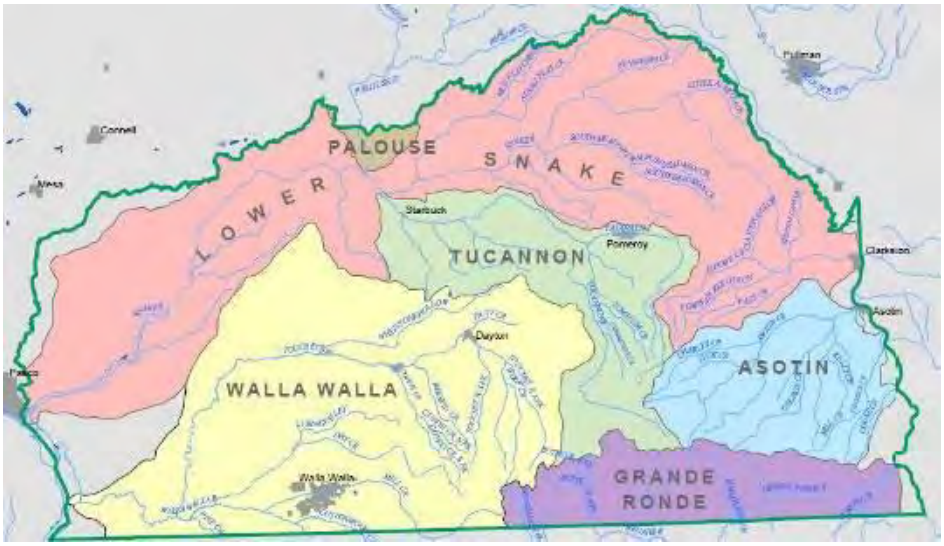
- The Tucannon River population remains at high risk of extinction and the Asotin Creek population has an uncertain rating of moderate risk. Neither population is viable in its current state.

Proposed MPG Recovery Strategy

- Achieve at least Viable status (low risk) for both the Tucannon River and Asotin Creek populations, with one of the populations at Highly Viable (very low risk).

MPG-Level Recovery Strategies

- Implement FCRPS BiOp actions to reduce mortalities associated with passage through the mainstem Columbia and Snake River hydroelectric projects.
- Continue to manage Asotin Creek steelhead population for natural production only.
- Collect and analyze population-specific data to accurately determine population status.
- Protect, improve and increase freshwater habitat to support summer rearing and overwintering in high potential reaches, especially by restoring riparian, channel and floodplain functions, reducing temperatures, and increasing instream habitat.



- Improve adult and juvenile passage at artificial barriers and diversions.
- Manage risks from mainstem Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries through updated Fisheries Management Evaluation Plans and Tribal Resource Management Plans, and according to an abundance-based schedule.
- Conduct research to determine the cause of straying of Tucannon natural- and hatchery-origin fish that continue upstream of Lower Granite Dam instead of migrating into the Tucannon River, and take actions to reduce straying.
- Continue hatchery management practices that minimize impacts from hatchery releases on naturally produced fish.
- Utilize terminal fisheries to minimize the escapement of hatchery-origin fish and exotic predatory fish to natural production areas.

7.2.4 Clearwater River MPG

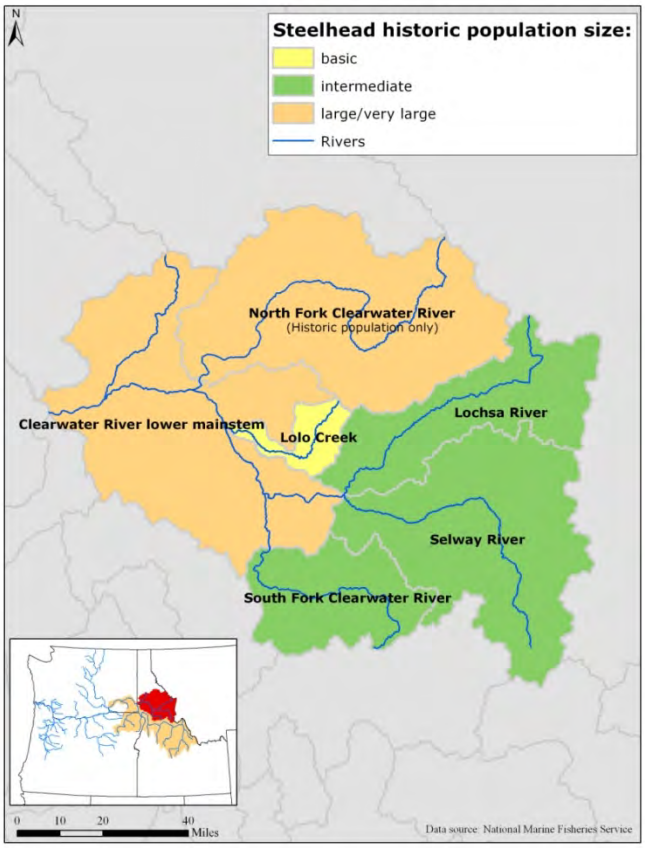
Current MPG Status

- Four populations in MPG (SF Clearwater, Lolo, Selway and Lochsa) remain at high risk, and the Lower Mainstem Clearwater population at moderate risk. All of the populations are considered non-viable.
- The NF Clearwater population is extirpated.

Proposed MPG Recovery Strategy

- Achieve at least Viable status (low risk) for the Lower Mainstem Clearwater, Selway and Lochsa populations, with one of the populations (target Lochsa) at High Viability (very low risk).
- Achieve at least Maintained status (moderate risk) for SF Clearwater and Lolo populations.

MPG-Level Recovery Strategies



- Implement FCRPS BiOp actions to reduce mortalities associated with passage through the mainstem Columbia and Snake River hydroelectric projects.
- Collect and analyze population-specific data to accurately determine population status.
- Maintain current wilderness protection and protect pristine tributary habitat.
- Preserve, restore, or rehabilitate natural habitat-forming processes in areas with high intrinsic potential by reestablishing riparian areas and reconnecting floodplains, and reducing surface runoff.
- Provide or improve access to and from historical habitat by removing/replacing culverts and other barriers and screening diversions.
- Reduce and prevent sediment delivery to streams by improving road systems and rehabilitating mining sites.
- Manage risks from mainstem Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries through updated Fisheries Management Evaluation Plans and Tribal Resource Management Plans, and according to an abundance-based schedule.
- Manage Selway and Lochsa population areas for natural production.
- Review hatchery programs in Lower Mainstem Clearwater, Lolo and South Fork Clearwater population areas, and consider strategies to reduce or eliminate releases of non-localized fish, and transition to locally adapted broodstock.
- Monitor straying of retuning hatchery-origin fish to spawning grounds. Manage returning hatchery fish to minimize straying and effects of hatchery fish on natural-origin spawners in affected populations.

7.2.5 Salmon River MPG

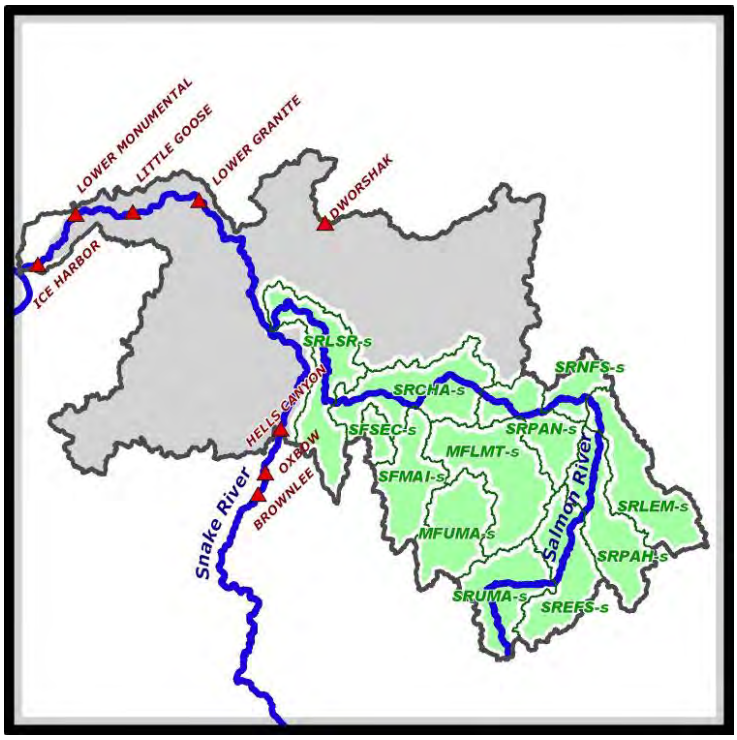
Current MPG Status

- Six of 12 populations in MPG remain at high risk (SF Salmon, Secesh, Chamberlain, Lower MF Salmon, Up. MF Salmon and Panther); the six others are at moderate risk (Little Salmon, NF Salmon, Lemhi, Pahsimeroi, EF Salmon, and Up. Main Salmon). All of the populations are considered non-viable.

Proposed MPG Recovery Strategy

- Achieve at least Viable status (low risk) for the SF Salmon, Chamberlain, Lower MF Salmon, Upper MF Salmon, Lemhi and Panther populations, with at least one population (target: Lower MF Salmon) at Highly Viable (very low risk).
- Achieve at least Maintained status (moderate risk) for Secesh, Pahsimeroi, EF Salmon, Little Salmon, Up. Main Salmon, and NF Salmon populations.

