EXECUTIVE SUMMARY

Introduction

This is a recovery plan (Plan) for the protection and restoration of Middle Columbia River steelhead (*Oncorhynchus mykiss*), which spawn and rear in tributaries to the Columbia River in central and eastern Washington and Oregon (Figure ES-1). The Middle Columbia River steelhead distinct population segment (DPS) was listed as threatened under the Endangered Species Act of 1973 (ESA) on January 5, 2006 (71 FR 834).

Section 4(f) of the ESA requires NOAA's National Marine Fisheries Service (NMFS) to develop recovery plans for marine species listed under the Act. 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 need the protections of the ESA. Although recovery plans are guidance, not regulatory documents, the ESA clearly envisions recovery plans as the central organizing tool for guiding each species' recovery process. Recovery planning is an opportunity to search for common ground among affected parties, to organize protection and restoration of salmonid habitat, and to secure the economic and cultural benefits that accrue to human communities from healthy watersheds and rivers. While Federal, state, and tribal entities can make major contributions to the recovery of Middle Columbia steelhead, the actions of individuals on their land, as well as city and county codes and ordinances promoting conservation, are also essential.

Nineteen of the 33 salmon and steelhead species in the Northwest region are listed as threatened or endangered. The Middle Columbia steelhead is among those with the best prospects of recovery, although it will require considerable political will and investment of long-term effort and funding. Modeling of the potential effects of the actions that are proposed in this plan (see Chapter 9) predicts that the DPS can achieve a low risk of extinction within a reasonable time frame – e.g. 25 to 50 years – if the actions are taken and if they have the predicted effects on steelhead habitat and survival. Cautious though this statement may be, it is a beacon of hope in the complex realm of salmon and steelhead recovery in the Northwest. The following sections tell the story.