MPG-Level Recovery Strategies



- Implement FCRPS BiOp actions to reduce mortalities associated with passage through the mainstem Columbia and Snake Rivers.
- Collect and analyze population-specific data to accurately determine population status.
- Maintain wilderness protection and protect pristine tributary habitat.
- Preserve, restore, or rehabilitate natural habitat-forming processes in areas with high intrinsic potential by reestablishing riparian areas and reconnecting floodplains.
- Upgrade irrigation diversions to provide instream flow and fish passage.
- Eliminate passage barriers and improve connectivity to historical habitat.
- Acquire irrigation flow by lease or purchase to improve instream flow in Lemhi River.
- Reduce and prevent sediment delivery to streams by rehabilitating roads and mining sites.
- Manage risks from mainstem Columbia River fisheries through *U.S. v. Oregon*.
- Manage risks from tributary fisheries through updated Fisheries Management Evaluation Plans and Tribal Resource Management Plans, and according to an abundance-based schedule.
- Manage Rapid River, SF Salmon, Secesh, U. MF Salmon, L. MF Salmon, Chamberlain, Panther and NF Salmon populations for natural production; Consider managing Lemhi population for natural production.
- Review hatchery programs in Lemhi, Pahsimeroi, EF Salmon and Upper Salmon populations; consider strategies to reduce/eliminate releases of non-localized fish, and transition to locally adapted broodstock.
- Monitor straying of retuning hatchery-origin fish to spawning grounds. Manage returning hatchery fish to minimize straying and effects of hatchery fish on natural-origin spawners in affected populations.

7.4 Key Information Needs

In addition to the types of key information needs that are common for both Snake River species, as identified in Chapter 5, several key information needs are specific to recovery of Snake River steelhead. The management unit plans for northeast Oregon, southeast Washington and Idaho discuss these key information needs in more detail.

Information on current population status

- What is the current status of each population in terms of abundance, productivity and distribution?
- What is the current status of life history, genotypic and phenotypic diversity for each population?
- What is the relative proportion of hatchery-origin steelhead in natural spawning areas, particularly near major hatchery release sites?
- How do steelhead jacks contribute to population, MPG and DPS status and recovery?

Information on effects of current threats across the life cycle

- How are current hatchery programs influencing abundance, productivity, spatial structure and diversity of the natural populations?
- How are mainstem hydropower operations and operational improvements influencing population viability?
- What factors are reducing juvenile survival during outmigration through the lower Salmon River and Snake River to Lower Granite Dam?
- Why are Tucannon natural- and hatchery-origin fish continuing to stray upstream of Lower Granite Dam instead of migrating into the Tucannon River?
- What conditions are contributing to the Joseph Creek steelhead population's high viability, and how might conditions be improved in other areas to recover other steelhead populations in the MPG?
- What are the demographic risks versus the conservation benefits associated with sliding scale hatchery management actions?
- How are straying hatchery-origin fish impacting natural population abundance, productivity and diversity?
- What are the effects of current harvest management strategies on the abundance, productivity and diversity of the natural populations?
- What are the effects of predation, competition and disease on abundance and productivity of the natural populations?

Information on recovery action effectiveness

As part of action implementation, three general types of key information need to be examined to determine action effectiveness:

- Can and will the proposed actions be implemented effectively?

- Will implementation of the proposed actions translate into the benefits expected?
- Will the benefits achieved by the actions allow the populations and MPGs to recover to desired levels where the species can be delisted?

Chapter 9 describes the approach that will be taken to gain this information. The research, monitoring and evaluation program is designed to assess the status of the listed species and their habitat, track progress toward achieving recovery goals, and provide information needed to refine recovery strategies and actions through the process of adaptive management. Programs specific for each management unit are described in the three management unit plans.

7.5 Delisting Decision for Snake River Steelhead

The requirement for determining that a species no longer requires the protection of the ESA is that the species is no longer in danger of extinction or likely to become endangered within the foreseeable future, based on evaluation of the listing factors specified in ESA section 4(a)(1). To remove the Snake River steelhead DPS from the Federal List of Endangered and Threatened Wildlife and Plants (that is, to delist the DPS), NMFS must determine that the DPS, as evaluated under the ESA listing factors, is no longer likely to become endangered.

The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria that, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). The recovery criteria in this plan (both biological and threats criteria) meet this statutory requirement.

The ICTRT used the viability criteria to describe recovery scenarios for the Snake River steelhead DPS. As discussed in Chapter 3, if these scenarios (summarized in Table 3-2) were achieved, they would meet the ICTRT's MPG-level viability criteria and support delisting of the DPS. Using the recovery scenarios, NMFS worked with the recovery planners to design MPG-level recovery strategies for the Snake River steelhead DPS that target populations within the MPGs for viable and highly viable status based on available science concerning how best to achieve recovery. These MPG-level recovery strategies (summarized in Section 7.2) take into consideration opportunities for improvement in view of historical production, current habitat conditions and potential, as well as the desire to accommodate objectives such as maintaining harvest opportunities.

The recovery plan, and associated management unit plans, recognize that achieving desired status levels and recovering the Snake River steelhead DPS demands an all-H (Habitat, Hydro, Harvest, and Hatcheries) restoration approach — and that much uncertainty remains regarding how best to implement this approach and achieve DPS recovery. Thus, besides defining a strategic approach to address limiting factors and threats across all life stages, the plan lays out a research, monitoring and evaluation program (summarized in Chapter 9) to gain key information about the different populations and their habitats, track progress toward achieving recovery goals, and provide information to refine recovery efforts through the process of adaptive management. Further, information gained through future monitoring will also show changes in population performance and help planners determine which population(s) in an MPG can best

achieve highly viable status. As a result, the populations targeted for viable and highly viable status in the MPGs, and the recovery actions, may change depending on how the populations respond to recovery efforts. The northeast Oregon, southeast Washington and Idaho management unit plans provide detailed discussions of the recovery strategies and the research, monitoring and evaluation program.

In accordance with our responsibilities under section 4(c)(2) of the Act, NMFS will conduct reviews of Snake River Spring Summer Chinook and Snake River Steelhead every 5 years to evaluate the status of the species and determine whether the ESUs should be removed from the list or changed in status. NMFS will base such evaluations on the best scientific information available at that time and take into account the following:

- The biological recovery criteria (ICTRT 2007c) and listing factor (threats) criteria described above.
- The management programs in place to address the threats.
- Principles presented in the Viable Salmonid Populations paper (McElhany et al. 2000).
- Best available information on population and ESU/DPS status and new advances in risk evaluation methodologies.
- Other considerations, including: the number and status of extant spawning groups; the status of the major spawning groups; linkages and connectivity among groups; the diversity of life history and phenotypes expressed; and considerations regarding catastrophic risk.

8 ▪ Time and Cost Estimates

The ESA section 4(f)(1) requires that recovery plans include "estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal" (16 U.S.C. 1531-1544, as amended). This chapter and information presented in the management unit plans are intended to meet this ESA requirement.

8.1 Time Estimates

There are unique characteristics and challenges in estimating the time required for salmon and steelhead recovery given the complex relationship of the fish to their environment and to human activities in the water and on land. The many uncertainties that preclude a precise estimate of recovery time include biological and ecosystem responses to recovery actions and the unknown impacts of future economic, demographic, and social developments. As a result, NMFS estimates that recovery of the Snake River Chinook salmon ESU and steelhead DPS, like recovery for most of the ESA-listed Pacific Northwest salmon and steelhead, could take 50 to 100 years.

Given the large number of economic, biological and social uncertainties involved, NMFS and the management unit planners believe it is impracticable to estimate all projected actions and costs over 50 or 100 years. Instead, the plan focuses on the first 10 years of implementation, with the provision that before the end of the first implementation period, specific actions and costs will be estimated for subsequent years. Over the longer term, the recovery plan relies on ongoing monitoring and periodic plan review regimes to add, eliminate, modify, and prioritize actions through the adaptive management process as information becomes available, and until such time as the protection of the Endangered Species Act is no longer required.

8.2 Cost Estimates

Recovery planners for the three management unit plans worked with staff from NMFS and other federal, state, tribal, and local agencies to define recovery strategies and actions to address the limiting and threats identified in the plan. The resulting lists of strategies and actions for MPG and population recovery were developed using the most up-to-date assessment information for the species, without consideration of cost or potential funding. This section summarizes the potential costs for project implementation in the different management units, where information was available to provide them.

The costs identified in the management unit plans are primarily associated with implementation of tributary habitat actions during the first 10 years. These actions range widely from fish passage projects to habitat protection and enhancement. The total estimated cost of tributary habitat recovery actions for the Snake River spring/summer Chinook salmon ESU and steelhead DPS is approximately --- million over the initial 10-year period. The approach taken to estimate the total cost of each habitat project was to use the scale described for each action, where available, together with unit costs for each project type. For example, scale was measured either in stream miles of treatment or number of structures. For some actions, no scale estimate was available at this time, in which case no cost estimate was provided. The unit cost of a project was

estimated using cost data from existing habitat restoration projects and professional judgment. In many cases, the costs reflect the materials and labor needed to implement a project.

Table 8-1. Summary of cost estimates for tributary habitat projects for Snake River spring/summer Chinook salmon and steelhead.

Management Unit Plan	First 10 years ($M)	Total Cost ($M)
Northeast Oregon	Need estimate	$214.2
Southeast Washington	$79	Need estimate
Idaho	Need estimate	Need estimate
Total		

It is important to note that caution is needed regarding these estimated costs. For example, many of the costs are associated with baseline actions, which are part of ongoing, existing programs that will be implemented regardless of this recovery plan. In addition, many of the costs remain incomplete in scope, scale or magnitude until actions are better defined. Cost estimates may be adjusted up or down as unit cost estimates, scale of projects, total number of actions, and currently unforeseen costs for actions are determined during the implementation phase. NMFS will work with regional experts during the implementation phase to identify costs, for actions that require more information.

The costs provided in the management unit plans do not include costs associated with recovery actions for Snake River spring/summer Chinook salmon and steelhead that will be needed outside of the management units to improve conditions across the species' life cycle, including in the Columbia River estuary and Columbia/Snake River hydrosystem. Many of these additional expenditures have a basin-wide scope and are expected to benefit all, or many, of the 13 listed Columbia River ESUs and DPSs. Costs for these improvements are associated with implementation of actions proposed in the Estuary Module and the 2008 FCRPS Biological Opinion and its 2010 Supplement (NMFS 2008f and 2010a).