ESA Requirements

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

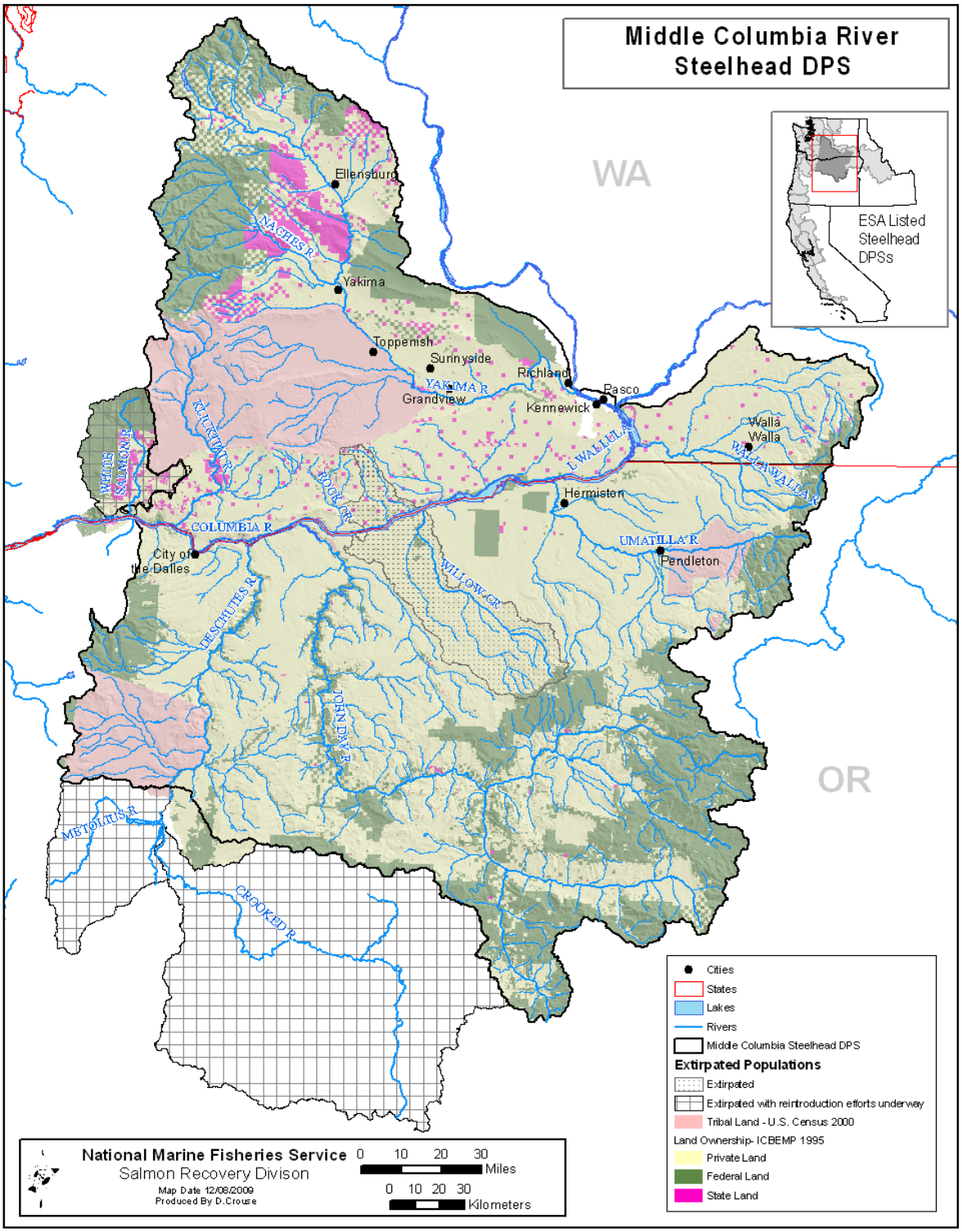


Figure ES-1. Geographic Boundaries of the Middle Columbia River Steelhead DPS, showing land ownership.

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

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, and;
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 these conclusions (NMFS 2006).

Once a species is deemed recovered and therefore removed from listed status, section 4(g) of the ESA requires the monitoring of the species for a period of not less than 5 years to ensure that it retains its recovered status.

Steelhead Distribution and Life History

The spawning range of the Middle Columbia River steelhead DPS extends over an area of approximately 35,000 square miles in the Columbia plateau of eastern Washington and eastern Oregon. The DPS includes all naturally spawned populations of steelhead in drainages upstream of the Wind River, Washington, and the Hood River, Oregon (exclusive), up to, and including, the Yakima River, Washington, excluding steelhead from the Snake River Basin (64 FR 14517; 71 FR 849). Major drainages in this DPS are the Deschutes, John Day, Umatilla, Walla Walla, Yakima, and Klickitat river systems. The Cascade Mountains form the western border of the plateau in both Oregon and Washington, while the Blue Mountains form the eastern edge. The southern border is marked by the divides that separate the upper Deschutes and John Day basins from the Oregon High Desert and drainages to the south. The Wenatchee Mountains and Palouse areas of eastern Washington border the Middle Columbia on the north.

Most of the region is privately owned (64 percent), with the remaining area under Federal (23 percent), tribal (10 percent) and state (3 percent) ownership (Figure ES-1). Most of the landscape consists of rangeland and timberland, with significant concentrations of dryland agriculture in parts of the range. Irrigated agriculture and urban development are generally concentrated in valley bottoms. Human populations in these regions are growing.

Steelhead produced in four artificial propagation programs are considered part of the DPS: the Touchet River Endemic Summer Steelhead Program, the Yakima River Kelt Reconditioning Program, and the Umatilla River and Deschutes River steelhead hatchery programs.

The species *Oncorhynchus mykiss* exhibits perhaps the most complex suite of life history traits of any species of Pacific salmonid. These fish can be anadromous (migratory) or freshwater residents (and under some circumstances, apparently yield offspring of the opposite form). Steelhead can spawn more than once (iteroparous), whereas all other *Oncorhynchus* except cutthroat trout (*O. clarki*) spawn once and then die (semelparous).

Within the range of West Coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity. The "runs" are usually named for the season in which the peak occurs. Most steelhead can be categorized as one of two run types, based on their sexual maturity when they re-enter freshwater and how far they go to spawn. In the Pacific Northwest, summer steelhead enter freshwater between May and October and require several months to mature before spawning; winter steelhead enter freshwater between November and April with well-developed gonads and spawn shortly thereafter. Summer steelhead usually spawn farther upstream than winter steelhead (Withler 1966; Roelofs 1983; Behnke 1992).

The Middle Columbia River steelhead DPS includes populations of inland winter steelhead in the Klickitat River, White Salmon River, Fifteenmile Creek, and possibly Rock Creek.

Relationship of Steelhead DPS to Resident *O. mykiss*

"Steelhead" is the name commonly applied to the anadromous (migratory) form of the biological species *Oncorhynchus mykiss*. The common names of the non-anadromous, or resident, form are rainbow trout and redband trout. When NMFS originally listed the Middle Columbia River steelhead as threatened on March 25, 1999 (64 FR 14517), it was classified as an "evolutionarily significant unit" (ESU) of salmonids that included both the anadromous and resident forms. Recently, NMFS revised its species determinations for West Coast steelhead under the ESA, delineating anadromous, steelhead-only "distinct population segments" (DPS). NMFS listed the Middle Columbia River steelhead DPS as threatened on January 5, 2006 (71 FR 834). Rainbow trout and redband trout are under the jurisdiction of the states unless they are listed, when they come under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS). This recovery plan addresses steelhead and not rainbow trout, as is consistent with the 2006 ESA listing decision.

Context of Plan Development

While NMFS is directly responsible for ESA recovery planning for salmon and steelhead, NMFS 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.

This Plan is the product of a collaborative process initiated by NMFS with assistance from the Middle Columbia Recovery Forum (Mid-C Forum), a group convened by NMFS to provide input on the development of the DPS recovery plan. NMFS developed this Plan by drawing upon the best available scientific information provided by the four regional recovery plans included as appendices to this Plan (i.e. the management unit plans, described below and in Section 1.6.), and by a regional team of scientists (the Interior Columbia Technical Recovery Team, described below). The Draft Plan went through repeated reviews and revisions in response to comments from both the scientific team and the Mid-C Forum. Participants in the Mid-C Forum include the Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), the Yakama Nation, Confederated Tribes of the Warm Springs Indian Reservation, Confederated Tribes of the Umatilla Indian Reservation, Washington Governor's Salmon Recovery Office, Oregon Governor's Natural Resources Office, Snake River Salmon Recovery

Board, Yakima Basin Fish and Wildlife Recovery Board, US Bureau of Reclamation (BOR), US Fish and Wildlife Service (USFWS), US Forest Service (USFS), US Army Corps of Engineers (COE), Klickitat County, and NMFS Northwest Region. The Draft Recovery Plan, including the four management unit plans and two scientific reports (McClure et al. 2003; ICTRT 2007) that provide the scientific basis for the Plan, was made available for public review as a Proposed Recovery Plan. NMFS revised the Proposed Plan in response to public comments, including comments from the ICTRT as peer reviewers. The responses to public comments are available on the NMFS website, at http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Mid-Columbia/Mid-Col-Plan.cfm.

Tribal Trust and Treaty Responsibilities

Northwest Indian Tribes have legally enforceable rights reserving to them a share of the salmon harvest. A complex history of treaties, executive orders, legislation, and court decisions have culminated in the recognition of tribes as co-managers who share management responsibilities and rights for fisheries in the Columbia Basin.

Ensuring a sufficient abundance of salmon and steelhead to sustain harvest is an important element in fulfilling trust responsibilities and treaty rights as well as garnering public support for recovery plans. ESA and tribal trust responsibilities complement one another. Both depend on a steady upward trend toward ESA recovery and delisting in the near term, while making aquatic habitat, harvest, and land management improvements for the long term.

Recovery Domains and Technical Recovery Teams

Currently, there are 19 ESA-listed ESUs/DPSs of Pacific salmon and steelhead in the Pacific Northwest. For the purpose of recovery planning for these species, NMFS Northwest Region designated five geographically based "recovery domains" (Figure ES-2). The range of the Middle Columbia River steelhead DPS is located in the Middle Columbia sub-domain of the Interior Columbia domain.

For each domain, NMFS appointed a team of scientists, nominated for their geographic and species expertise, to provide a solid scientific foundation for recovery plans. The charge of each Technical Recovery Team (TRT) was to define ESU/DPS structures, develop recommendations on biological viability criteria for each ESU or DPS and its component populations, provide scientific support to local and regional recovery planning efforts, and provide scientific evaluations of proposed recovery plans. The Interior Columbia TRT (ICTRT) includes biologists from NMFS, states, tribes, and academic institutions.

Viable Salmonid Populations

All the TRTs used the same biological principles for developing their recommendations for ESU/DPS and population viability criteria – criteria that may be used, along with criteria based on mitigation of the factors for decline, in determining whether a species has recovered sufficiently to be downlisted or delisted. These principles are described in a NMFS technical memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000).

Viable salmonid populations (VSP) are defined in terms of four parameters: abundance, productivity (growth rate), spatial structure, and diversity. A viable ESU/DPS is naturally self-sustaining, with a high probability of persistence over a 100-year time period. Each TRT made recommendations using the VSP framework, based on data availability, the unique biological characteristics of the ESUs/DPSs and habitats in the domain, and the members' collective