Costs for hatchery actions required through other processes such as consultations, permits, and 4(d) Rule implementation also are not part of recovery costs reported here because the programs are already in existence or are undergoing required modifications. In addition, there are few estimated costs for recovery actions associated with harvest to report at this time. This is because no actions are currently proposed that go beyond those already being implemented through *U.S. v. Oregon* and other harvest management forums. If additional harvest actions are implemented through these forums, those costs will be added during the implementation phase of this recovery plan. All cost estimates will be refined and updated over time.

Further, while the management unit plans provide some preliminary cost estimates for research, monitoring and evaluation, these costs are incomplete pending completion of research and monitoring plans and further development of each project. The implementation teams for each management unit will work with NMFS to develop study designs that define specific research, monitoring and evaluation needs to support adaptive management, and allow managers to make sound decisions. Coordination and funding will also be needed to provide a comprehensive monitoring program for the Snake River subdomain that includes the full range of monitoring needed for this recovery plan (e.g., monitoring of population-level spatial structure and diversity, monitoring of habitat status and trends at various scales, and action effectiveness monitoring).

Northeast Oregon Management Unit

Because of the large effort needed to recover the populations, and the amount of time that recovery will likely take, planners for the northeast Oregon management unit did not attempt to quantify the amount or extent of the tributary habitat actions. Instead, they worked with natural resource specialists to develop a list of potential projects and associated costs for recovery of the populations with the intent that the list would be used for guidance and planning purposes. This list — developed by a team including staff from NMFS, other federal and state agencies, tribes, and stakeholder groups — addresses limiting factors and threats for the populations within the management unit. Overall, the planners estimated the total cost for implementation of all identified potential tributary habitat actions for recovery of Oregon spring/summer Chinook and steelhead populations, where costs are available for all populations, at approximately $214.2 million. They estimated that, given the estimated costs of project implementation, accomplishing all of the identified restoration actions at the current rate of spending would take roughly 80 to 100 years; or 35 to 40 years at twice the current rate of spending for implementation.

The recovery plan for the northeast Oregon management unit recognizes that many ongoing recovery efforts and pre-existing laws or regulations will benefit the species and their environments — including ongoing resource management and habitat restoration activities of the Forest Service, ODFW, Grande Ronde Model Watershed, tribes, and soil and water conservation districts. It also recognizes that actions and priorities for habitat restoration in northeast Oregon will change as new information becomes available. For example, studies such as the Catherine Creek Tributaries Assessment (BOR 2011) are providing new scientific information on how channel and floodplain processes are affecting salmonid habitat. The implementation process in the plan allows results from such studies to be used to promote and implement alternative actions to those proposed in the plan to achieve recovery goals. The plan also recognizes that actions to achieve a specific recovery strategy may vary due to logistics, project opportunities, willingness of landowners to participate, funding constraints, or an organization's authorities and administrative processes. The plan does not constrain or inhibit entities or individuals from implementing actions as opportunities or funding become available.

Given the uncertainties in developing project cost estimates, the plan directs that the NE Oregon Snake River Implementation Team will work with NMFS to develop an implementation schedule with specific project costs and directions on how recovery plan implementation will be coordinated. Recovery costs will be revised as specific project budgets are completed.

Southeast Washington Management Unit

The southeast Washington management unit plan for Snake River spring/summer Chinook salmon and steelhead describes actions to move the listed populations toward recovery, but recognizes that the populations will not likely meet the biological and threats criteria for delisting for many years. Because of the possible lengthy recovery period, the plan stops short of predicting the time and cost of meeting the criteria for those populations, but instead provides the intermediate steps toward that goal as represented by the 10-year actions and costs. The actions specified in the plan are intended to make incremental improvements needed to move southeast Washington populations from their current status to healthy and harvestable levels.

The recovery plan includes near-term site specific actions and costs, and a 10-year list of actions and costs at a broader geographic scale within the management unit. Table 8-2 estimates the costs for implementing proposed projects in the southeast Washington management unit.

Table 8-2. Estimated 10-year implementation costs for recovery of Snake River spring/summer Chinook salmon and steelhead in the southeast Washington Management Unit.

Projects and Expenditures	Snake River DPS and ESU
Capital Project	Estimated Cost ($M)
Habitat Restoration	$24
Land and Easement Acquisition	$19
Passage Barrier Retrofits	$2
Instream Flow Enhancement	$3
Water Quality Improvements	$10
Subtotal for Capital Expenditures	*$58*
Non-Capital Expenditures	
Program Operations	$4
Monitoring, Studies and Assessments*	$15
Outreach and Education	$1
Development and Regulation	$1
Subtotal for non-capital Expenditures	*$21*
Total**	$79

*Many of the specific RM&E tasks have costs that are yet to be determined so the values in this table represent the minimum expense for the overall category at this time.

**The costs shown for program operations, outreach/education and development of regulations are half the estimated costs for the total MU, which includes steelhead in the Mid-Columbia DPS.

The plan recognizes that adjustments in effort or direction will be made if actions do not achieve their desired goals, and to take advantage of new information, more specific objectives and changing opportunities. It proposes that the adaptive management process provide the mechanism to facilitate these adjustments and updated cost estimates based on new information/data, objectives and opportunities.

The plan notes that actions will be implemented through a variety of funding sources. Currently, a mix of sources fund capital activities in the management unit, including the Salmon Recovery Funding Board (Pacific coastal salmon recovery and state funding), BPA, USDA, DOE, land trusts, Regional Fisheries Enhancement Groups, NGO‘s, landowners, and other state and federal sources. Funding for non-capital activities is currently provided by the Salmon Recovery Funding Board, BPA, DOE, USFS, Conservation Commission, and Regional Fisheries Enhancement Groups. As of 2011, approximately $6 million in funding was provided for capital expenses while about $2 million went for non-capital expenses. At this rate of funding, planners estimate that funds will be sufficient to support only about one-third of the costs proposed in the plan. The largest gap in funding for capital projects is habitat restoration followed by instream flow enhancement, passage barrier retrofit, land and easement acquisition and water quality improvements. The vast majority of the gap in funding for non-capital activities is monitoring.

Idaho Management Unit

Recovery strategies to address limiting factors for Idaho Snake River spring/summer Chinook salmon and steelhead populations include short-term and long-term actions. The short-term actions are projects scheduled to be implemented within the next 10 years by a resource management agency or local stakeholder group. The Idaho management unit plan provides cost estimates for specific projects scheduled for the first 10 years in each population area. Overall, the planners estimated the total cost for implementation of all identified potential tributary habitat actions for recovery of Idaho spring/summer Chinook and steelhead populations, where costs are available, at approximately $ ----.

The plan also identifies long-term actions to increase population abundance, productivity, spatial structure and diversity. Long-term actions are categories of actions that could increase productivity for the population, but for which a specific project has not yet been proposed by a resource management agency or other stakeholder. These more general long-term actions include reducing sediment loading through road decommissioning and riparian enhancement, restoring riparian function by improving riparian vegetative communities, and eliminating fish passage barriers. The plan does not estimate the potential costs associated with these long-term actions because specific projects have not yet been proposed.

Similar to the northeast Oregon and southeast Washington plans, recovery planners for the Idaho management unit plan recognize that there is a high degree of uncertainty in estimating the amount of improvement necessary to achieve the viability target for the different Snake River spring/summer Chinook salmon and steelhead populations. Due to this uncertainty, the plan proposes an adaptive management strategy that will be used in conjunction with the ESA's five-year status reviews and information from research, monitoring, and evaluation chapter to further identify and prioritize actions to achieve desired improvements.

The plan recognizes that the many groups in Idaho that represent private, state, federal and tribal entities that manage land and other resources within the watershed have created an effective process for working together, providing technical reviews of proposed projects and working with interested parties to accomplish conservation on the ground. The entities include the IDWR, irrigation districts, IDFG, USFS, BLM, NMFS, the Natural Resource Conservation Service, Idaho Soil Conservation Commission, Nature Conservancy, private landowners and many other groups necessary to accomplish habitat restoration goals. These agencies and groups are all potential partners with NMFS in some capacity in recovering listed salmon and steelhead.

9 ▪ Adaptive Management and Research, Monitoring and Evaluation

Because of the length and complexity of the salmonid life cycle and the habitat conditions these anadromous fish require at different stages, there are many uncertainties involved in improving salmon or steelhead survival. Simply identifying cause-and-effect relationships between a given management action and characteristics of fish populations can be a scientific challenge. It is essential to design a monitoring and evaluation program that will answer these basic questions:

- How will we know we are making progress?
- How will we get the information we need?
- How will we use the information in decision-making?

All three of these questions should be answered in a recovery plan. We should know before we implement actions what we are going to measure (metrics, indicators), how we are going to collect the data (monitoring plan), and what are the triggers that will be used to make decisions, adapt, and manage (evaluate data).

Research, monitoring, and evaluation (RM&E) provide the science that supports the recovery strategy at every stage, from designing and planning to readjusting the course through time. Taking account of new information and changing actions as needed is called adaptive management. Although a great deal is known about salmonid habitat and survival requirements, less is known about species and ecosystem responses to different management approaches, or to inevitable changes in the environment, economy and social desires. Adaptive management allows managers to manage in the face of these uncertainties and learn by doing. As adaptive management progresses, managers develop a greater understanding of their system and which management techniques work best under a variety of conditions (Morghan et al. 2006).

The recovery plan itself can be updated as actions are implemented and monitored and the information is fed back to managers, planners, and scientists. A detailed implementation schedule that is updated at regular intervals (for example, annually or every three years) is a tool for both adaptive management and for updating the plan; it indicates priorities and provides specifics about actions.

This recovery plan for Snake River spring/summer Chinook salmon and steelhead provides an overview of the RM&E needed to support adaptive management for recovery of these species. The management unit recovery plans provide specific RM&E plans for their areas, based on regional guidance for adaptive management and RM&E, the best available science for the listed populations and MPGs in each management unit, and the expectations and standards described in this document. The management unit RM&E plans and their respective implementation plans should be used to guide recovery planning efforts, actions, and funding in their respective regions.

Within the Columbia River basin and the Snake River subbasin, many different organizations, including federal, state, tribal, local, and private entities, conduct programs and actions designed

to improve tributary fish habitat; they also conduct various kinds of monitoring. Developing regional coordination for management actions, RM&E, and shared databases is essential, and such regional coordination is underway.

This chapter provides the following information:

- An overview of adaptive management
- A summary of regional guidance for adaptive management and RM&E
- An overview of the research, monitoring, and evaluation that is needed to support adaptive management for all four listed Snake River salmon species
- A summary of the key information needs for which research is recommended or underway

9.1 Overview of Adaptive Management and RM&E Needs

Adaptive management is a structured process designed to improve understanding and management by helping managers and scientists learn from the implementation and consequences of natural resource policy decisions (Holling 1978; Walters 1986; Lee 1993). It is an application of systems theory to fisheries management; it provides a conceptual model that goes beyond simplistic, linear cause-and-effect relationships to give managers a more complete view of their own actions in the context of a dynamic and constantly changing environment (ibid.). Recovery strategies are treated like working hypotheses that can be acted upon, tested, and revised (Lee 1999).

Planners and managers working on salmon recovery must live with many uncertainties in the available data and the probable causal links between fish survival and the actions taken (NMFS 2007). It may be overwhelming or impossible to research all the questions scientists may have, but it is both possible and essential to conduct research on the most important questions related to a well-planned program of actions. Given limited resources, it is important to identify and focus on key questions in terms of the issues at hand.

Research, monitoring, and evaluation associated with recovery plans need to gather the information that will be most useful in tracking and evaluating implementation and action effectiveness, and assessing the status of listed species. Planners and managers then need to use the information collected to guide and refine recovery strategies and actions. This process is crucial for salmon recovery because of the complexity of the species' life cycle, the range of factors affecting survival, and the limits to our understanding of how specific actions affect species' characteristics and survival.

Adaptive management works by coupling decision making with data collection and evaluation. Most importantly, it offers an explicit process through which alternative approaches and actions can be proposed, prioritized, implemented, and evaluated (Figure 9-1). Successful adaptive management requires that monitoring and evaluation plans be incorporated into overall implementation plans for recovery actions. These plans should link monitoring and evaluation results explicitly to feedback on the design and implementation of actions.

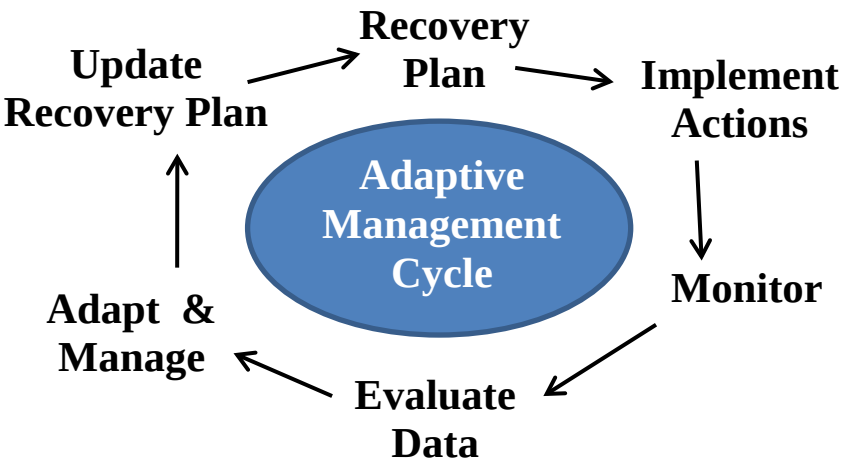


Figure 9-1. The Adaptive Management Cycle.

9.2 Regional Guidance for Adaptive Management and RM&E

The adaptive management and RM&E plan for Snake River spring/summer Chinook salmon and steelhead is based in part on principles and concepts identified in the NMFS guidance document, *Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance* (NMFS 2007). This document offers conceptual level guidance, not specific instructions, on gathering the information that will be most useful in tracking progress and assessing the status of listed species.

Since the publication of the NMFS 2007 adaptive management guidance document, regional scientists and planners, including federal, state, tribal, and local entities, have collaborated to produce several other documents that fill in the specifics for RM&E to support recovery planning at every level, from watersheds and salmonid populations to ESU/DPS and Columbia Basin-wide perspectives. Much of this collaboration was stimulated by the completion of NMFS' 2008 Biological Opinion on the operation of the Federal Columbia River Power System (BiOp). The BiOp recommended a complex suite of actions to improve survival of salmonids through the migratory corridor of the Columbia River. Subsequently, federal, state, and tribal entities have organized technical work groups to determine how best to implement the recommendations in the BiOp and how to conduct RM&E to support them. Various guidance documents have been produced in this process.

Following is a brief summary of currently available regional guidance documents for RM&E, starting with NMFS' 2007 adaptive management guidance document.

9.2.1 Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance

NMFS' 2007 adaptive management guidance document, *Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance,* describes the

information NMFS needs to meet the statutory and regulatory requirements for delisting a species. A delisting decision must be based on an evaluation of both the ESU's biological viability and the extent to which the threats facing the ESU have been addressed. The guidance document provides a listing status decision framework (Figure 9-2), which is a series of questions that NMFS asks in evaluating species status and making listing and delisting decisions.

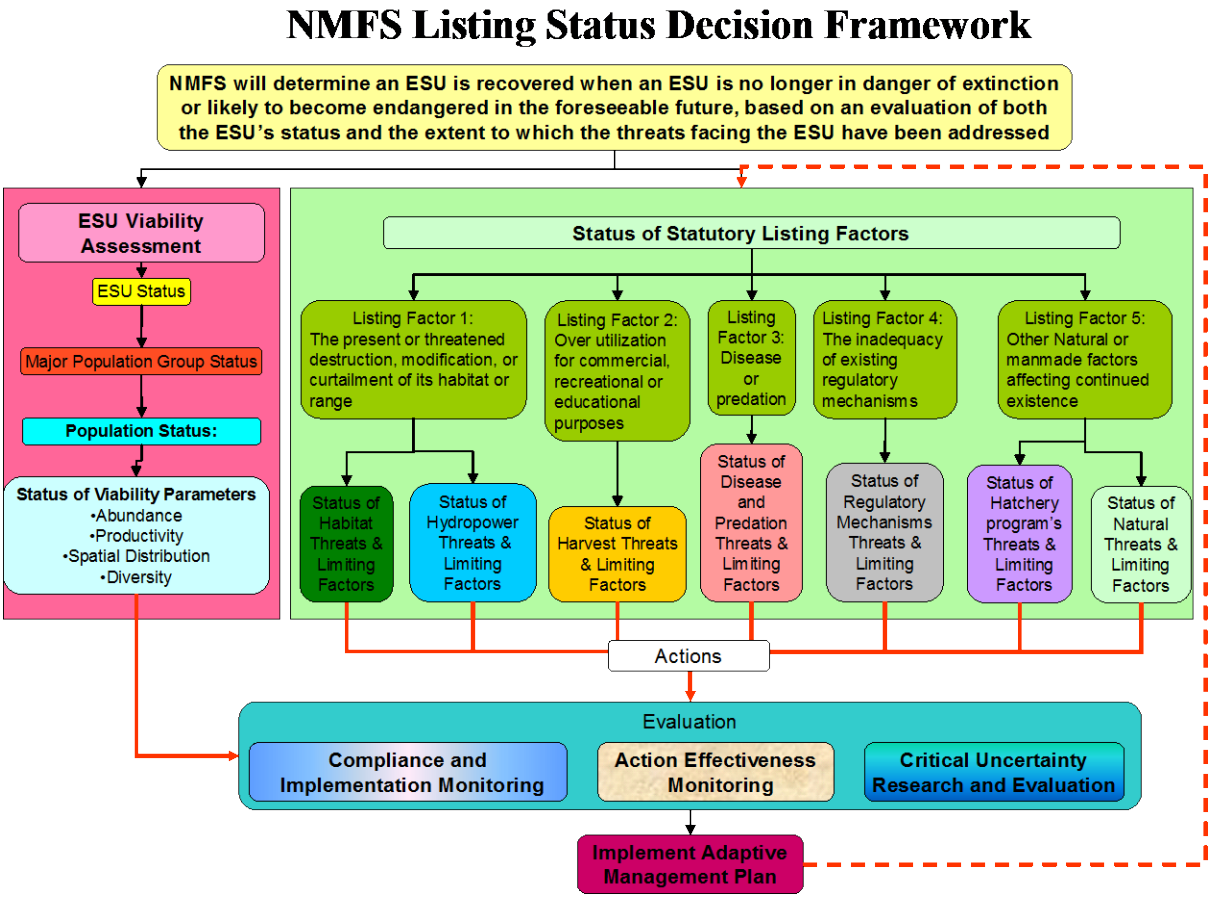


Figure 9-2. Flow diagram outlining the decision framework used by NMFS to assess the status of biological viability criteria and limiting factors criteria.

The guidance document emphasizes that adaptive management is an experimental approach in which the assumptions underlying recovery strategies and actions are clearly stated and subject to evaluation (NMFS 2007). It further states that a monitoring and evaluation plan to support adaptive management should provide (1) a clear statement of the metrics and indicators by which progress toward achieving goals can be tracked, (2) a plan for tracking such metrics and indicators, and (3) a decision framework through which new information from monitoring and evaluation can be used to adjust strategies or actions aimed at achieving the plan's goals.

The document also discusses the various types of monitoring needed for salmon recovery, categorized as status and trend monitoring, effectiveness monitoring, validation monitoring, implementation monitoring, and research on critical uncertainties.