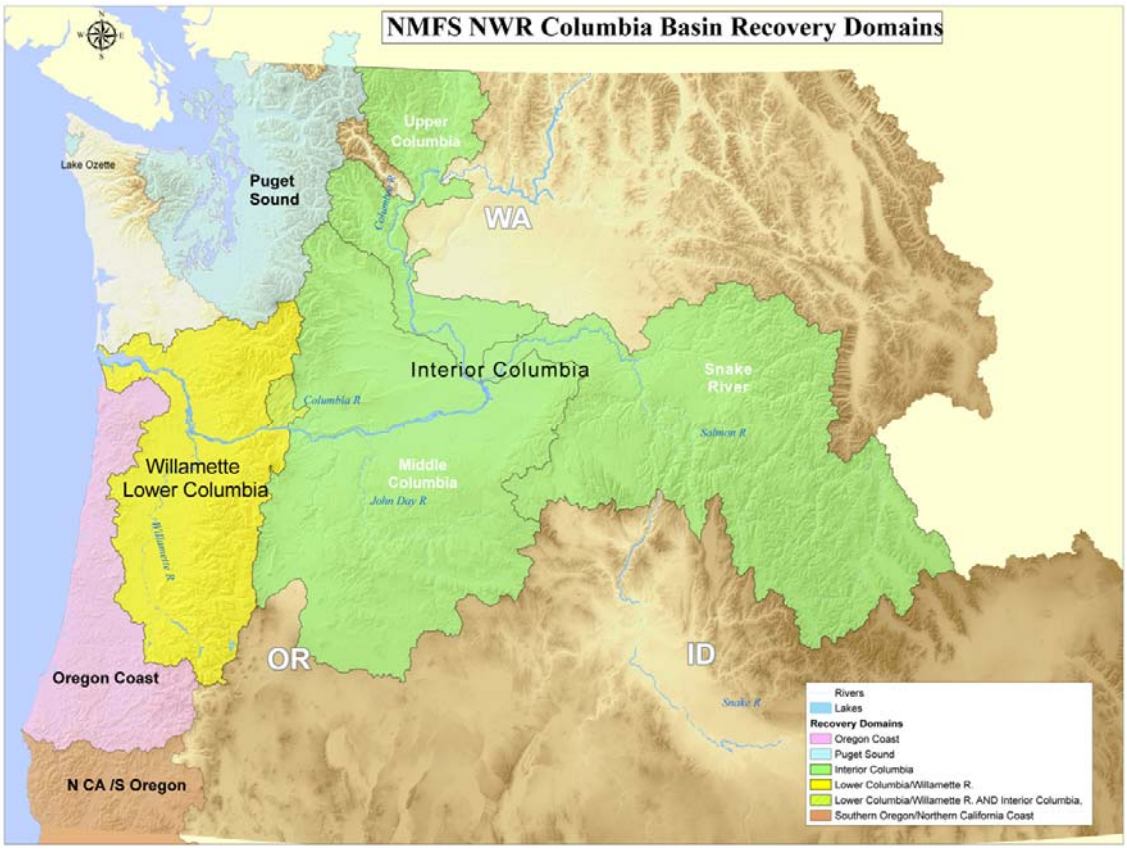


Figure ES-2. Columbia Basin Recovery Domains for NMFS Northwest Region.

experience and expertise. Although NMFS has encouraged the TRTs to develop regionally specific approaches for evaluating viability and identifying factors limiting recovery, all the TRTs are working from a common scientific foundation. Viability criteria are an important part of recovery goals, as described later in this summary.

Management Units

In each domain, NMFS worked with state, tribal, local, and other Federal entities to develop planning forums that build to the extent possible on ongoing, locally led recovery efforts. NMFS defined "management units" based on jurisdictional boundaries as well as areas where local planning efforts were underway (Figure ES-3). It can be seen from the figure that the management units do not necessarily correspond to biological units, such as steelhead populations, but are defined for planning and administrative purposes. The Middle Columbia management units are (1) Oregon; (2) Washington Gorge, which, in turn, is subdivided into three planning areas, White Salmon, Klickitat, and Rock Creek; (3) Yakima subbasin; and (4) Southeast Washington.

Management Unit Recovery Plans and the Modules

Although NMFS has prepared this plan for the entire DPS, the management unit plans (Appendices A-E) are the work of local groups and county, state, Federal, and tribal entities within the Middle Columbia River region on both sides of the river. The management unit plans built on existing recovery plans, in particular, the Northwest Power and Conservation Council's subbasin plans, and targeted the specific ESA recovery needs of Middle Columbia steelhead. In addition, to deal with system effects that transcend the individual subbasins, domains, and management units, NMFS prepared two recovery planning modules: the Hydro Module (Appendix F), which summarizes the 2008 Federal Columbia River Power System Biological Opinion, and the Estuary Module (Appendix G), prepared by NMFS in collaboration with the Lower Columbia River Estuary Partnership.

- **Oregon Management Unit:** ***Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead Distinct Population Segment (Oregon Steelhead Recovery Plan) (Appendix A)***

The Oregon Department of Fish and Wildlife (ODFW) is the lead for the Oregon Steelhead Recovery Plan. ODFW drew together three groups to help with the plan: the Middle Columbia Recovery Planning Team, made up of ODFW staff biologists and representatives from eight state natural resource agencies; a planning forum, the Middle Columbia Sounding Board, made up of representatives of local communities, agricultural water users, Federal and non-Federal land managers, governing bodies, tribes, and industry and environmental interests; and an Expert Panel of 12 biologists to examine limiting factors and threats for the 10 independent steelhead populations in Oregon.

- **Washington Gorge Management Unit:** ***Recovery Plans for the Klickitat River (Appendix B) and Rock Creek (Appendix C) subbasin populations of Middle Columbia River steelhead (the Klickitat Plan and the Rock Creek Plan)***

Since there is not presently a Washington State sponsored salmon recovery planning board for this area, NMFS staff drafted the Klickitat and Rock Creek plans in collaboration with the Yakama Nation, Washington Department of Fish and Wildlife, Klickitat County, the Washington State Governor's Salmon Recovery Office, other Federal agencies, state agencies, local governments, and the public. The White Salmon River subbasin, which historically supported a population of Middle Columbia River steelhead, is also part of this management unit, but the recovery plan for that population will be finalized as part of the Lower Columbia ESA Recovery Plan. Single populations of three listed ESUs of salmon (Lower Columbia River Chinook, Lower Columbia River Coho, and Columbia River Chum) spawn in the White Salmon River subbasin in addition to steelhead. The need for an ecosystem approach warrants addressing in one single plan all the listed salmonids that spawn in the White Salmon subbasin. However, the delisting criteria, actions, and costs for the White Salmon steelhead are included in this DPS plan in order to have all the information on the Middle Columbia steelhead DPS in one place.

- **Southeast Washington Management Unit:** ***Snake River Salmon Recovery Plan for Southeast Washington (Southeast Washington Plan) (Appendix D)***

The Snake River Salmon Recovery Board developed the recovery plan for the Southeast Washington management unit, which is called the Southeast Washington Plan here in order to differentiate it from the forthcoming recovery plan for the five species of listed salmon and steelhead in the Snake River region (which includes parts of Washington, Oregon, and Idaho). The Snake River Salmon Recovery Board consists of representatives of the Confederated Tribes of the Umatilla Indian Reservation; a county commissioner and citizen representative from Asotin, Columbia, Garfield, Walla Walla and Whitman counties; a land owner representative from Asotin, Columbia and Garfield counties; and the Walla Walla county irrigation district. The Board appointed a Regional Technical Team for technical and scientific assistance.

- **Yakima Management Unit:** ***Yakima Steelhead Recovery Plan (Appendix D)***

The Yakima Basin Fish and Wildlife Recovery Board (YBFWRB), which includes representatives from the Yakama Nation, Benton, Kittitas, and Yakima counties, and 18 of the 24 municipalities in the Yakima Basin, developed the Yakima Steelhead Recovery Plan (available at www.ybfwrb.org).

- **Hydro Module (Appendix F)**

The Hydro Module summarizes the general effects of Columbia River mainstem hydropower projects on all 13 ESA-listed salmonids in the Columbia basin, including the limiting factors and threats and expected actions (including site-specific management actions), or strategy options, to address those threats. This module supports recovery plans for the Snake River, Upper Columbia, Middle Columbia, Lower Columbia, and Upper Willamette River species. It is a synthesis of information that has undergone public processes for review, including, but not limited to, the Federal Columbia River Power System (FCRPS) 2008 Biological Opinion, Federal Energy Regulatory Commission (FERC) licensing proceedings, and Habitat Conservation Plans (HCPs). This module may be updated as additional information becomes available.

- **Estuary Module (Appendix G)**

The Estuary Module focuses on habitat in the lower Columbia River below Bonneville Dam and how that habitat affects the survival of ESA-listed chum, steelhead, Chinook, and coho from throughout the Columbia River basin. It identifies and prioritizes limiting factors and threats in the estuary, then identifies 23 broad actions whose implementation would reduce the threats and thus increase survival of salmon and steelhead during their time in the estuary. The module also estimates the cost of implementing each action over a 25-year period. A description of monitoring, research, and evaluation needs that are appropriate to the management actions is included as an appendix to the module.