- *Status and trends monitoring:* Status monitoring is used to characterize existing or undisturbed conditions and to establish a baseline for future comparisons. For monitoring of salmon and steelhead status, the parameters of interest are abundance, productivity, diversity, and spatial structure. Parameters also need to be established to monitor the status of threats to salmon and steelhead (such as hydropower, hatcheries and harvest). Trend monitoring involves measurements taken at regular time or space intervals to assess the long-term or large-scale trend in a particular parameter.

- *Effectiveness monitoring:* Effectiveness monitoring evaluates the direct effects of management actions. Success may be measured against reference areas, baseline conditions, or desired future conditions. Effectiveness monitoring can be implemented at the scale of individual actions, suites of actions across space, or for an entire strategy consisting of multiple actions at a single place.

- *Validation monitoring*: Validation monitoring answers the question: Did the management actions create the intended outcome? This question often involves evaluating the effects of numerous projects on a watershed or species. An example would be evaluating whether the cumulative effects of habitat restoration actions in a specific river basin resulted in increased production of juvenile salmon.

- *Implementation (compliance) monitoring:* Implementation monitoring determines whether activities were carried out as planned, and is generally carried out as an administrative review or site visit. This type of monitoring cannot directly link restoration actions to physical, chemical, or biological responses because none of these parameters are measured (NMFS 2007).

- *Research on critical uncertainties:* The adaptive management guidance notes that research on the many unknowns in salmon recovery may seem expensive or unnecessary, but in the long run will reduce monitoring and implementation costs (NFMS 2007).

The adaptive management guidance also discusses considerations for prioritizing monitoring and examines the consequences of different sorts of incomplete data. Management decisions and delisting decisions often must be made with incomplete information. Different types of incomplete information pose correspondingly different types of risks for delisting decisions. This discussion is intended to help planners consider how their own implementation and monitoring decisions may affect NMFS' assessment of ESU status.

9.2.2 Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead

Another document from the NMFS Northwest Region, *Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead* (Crawford and Rumsey 2011), builds on the 2007 adaptive management guidance document with specific recommendations for monitoring, data collection, and reporting ESA information (Crawford and Rumsey 2011). NMFS intends this document to assist those involved with salmon recovery in understanding the desired level of monitoring and the associated level of certainty needed at the regional, local, and project levels to support ESA status evaluations and listing and delisting decisions. NMFS also intends the guidance to assist in the development and implementation of a regional monitoring strategy that

will provide the necessary monitoring information in the most cost-effective way for the region. The document does not establish new requirements or modify any existing requirements.

The recommendations included are for federal and state agencies, tribes, local governments, and watershed organizations. Recommendations include monitoring that addresses all of the viable salmonid population (VSP) criteria and the threats to salmon and steelhead (organized under the five ESA listing factors). The guidance also makes recommendations for setting up regional databases and coordinating regional data collection so that the various agencies and tribes involved in salmon recovery can share data as well as report it efficiently to NMFS.

Recommendations for VSP monitoring address adult spawner abundance, productivity, spatial distribution, and diversity. Abundance considerations include use of a sampling design that has known precision and accuracy, monitoring of hatchery contributions, and a goal of a coefficient of variation of 15 percent or less for all populations. Productivity considerations include (1) developing at least 12 brood years of spawner to allow use of the geometric mean of recruits per spawner to develop productivity estimates, and (2) obtaining estimates of juvenile migrants for at least one significant population within each stratum. The guidance recommends certainty levels for detecting changes in spatial distribution and, for diversity, suggests short-term strategies (use of spawn timing, age distribution, and other observations) and long-term strategies (genetic baseline information for each population).

Habitat-related recommendations include use of a generalized random tessellation stratified (GRTS) sampling program coupled with remote sensing of land use and land cover and coordinated with fish-in/fish-out monitoring where possible. Implementation of habitat restoration efforts should be capable of being reported and correlated with limiting factors as defined in the NMFS data dictionary (Hamm 2012). Reach-scale effectiveness monitoring should be conducted for various habitat improvement categories using a Before and After Control Impact (BACI) design wherever possible. There should also be at least one intensively monitored watershed (IMW) in each recovery subdomain. The U.S. Environmental Protection Agency, state agencies, and local governments should monitor stormwater and cropland runoff for concentrations of toxic contaminants and to identify their sources. For monitoring of hydropower-related threats, the guidance largely refers to specific requirements that have been written into FERC licenses.

For monitoring of harvest status and trends, the NMFS monitoring guidance notes the need for improved estimates of population-level harvest impacts, improved models for predicting harvest impacts to populations, and improved monitoring of incidental take and exploitation rate management.

For disease and predation, the guidance suggests that the status of existing invasive species should be compiled for each ESU/DPS and that watershed-level assessments should be conducted for species known to affect salmon and steelhead.

For threats related to hatchery production, the guidance recommends that states and tribes be able to determine annually and with known precision the proportion of hatchery origin spawners (pHOS) for each population. The proportion of natural influence (PNI) for primary populations

with supplementation programs should be calculated periodically. Hatchery operators should complete Hatchery and Genetics Management Plans (HGMPs), submit them to NMFS for approval, and track and report on their implementation. Hatchery action effectiveness monitoring should include development of large-scale treatment/reference design to evaluate long-term trends in abundance and productivity of supplemented populations.

To evaluate the adequacy of regulatory actions, the guidance notes the need for a recovery action tracking system capable of recording whether entities have implemented regulatory actions proposed in recovery plans. It also suggests development of a randomized sampling program to test whether permits issued under regulatory programs designed to protect riparian and instream habitat are in compliance and adequately enforced.

Noting the regional needs to coordinate data collection, evaluation, and reporting, the guidance also makes several other recommendations. (1) Regional environmental databases should be coordinated such that information can be readily reported to NMFS and shared among participants. (2) Methods and calculations used to assess and evaluate data should be transparent and repeatable. (3) All project tracking should be consistent with the PCSRF project tracking database and the NMFS data dictionary. (4) Regional salmon recovery partners should build a distributed data system that can communicate among agencies and report to the public. (5) Sampling programs for habitat, water quality, and fish VSP criteria should be coordinated to fit within an integrated master sample program.

9.2.3 Anadromous Salmonid Monitoring Strategy

The Anadromous Salmonid Monitoring Strategy (ASMS) grew out of a regional workshop (Columbia Basin Coordinated Anadromous Monitoring Workshop) convened by the Bonneville Power Administration, Columbia Basin Fish and Wildlife Authority, NMFS, and Northwest Power and Conservation Council in October and November 2009 in Skamania, Washington. The purpose of the workshop was to develop a coordinated anadromous fish monitoring strategy for the Columbia Basin; to reach agreement among participants on an efficient and effective framework for monitoring; and to project a specific implementation strategy.

The workshop participants agreed that the monitoring should assess (1) viable salmonid population (VSP) parameters; (2) habitat effectiveness; and (3) hatchery effectiveness in the Columbia Basin. Hatchery effectiveness refers to monitoring that would determine whether supplementation strategies are being effective in restoring wild populations and how they affect the task of determining natural abundance and productivity. It does not address actions taken at a hatchery to improve operations under an HGMP. The agreed-upon framework and strategy was intended to address the needs of the NPCC's Fish and Wildlife Program, meet the needs of the FCRPS BiOp (at a minimum), and contribute to the monitoring needs of ESA recovery planning and other regional fisheries management needs.

The ASMS provides a monitoring strategy for the Snake River sub-region. Co-managers subscribing to this strategy include: Idaho Fish and Game; Nez Perce Tribe; Oregon Department of Fish and Wildlife; Confederated Tribes of the Umatilla Indian Reservation; Washington Department of Fish and Wildlife; and Shoshone-Bannock Tribe. The Snake strategy focuses

mainly on implementing VSP monitoring, but also addresses habitat action effectiveness and hatchery effectiveness for steelhead, spring-summer Chinook, fall Chinook, and sockeye.

ASMS contains as appendices the following detailed elements of the strategy:

- Populations targeted to receive both habitat status and trend and fish in/fish out monitoring, to be used to assess habitat action effectiveness on fish (ASMS, appendix E)
- Inventory tables of monitoring existing as of 2009 (ASMS, appendix F)
- Monitoring priorities (ASMS, appendix G)
- Description of monitoring gaps and proposed projects to address these gaps, including gaps for addressing monitoring needs for the FCRPS BiOp as of November 2009 (ASMS, appendix H)
- Final master spreadsheet of prioritized projects and associated cost (ASMS, appendix I).

9.2.4 Biological Opinions and Records of Decision

Several federal agencies have natural resource responsibilities related to the ESA, and issue biological opinions or records of decision that include RM&E that may be relevant to salmon recovery. The following is a summary of the RM&E expectations and programs contained in such documents that should also be incorporated into the Snake River spring/summer Chinook salmon and steelhead recovery plan monitoring strategy at ESU and management unit levels.

- *Recommendations for Implementing Research, Monitoring and Evaluation for the 2008 NOAA Fisheries FCRPS Biological Opinion (*AA/NOAA/NPCC RM&E Workgroups, June 2009 and May 2010). Under the FCRPS Biological Opinion, federal dams are configured and operated through 2018, subject to a number of fish conservation actions set out in the Reasonable and Prudent Alternatives (RPA) to meet objective performance standards for fish passage survival. The 2008 FCRPS Biological Opinion and its 2010 Supplement recommended a complex suite of actions to improve survival of salmonids through the migratory corridor of the Columbia River and to improve habitat below Bonneville Dam. Subsequently, federal, state, and tribal entities organized technical work groups to determine how best to implement the recommendations in the Biological Opinion and its Supplement and how to conduct RM&E to support them. Various guidance documents have been produced through this process and are available at http://www.salmonrecovery.gov/ResearchReportsPublications.aspx. The workgroup reports incorporate monitoring recommendations related to the Biological Opinion. Ongoing workgroup reviews and assessments annual reports represent a major mechanism for integrating RM&E efforts in the Columbia Basin.

- *FCRPS Adaptive Management Implementation Plan* (AMIP) (an amendment to the 2008-2018 Federal Columbia River Power System Biological Opinion) (NMFS September 11, 2009). The Adaptive Management Implementation Plan is an amendment to the FCRPS Biological Opinion. It describes how to accelerate and enhance mitigation actions promised in the Biological Opinion RPA; collect more data and improve analytic tools to better inform future adaptive management decision-making; and add new

biological triggers that when tripped will activate near- and long-term contingency actions, should the agencies detect a significant decline in the species' condition.

9.2.5 Integrated Status and Effectiveness Monitoring Program

The Integrated Status and Effectiveness Monitoring Program (ISEMP), created in 2003 and funded by BPA, is an ongoing collaborative effort led by scientists at NOAA's Northwest Fisheries Science Center. The purpose of the program is to design, test, implement, and evaluate status and trends monitoring for salmon and steelhead populations and their habitat, and watershed-scale effectiveness monitoring for management actions affecting salmon and steelhead populations and habitat (ISEMP 2009 Annual Report, ISEMP Website, May 30, 2010) http://www.nwfsc.noaa.gov/isemp.

The Integrated Status and Effectiveness Monitoring Program provides a cost-effective means of developing a region-wide RM&E program that can efficiently collect information to address multiple management objectives over a broad range of scales. This RM&E pilot program will assess the status of anadromous salmonid populations, their tributary habitat, and restoration and management actions, and will test specific protocols to determine which are most responsive to fish habitat evaluations. In addition, ISEMP has played an important role in the Action Agencies' 2008 FCRPS Biological Opinion habitat restoration strategy by providing significant input into developing the design and monitoring necessary for evaluating the watershed-scale habitat rehabilitation actions necessary for the off-site mitigation program as proposed in Table 5 of the BiOp.

ISEMP is analyzing the data from four intensively monitored watersheds (IMWs), two of which are in the Snake River Basin. The basic premise of the IMW project is that the complex relationships controlling salmon response to habitat conditions can best be understood by concentrating monitoring and research efforts at a few locations (Bilby et al. 2004). The type of data required to evaluate the response of fish populations to management actions that affect habitat quality or quantity are difficult and expensive to collect. Focusing efforts on a relatively few locations enables enough data on physical and biological attributes of a system to be collected to develop a comprehensive understanding of the factors affecting salmon production in freshwater (Bilby et al. 2004).

9.3 Research, Monitoring and Evaluation Plans for Management Units

Within the framework of the guidance described above, local recovery planners for northeast Oregon, southeast Washington and Idaho have or will develop RM&E programs for their management unit recovery plans. These plans will provide conceptual-level guidance to RM&E implementation efforts at the local and regional scale. Implementation of these RM&E plans will also be influenced by the regional coordination efforts.

Consistent with direction in the adaptive management guidance document, the management unit monitoring and evaluation programs for Snake River spring/summer Chinook salmon and steelhead will provide (1) a clear statement of the metrics and indicators by which progress toward achieving goals can be assessed, (2) a plan for tracking such metrics and indicators, and (3) a decision framework through which new information from monitoring and evaluation can be

used to adjust strategies or actions aimed at achieving the Plan's goals. NMFS will work with the implementation teams for each management unit to establish priorities before the RM&E plans or monitoring actions are implemented. In addition, before monitoring activities begins, monitoring objectives for each MPG will be prioritized using information in NMFS's document, *Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead* (Crawford and Rumsey 2011), and other relevant guidance. NMFS anticipates working with implementation teams for each management unit to coordinate prioritization of monitoring actions and set timelines for RM&E tasks to ensure they are consistent with relevant guidance, and that the information is developed and made available for consideration during future 5-year reviews.

Management unit RM&E plans are shown in the associated management unit recovery plans in Appendix A (northeast Oregon), Appendix B (southeast Washington) and Appendix C (Idaho).

9.4 Tracking Progress through Adaptive Management and RM&E

NMFS' 2007 adaptive management guidance document, discussed in Section 9.2.1, provides direction for tracking progress made toward delisting.

9.4.1 Five-Year Reviews, ESU/DPS Status Assessments, and Adaptive Management

The ESA requires that, at least every five years, the Secretary shall conduct reviews of all ESA-listed species and determine whether any species should (1) be removed from such list, (2) be changed in status from an endangered species to a threatened species, or (3) be changed in status from a threatened species to an endangered species. In accordance with this ESA requirement, every five years NMFS will conduct reviews of the Snake River spring/summer Chinook salmon ESU and steelhead DPS. These reviews will consider information that has become available through research, monitoring and evaluation since past listing determinations, and make recommendations whether the ESU or DPS may warrant a change in status consistent with section 4(a) of the ESA. Any status reviews will be based on the NMFS Listing Status Decision Framework in the adaptive management guidance document (see Figure 9-2) and will be informed by the information obtained through implementation of the monitoring, research, and evaluation programs in each management unit plan and the recovery modules.

Similarly, new information considered during 5-year reviews may also compel more in-depth assessments of implementation and effectiveness monitoring and associated research to inform adaptive management decision at the management unit level.

9.4.2 Research on Key Information Needs

As described in Chapter 5, many important factors have reduced, and continue to reduce, the abundance, productivity, spatial structure and diversity of Snake River spring/summer Chinook salmon and steelhead. While actions need to be implemented to address these factors throughout the salmonid life cycle, many questions remain that can affect the success of the actions.

Recovery planners have identified key information needs that will help focus research, monitoring and evaluation efforts. Gaining this information to resolve uncertainties will greatly improve chances of attaining recovery goals outline in this plan. The key information needs for

both species are summarized below and described further in Section 5.8. Section 6.4 identifies key information needs specific to recovery of Snake River spring/summer Chinook salmon, and Section 7.4 identifies information needs specific to Snake River steelhead recovery. The management unit plans for northeast Oregon, southeast Washington and Idaho provide more detail on these key information needs.

These preliminary priorities were identified by Oregon, Washington and Idaho recovery planners and NMFS Northwest Regional Office and Northwest Fisheries Science Center staff. They are preliminary priorities only and are not in ranked order. Additional discussion among local recovery planners, NMFS staff and others will be needed to finalize future research and monitoring priorities for Snake River spring/summer Chinook salmon and steelhead. NMFS expects to work with management unit recovery planners to finalize research and monitoring priorities and to ensure that results are incorporated into future 5-year reviews. The key information needs and critical uncertainties identified in the management unit plans and in this recovery plan will provide the basis for continuing discussion of how to prioritize funds and activities for monitoring and research in the Snake River Basin.

Population Viability Status

Much uncertainty remains about the viability status of many populations, particularly for Snake River steelhead populations. Better information is needed to understand the status of the populations and the presence of similar genetic traits among the populations, including similarities and differences in their responses to variability in freshwater and marine productivity.

Information on population abundance and productivity can be improved by conducting population-specific abundance estimates using probabilistic sampling protocol for either redd counts or tagging studies (ICTRT 2007). Information is also needed on the relative distribution of hatchery spawners at the population level. In addition, investigations need to examine factors influencing the adoption of alternative life history patterns, and how such changes might contribute to the abundance and productivity of affected populations. The effects of different habitat restoration actions can be tested by comparing long-term trends of actions with natural abundance and productivity of Snake River spring/summer Chinook salmon and steelhead populations.

Information on spatial structure and diversity can be improved by conducting studies to examine salmon and steelhead distribution and habitat preference. Ongoing improvements in the monitoring, evaluation, and reporting of habitat metrics and fish population response will allow us to assess the effectiveness of habitat restoration actions and progress toward the viability criteria for these ESUs and DPS.

Ocean Productivity and Natural Variation

Global-scale processes in the ocean and atmosphere can regulate the productivity of marine, estuarine, and freshwater habitats of salmon and steelhead. A better understanding of natural variability is needed to correctly interpret the response of salmon and steelhead to management actions over the full range of environmental conditions they are likely to encounter.

Climate Change

Scientists predict that expected changes in climate and resulting changes in temperature, precipitation, wind patterns, ocean acidification, and sea level height could have significant implications for survival of Snake River spring/summer Chinook salmon and steelhead in their freshwater, estuarine, and marine habitats. It will be important to monitor key environmental variables to document climatic effects on freshwater, estuary and ocean productivity, and adjust recovery actions accordingly through adaptive management.

Hatchery Effectiveness

Information is needed regarding the potential for both benefits and harm of hatchery-produced fish on natural-origin salmon and steelhead populations. This includes information on the impacts of hatchery releases on natural-origin population abundance, productivity, and genetic integrity, as well as a determination of contributing factors for lower or greater reproductive success rates for hatchery fish. Managers need to implement relevant reproductive success studies and evaluate spawner effectiveness of hatchery fish. They also need to evaluate the impacts of other hatchery fish releases (both anadromous and resident) on Snake River spring/summer Chinook salmon and steelhead viability in the tributary, mainstem, estuary and ocean environments. Additional research will also help managers assess the demographic risks versus conservation benefits of hatchery supplementation, sliding scale hatchery management, and the overall implications of hatchery programs. Further, the impacts of associated RM&E efforts remain uncertain, including impacts from RM&E handling (electrofishing, weirs, catch and release, tagging, marking, trapping and sorting).

Hydropower System

Additional research and monitoring is needed to gain a better understanding of smolt migration timing and mortality rates through the lower Snake and Columbia Rivers, including the effects of spring and summer spills. Investigations are also needed concerning factors that could contribute to latent mortality of fish passing through the hydro system.

Harvest Management

While harvest management has improved greatly in recent years, additional benefits may be gained with better information. Conducting pit tag detection for all harvested fish could improve harvest management by providing a better understanding of the sources of losses in conversion rates. Estimates of catch and release impacts also need to be improved.

Predation, Competition, Disease

Non-indigenous species and other native species can compete directly and indirectly with Snake River spring/summer Chinook salmon and steelhead for resources, significantly altering food webs and trophic structure, and potentially altering evolutionary trajectories. More information is needed to evaluate the effects of these threats on population and ESU/DPS viability.