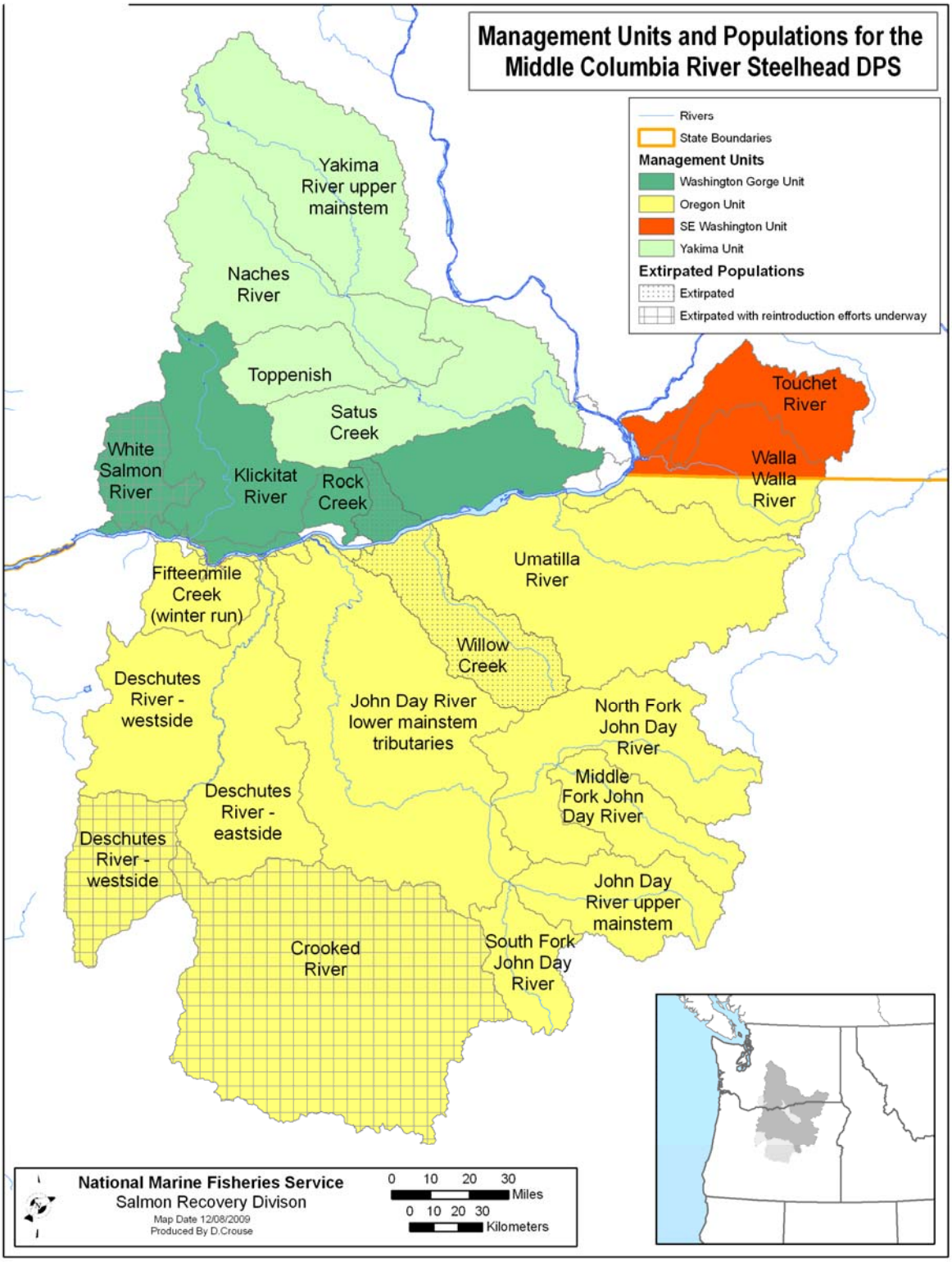


Figure ES-3. Management Units and Populations for the Middle Columbia River Steelhead DPS.

Important Concepts in Steelhead (and Salmon) Biology

Salmonid species' homing propensity (their tendency to return to the locations where they originated) creates unique patterns of genetic variation and connectivity that mirror the distribution of their spawning areas across the landscape. Diverse genetic, life history, and morphological characteristics have evolved over generations, creating runs highly adapted to diverse environments. It is this variation that gives the species as a whole the resilience to persist over time.

Historically, a salmon ESU or steelhead DPS typically contained multiple populations connected by some small degree of genetic exchange that resulted from some spawners "straying" into neighboring streams. Thus, the overall biological structure of the ESU/DPS is hierarchical; spawners in the same area of the same stream will share more characteristics than those in the next stream over. Fish whose natal streams are separated by hundreds of miles will have less genetic similarity.

Definition of Evolutionarily Significant Units/Distinct Population Segments

An ESU is defined as a group of Pacific salmon that is "substantially reproductively isolated from other conspecific units and represents an important component of the evolutionary legacy of the species" (Waples 1991). A "population segment" is considered distinct (a DPS and hence a "species" for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics; or if it occupies an unusual or unique ecological setting; or if its loss would represent a significant gap in the species' range (71 FR 834).

ESUs/DPSs may contain multiple populations that are connected by some degree of genetic exchange through straying, and hence may have a broad geographic range across watersheds and river basins.

Major Population Groups

Within an ESU/DPS, independent populations can be grouped into larger populations that share similar genetic, geographic, and/or habitat characteristics (McClure et al. 2003). These "major groupings" of populations (MPGs) are isolated from one another over a longer time scale than that defining the individual populations, but retain some degree of connectivity greater than that between ESUs/DPSs.