Exposure to Toxics

Chemical contaminants are increasingly being recognized as a factor contributing to the decline of listed species. More information is needed to determine the role of these chemical contaminants in limiting salmon and steelhead population viability.

Interacting Strategies/Actions

It is unclear how strategies and actions implemented within each of the sectors (Harvest, Hatcheries, Hydropower, and Habitat) will interact to impact the environment and contribute to population, MPG and species recovery. Ongoing improvements in the monitoring, evaluation, and reporting of habitat metrics and fish population response will allow us to document the effectiveness of habitat restoration actions and progress toward the viability criteria for these ESUs and DPS in the future.

Reintroduction Opportunities

Information is needed to determine the potential benefits of additional reintroductions into historical habitats in blocked areas, considerations under which reintroductions would be suitable, and potential alternative reintroduction strategies and techniques.

10 ▪ Implementation and Coordination

Recovery plan implementation involves many entities and stakeholders, and the needs for coordination are complex and occur at multiple levels. For instance, implementation and coordination needs exist at the management unit and subdomain levels and involve government entities at the federal, state, tribal, and local levels and also nongovernmental entities. Coordination at the subdomain level is further complicated by the tri-state nature of the Snake River subdomain and the need for coordination on issues of regional scope.

Coordination needs may differ depending on the type and scale of action in question. For instance, habitat actions require extensive local coordination but also coordination at the ESU or DPS level to ensure that overall recovery needs are being met. Similarly, although many funding decisions are made locally, there is a need for coordination of funding sources at the subdomain scale to ensure the most effective use of limited funds. Recovery strategies and actions related to harvest and hatcheries are another example of actions that require coordination at both state and subdomain scales and with NMFS and other entities.

In general, the management unit plans are the primary documents guiding implementation in the Snake River subdomain. Coordination at the subdomain scale will occur as needed and will be achieved primarily through efforts of the Snake River Coordination Group. The Coordination Group will bring together representatives from the southeast Washington, northeast Oregon and Idaho Snake River management units and other relevant parties to coordinate policy and technical issues across the salmon and steelhead ESUs and DPS for the Snake River Recovery Plan. It will provide organizational structure for communication and coordination on a tri-state and multi-tribal level across the Snake River subdomain, and promote recovery plan implementation.

This chapter presents NMFS' vision for recovery plan implementation, defines implementation responsibilities for NMFS and the management units, and describes how implementation of this recovery plan will be structured and coordinated.

10.1 NMFS' Vision for Recovery Implementation

In general, NMFS' vision for recovery implementation is that recovery plan actions are carried out in a cooperative and collaborative manner so that recovery and delisting occur (NMFS 2008d). NMFS' strategic goals to achieve that vision are as follows:

1. Sustain local support and momentum for recovery implementation.
2. Implement recovery plan actions within the time periods specified in each plan.
3. Encourage others to use their authorities to implement recovery plan actions.
4. Ensure that the implemented actions contribute to recovery.
5. Provide accurate assessments of species status and trends, limiting factors, and threats.

NMFS' strategic approach to achieving these goals is as follows:

- Support local efforts by using Domain Teams to coordinate (internally and externally) and encourage recovery plan implementation.[8]
- Use recovery plans to guide regulatory decision making.
- Provide leadership in regional forums to develop research, monitoring, and evaluation processes that track recovery action effectiveness and status and trends at the population and ESU/DPS levels.
- Provide periodic reports on species status and trends, limiting factors, threats, and plan implementation status.
- Staff and support the Snake River Coordination Group.

NMFS will carry out its vision, goals, and strategic approach to recovery for the Snake River spring/summer Chinook salmon ESU and steelhead DPS by working in partnership with the Snake River Coordination Group, management unit recovery planners, and others with authority to implement recovery efforts.

10.2 Implementation of Roles and Responsibilities

Effective implementation of recovery actions for Snake River spring/summer Chinook salmon and steelhead will require coordinating the actions of diverse private, local, state and federal parties spread across three states. In Washington, regional recovery boards have taken the lead on coordinating recovery implementation within the southeast Washington Snake management unit. In Oregon, an implementation team will lead recovery plan implementation, supported by the governance structure for the Oregon Plan for Salmon and Watersheds. In Idaho, NMFS will work with state, tribal, federal and private entities to prioritize actions and implement the management unit's recovery plan. Actions in the Columbia River, its estuary, and the ocean will be implemented by a broad range of partners, including NMFS, the Northwest Power and Conservation Council, the Bonneville Power Administration, the Bureau of Reclamation, the Army Corps of Engineers, federal land management agencies, state and tribal fisheries co-managers, the Columbia River Estuary Partnership, and local parties and jurisdictions interested in salmon recovery. The Snake River Coordination Group will take the lead in efforts to coordinate the actions of these many players at an ESU and DPS level, supported by both local and regional science and technical teams.

[can we add a figure here showing implementation structure?]

[8] Domain teams are an organizational structure internal to NMFS whose purpose is to coordinate recovery plan completion and implementation. The teams promote consistency in internal decision making and work with federal, state, tribal, and local recovery parties to achieve recovery plan objectives.

10.2.1 NMFS' Role in Coordination

NMFS' role in Snake River spring/summer Chinook salmon and steelhead recovery is threefold. The first role is to ensure that the agency's statutory responsibilities for recovery under the ESA are met. The second role is to ensure coordination of recovery planning efforts with other related efforts in the Columbia Basin. The third role is to serve as the convening partner for the Snake River Coordination Group and to update forum members on issues relevant to recovery strategies. Group meetings, for example, might contain standing agenda items where updates can be provided to the members on hatchery and harvest issues.

ESA Responsibilities

NMFS is responsible for the following tasks under the ESA:

- Ensure the recovery plan meets ESA statutory requirements, tribal trust and treaty obligations, and agency policy guidelines.
- Develop ESU and DPS-wide performance measures consistent with the recovery strategies outlined in Chapter 5 and Chapter 6.
- Conduct 5-year reviews (see Section 8.4.1).
- Make delisting determinations.
- Coordinate with other federal agencies to ensure compliance under the ESA.
- Implement recovery plans.

Basinwide Coordination

NMFS will work with the Snake River Coordination Group and management unit leads to ensure that Snake River recovery efforts are closely coordinated with related regional efforts. These include related recovery efforts in the Columbia River estuary and mainstem, actions being implemented through the FCRPS BiOp to improve survival of salmonids through the migratory corridor of the Columbia and Snake Rivers, and other related efforts by the Northwest Power and Conservation Council, Bonneville Power Administration, Bureau of Reclamation, Army Corps of Engineers, and federal land and water management agencies.

Snake River Domain Convening Partner

As convening partner for the Snake River Coordination Group, the NMFS Northwest Regional Office, working through its Snake River Recovery Coordinator and Domain Team, will:

- Convene Coordination Group meetings on a regular basis (once or twice a year) and convene additional meetings as needed.
- Provide meeting facilitation services and manage the meeting process.
- Provide Coordination Group meeting venues.
- Prepare and distribute meeting notes and follow up on tasks agreed to by the Coordination Group.
- Serve as central clearinghouse for information, to include: ESU/DPS-wide stock status, relevant federal scientific research, and ESU/DPS-wide gaps in recovery efforts.

- As requested by the Coordination Group, establish and facilitate state, federal and tribal meetings necessary for the coordination of recovery activities.

10.2.2 Snake River Coordination Group's Role in Coordination

The Snake River Coordination Group will be responsible for coordination across the Snake River recovery domain. The Coordination Group provides organizational structure for communication and coordination on a tri-state and multi-tribal level across the entire ESU and DPS.

Specific functions include the following:

- Facilitate coordination and communication between federal agencies, the Northwest Power and Conservation Council, states, tribes, management unit leads, and local recovery boards.
- Advocate for the recovery of Snake River spring/summer Chinook salmon and steelhead.
- Promote the application of adaptive management in the ESU and DPS.
- Provide recommendations for resource prioritization.
- Network with other multi-jurisdictional Columbia recovery planning groups (e.g. Mid-Columbia, Lower Columbia and Upper Columbia) and Northwest Power and Conservation Council subbasin planning efforts.
- Provide a scientific interface with the Recovery Implementation Science Team.
- Coordinate and synthesize RM&E efforts and activities.

The Snake River Coordination Group will coordinate with broader efforts to develop common indicators for measuring trends. It may also identify legislative, congressional, and other funding opportunities for management actions and RM&E within the ESU and DPS. Policy issues will be resolved within respective local, state, federal and tribal authorities and agencies.

Organization/Membership: The Coordination Group is guided by a Steering Committee. NMFS will serve as the convening partner and provide facilitation, venues, and guidance. Steering Committee membership includes management unit leads (or their representative) in Oregon, Washington and Idaho and representatives from state governors' offices, NMFS, and tribes.

There is no established membership for participation in the broader activities of the Coordination Group. It is anticipated that participation in regular Coordination Group meetings, as distinguished from meetings of the Steering Committee, will vary depending on the topics and issues being addressed.

Operations: The Coordination Group and Steering Committee will conduct regular meetings annually, semi-annually, or as needed, and work to reach consensus on issues of dispute or discrepancy within the ESU and DPS.

Functional Topics: The Coordination Group will focus on four functional topics. For each topic the Coordination Group may establish subgroups to organize, implement, and track progress. The decision to establish such subgroups will be determined based on the anticipated scope of

work for each functional topic, Coordination Group members' available staffing and funding, and other considerations as the Coordination Group considers appropriate. The intent of these efforts is to support coordinated and effective implementation of the Snake River Recovery Plan and to ensure that 5-year status reviews by NMFS are informed and efficient. The four functional topics are:

1. Research, Monitoring & Evaluation: RM&E will be coordinated by a Science Team that will be composed of Recovery Implementation Science Team representatives, management unit technical representatives, ODFW/WDFW/IDFG/tribal co-manager technical representatives, etc. Focus areas may include:
    a. Review/compile new information on VSP parameters and update stock status summaries accordingly.
    b. Identify knowledge gaps that are high priorities across the ESU/DPS and review/coordinate efforts to address them.
    c. Identify how to track threats criteria and provide annual summaries of applicable data.
    d. Develop an ESU/DPS monitoring and evaluation and adaptive management plan.

2. Implementation: Subgroups may be composed of key project managers from management units, representatives from key funding programs (e.g., NMFS Restoration programs, Bonneville Power Administration, Columbia Basin Fish Accords[9], Northwest Power and Conservation Council, Oregon Watershed Enhancement Board, the Salmon Recovery Funding Board, and others), and key partners in recovery actions (such as USFS, BOR, and others). Their focus areas may include:
    a. Review status of implementation scheduling for each management unit.
    b. Share significant accomplishments by management units.
    c. Promote technology transfer relevant to implementation across management units.
    d. Communicate priorities for future actions to assist coordination across management units.
    e. Identify opportunities where shared advocacy and coordination help implement key recovery actions (e.g., combine suitable proposals into single programmatic proposal; share technical resources for design review).

3. Outreach: Subgroups may be composed of representatives from state governors' staffs, co-manager policy leads, management unit representatives, and/or partner agency policy people. Their focus is to develop/support outreach related to Snake River spring/summer Chinook salmon and steelhead recovery, including reviewing/drafting NMFS two-year reports and updates to key decision makers (elected officials, agency heads, etc.).

4. Policy: Policy issues will be managed by the Steering Committee, who may elect to organize subgroups for specific issues. Policy focus areas include:

[9] The Fish Accords consist of three Memorandums of Agreement (MOAs) entered into between the Federal Columbia River Power System (FCRPS) action agencies (Bonneville Power Administration, U.S. Army Corps of Engineers and the Bureau of Reclamation), four tribes, and one state.

a. Identify issues where joint advocacy supports Snake River spring/summer Chinook salmon and steelhead recovery action.
b. Track the status of related activities in the Northwest Power and Conservation Council, Federal Caucus, FCRPS BiOp, *U.S. v. Oregon*, and other regional forums.
c. Identify and, if appropriate, develop Snake River spring/summer Chinook salmon and steelhead policy proposals.

10.3.3 Management Unit Leads' Role in Coordination

The proposed organizational structure for plan implementation within Oregon, Washington and Idaho relies heavily on the agencies, organizations, entities, tribes and individuals that have been involved in the development of the respective management unit plans, and who have often worked for many years on Snake River salmon and steelhead recovery programs. While the implementation approaches for each management unit differ slightly, they have similar structures and responsibilities for plan implementation.

Management Unit Lead Responsibilities

The management unit leads have three primary responsibilities for implementing the tributary-based plans. Performance of these responsibilities will be influenced by management unit lead capacity, authority, and management unit priorities, and will likely require other support structures or processes to fully accomplish these responsibilities. Not all of these duties can be accomplished initially with the current resources available. Prioritization of the initial duties will be guided by the statutory requirements of the ESA and the individual state's guidance.

The first responsibility for management unit leads is to develop implementation schedules for the respective management units, organized in a spreadsheet format consistent with NMFS interim recovery planning guidance (NMFS 2006). While all of the management unit plans presently contain site-specific actions, priorities, and estimates of the time and cost sufficient to complete this ESU/DPS plan, further specificity will aid in local project selection and prioritization as well as in implementation reporting at the regional and national levels. The schedules should include:

- Site-specific recovery actions specific to populations within the management unit.
- Limiting factor(s) addressed by each action.
- Priority for completing the action. Organize actions by priority level.
- Duration of and schedule for action, indicating also whether the action is new or already underway.
- Biological benefits of the action(s).
- Lead entity(ies) to implement each action.
- Estimated cost for each action over each of the next 5 years and a total cost for that action to recovery.

The second responsibility for management unit leads is to coordinate implementation of recovery actions identified in the plan and implementation schedule. In this regard, they serve to facilitate two-way communication vertically (i.e., different spatial scales related to recovery plan

governance) and horizontally (i.e., related programs, interests, and oversight outside of recovery plan governance). A key related program is the implementation of the Northwest Power and Conservation Council's Fish and Wildlife Program Subbasin Management Plans. The management unit leads, in full coordination with the fishery agencies and tribes, should ensure that the project selection process for the Council's subbasin plans within the management unit is consistent with implementing the ESA priority actions specified in this plan and the implementation schedules. Specific responsibilities include:

- Coordinate with federal and state agencies, Northwest Power and Conservation Council, tribes, local government, and other stakeholders, with an emphasis on implementing tributary habitat actions.
- Coordinate development of implementation strategies for voluntary actions requiring complex coordination among various entities, including local outreach, incentives, technical help, project funding, project management, and monitoring/reporting.

The third responsibility for management unit leads is to track and report on progress of implementation in accordance with state and federal reporting requirements. Specific responsibilities include:

- Coordinate plan monitoring within the management unit.
  - ✓ Ensure appropriate tracking and reporting of recovery actions.
- Coordinate plan research within the management unit.
  - ✓ Include results and reports in system information/outreach materials.
- Report on plan progress in relation to goals, strategies, and actions, using mechanisms and processes established for tracking progress.
  - ✓ Highlight plan successes and needs.
- Review and revise implementation schedules as necessary.
  - ✓ Use monitoring and research to guide actions.
  - ✓ Incorporate adaptive management, as needed.
- Represent the management unit in the Snake River Coordination Group and Coordination Group subgroups, as necessary.

Northeast Oregon Coordination

An Implementation Coordinator, provided by ODFW, will be responsible for coordinating activities for this management unit and representing the management unit on the Snake River Coordination Group. The Coordinator will receive advice and guidance from the Northeast Oregon Snake River Recovery Team, which will include representatives from NMFS, ODFW, tribes, Grande Ronde Model Watershed, Oregon Watershed Enhancement Board, U.S. Forest Service and other entities as identified. The Recovery Team will be responsible for overall policy, leadership, coordination, direction, agenda setting for implementation of the management unit plan. It will coordinate at relevant federal, state and regional levels, and identify and seek funding for action implementation. It will also develop a three-year implementation schedule,

identify action priorities, and report annual progress on implementation and monitoring actions to the Implementation Team, ODFW and NMFS.

Two other teams are also part of the implementation framework for recovery of Oregon Snake River spring/summer Chinook salmon and steelhead: an Implementation Team, which provides guidance, recommendations and support on implementation, and a Science Team, which provides advice and guidance on technical and science issues. The implementation framework also includes the Action Implementers, which are the different organizations, agencies, tribes and others that implement local restoration and conservation actions. The northeast Oregon management unit plan provides more detail on the different teams that make up Oregon's implementation framework.

Southeast Washington Coordination

Coordination of actions and information sharing for the southeast Washington management unit will continue to occur through the Snake River Salmon Recovery Board (SRSRB) and associated subcommittees and teams. The Snake River Salmon Recovery Board comprises government and tribal representatives, landowners, and private citizens in Washington's corner of the Snake River basin. Other processes, including those implemented through the Lower Snake River Compensation Plan, also assist in regional coordination.

The SRSRB operates through several committees including the Lead Entity Project Review and Ranking Committee. This committee is responsible for developing a ranked habitat project list for the SRSRB to use in requesting funding from the state-level Salmon Recovery Funding Board. The SRSRB has also appointed a Regional Technical Team to review and provide input to the recovery effort from the technical and scientific standpoints. The Executive Committee is responsible for developing broad policy recommendations, guidance, and budgets. These recommendations are referred to the full SRSRB for consideration.

The SRSRB will make decisions for recovery plan implementation using a consensus-driven process. The Board is committed to implementing a recovery plan that is supported by science and the community. The plan proposes that the adaptive management process be used to facilitate adjustments in effort or direction to achieve desired goals and to take advantage of new information, more specific objectives, and changing opportunities. The southeast Washington management unit plan provides more detail on the different teams that make up Washington's implementation framework.

Idaho Coordination

While NMFS led the development of the Idaho management unit recovery plan, the plan represents the efforts and priorities for Snake River spring/summer Chinook salmon and steelhead recovery in Idaho. Several existing groups in Idaho currently implement actions to improve salmon and steelhead habitat conditions. These groups reflect strong representations by the private, state, federal and tribal entities that manage land and other resources within Idaho Snake River drainages. The entities include the IDFG, IDWR, Idaho Governor's Office of Species Conservation, various irrigation districts, U.S. Forest Service, BLM, NMFS, the Nez Perce Tribe the Natural Resource Conservation Service, Idaho Soil Conservation Commission, different county soil and water conservation districts, the Salmon Valley Stewardship, Upper

Salmon Basin Watershed Project, Nature Conservancy, Trout Unlimited, private landowners and many other groups necessary to accomplish habitat restoration goals. These different entities have created effective processes for working together, providing technical reviews of proposed projects and working with interested parties to accomplish conservation on the ground. They are all partners with NMFS in some capacity in recovering listed salmon and steelhead.

The plan proposes to implement salmon and steelhead recovery actions through an adaptive management strategy. This process will be used in conjunction with the ESA's 5-year status reviews and information from research, monitoring, and evaluation to further identify and prioritize actions to achieve desired improvements. [need more here]

10.3 Implementation Schedule and Responsibilities

The northeast Oregon, southeast Washington and Idaho management unit plans estimate that recovery of the Snake River spring/summer Chinook salmon and steelhead MPGs could take over 50 years. Given the large number of economic, biological and social uncertainties involved, NMFS and the management unit planners focus recovery actions to improve conditions in the first 10 years of implementation, with the provision that before the end of the first implementation period, specific actions and costs will be estimated for subsequent years. Over the longer term, the recovery plan relies on ongoing monitoring and periodic plan review regimes to add, eliminate, modify and prioritize actions through the adaptive management process as information becomes available, and until such time as the protection of the Endangered Species Act is no longer required.

Under the ESA, NMFS is required to review the status of listed species every 5 years, prepare biennial reports to Congress, and update key decision makers, such as elected officials and agency heads.

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