Independent Populations

McElhany et al. (2000) defined an independent population as follows:

> *"…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."*

Abundance and Productivity

Abundance refers to naturally produced spawners (adults on the spawning ground), measured over a time series, i.e. some number of years. 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:spawner ratios (returns per spawner or recruits per spawner) (or 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, typically subject to a high degree of annual variability and sampling-induced uncertainties.

Abundance and productivity are linked, as 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.

Spatial Structure and Diversity

Spatial structure and diversity considerations 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, p. 18). Diversity refers to the distribution of 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 (ibid., p. 19).

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. Population-level diversity is similarly important for long-term persistence. Populations exhibiting greater diversity are generally more resilient to short-term and long-term environmental changes.

Middle Columbia Steelhead Populations and Major Population Groups

The ICTRT (McClure et al. 2003) identified 20 historical populations of Middle Columbia steelhead, shown in Figure ES-4. This identification was based on genetic information, geography, life history traits, morphological traits, and population dynamics. Seventeen of these populations are extant, and three extirpated (White Salmon River, Deschutes Crooked River above Pelton Dam, and Willow Creek).

The ICTRT stratified the Middle Columbia River steelhead populations into MPGs based on ecoregion characteristics, life history types, and other geographic and genetic considerations. It identified four MPGs: Cascades Eastern Slope Tributaries, Yakima Basin, John Day Basin, and Umatilla/Walla Walla. The John Day River MPG is wholly within Oregon and the Yakima Basin MPG is wholly within Washington. The other two include populations on both sides of the Oregon/Washington boundary.

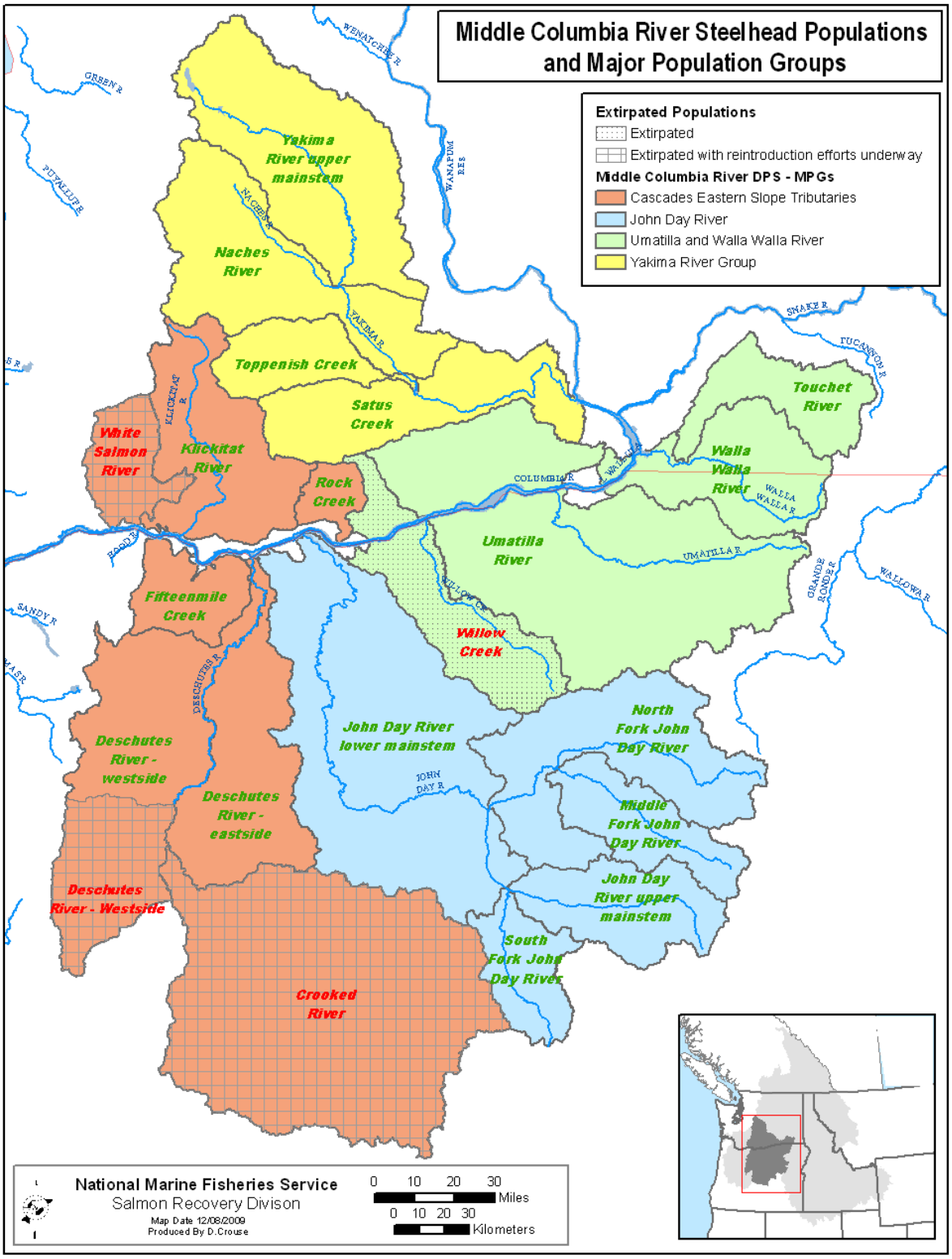


Figure ES-4. Middle Columbia River Steelhead Populations and Major Population Groups.

Recovery Goals and Delisting Criteria

The recovery goals that are incorporated into a locally developed recovery plan may include delisting and/or other "broad sense" goals that may go beyond the requirements for delisting to address, for example, other legislative mandates or social, economic, or ecological values. NMFS' delisting criteria may include both technical and policy considerations, and must meet the ESA requirements. A third term used in this recovery plan is recovery "scenarios" (Section 3.1.4). Recovery scenarios are combinations of viability status for individual populations within the DPS that will meet the ICTRT criteria for overall DPS viability.

Recovery criteria are of two kinds: the biological viability criteria, which deal with the VSP parameters at the population, MPG, and DPS levels, and the "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 these make up the "objective, measurable criteria" required under section 4(f)(1)(B) for the delisting decision.

The delisting criteria are based on the best available scientific information and incorporate the most current understanding of the DPS and the threats it faces. As this recovery plan is implemented, additional information will become available that can increase certainty about whether the threats have been abated, whether improvements in population and DPS status have occurred, and whether linkages between threats and changes in salmon status are understood. These criteria will be assessed through an adaptive management program under development for the Plan, and NMFS may review the criteria if appropriate during its 5-year reviews of the DPS.

Biological Viability Criteria

In 2007, the ICTRT completed its Technical Review Draft of *Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs* (ICTRT 2007a). Biological viability criteria describe DPS characteristics associated with a low risk of extinction for the foreseeable future. These criteria are expressed in terms of the VSP parameters of abundance, productivity, spatial structure, and diversity, according to guidelines developed by NOAA's Northwest Fisheries Science Center and published as a NOAA Technical Memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000; ICTRT 2007a). The ICTRT calculated varying levels of risk of extinction and related the risk levels to their criteria.

DPS Viability Criterion

Since MPGs are geographically and genetically cohesive groups of populations, they are critical components of ESU or DPS spatial structure and diversity. Having all MPGs within a DPS at low risk provides the greatest probability of persistence for the DPS.

DPS Viability Criterion (ICTRT 2007a)
All extant MPGs and any extirpated MPGs critical for proper functioning of the ESU/DPS[1] should be at low risk.

[1] The Middle Columbia steelhead DPS has four extant and no extirpated MPGs. The three extirpated populations are addressed as part of the MPG-level criteria.

MPG Viability Criteria

MPG viability depends on the number, spatial arrangement, and diversity associated with its component populations.

MPG-Level Viability Criteria
(ICTRT 2007a)

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 DPS criterion requiring viable populations in each of the extant MPGs would result in sustainable production across a substantial range of environmental conditions. The presence of viable populations across MPGs would preserve a high level of diversity within the DPS, thereby promoting long-term evolutionary potential for adaptation to changing conditions. The presence of multiple, relatively nearby, viable and maintained populations acts as protection against long-term impacts of localized catastrophic loss by serving as a source of re-colonization (ICTRT 2007a).

Population Viability Criteria

To be determined to be viable, populations should meet criteria for all four VSP parameters (abundance, productivity, spatial structure, and diversity). The abundance and productivity criteria are related to population size.

Population Size

The ICTRT developed criteria for characterizing the relative size and complexity of Interior Columbia Basin steelhead populations based on their analysis of the intrinsic or historical potential habitat available to the population (ICTRT 2005). Middle Columbia steelhead spawn in a wide range of tributary drainage areas, from small creeks, e.g. Fifteenmile Creek or Rock Creek, to very large rivers, such as the Lower John Day. The ICTRT categorized historical

population sizes as Basic, Intermediate, Large, and Very Large, and set minimum abundance thresholds for viable steelhead populations of each type. As explained in Section 2.4.1, abundance and productivity are linked, within limits; above a certain threshold, higher productivity can compensate for lower abundance and vice versa. Table ES-1 shows the minimum abundance and productivity thresholds for the Middle Columbia steelhead populations to have a 95 percent probability of persistence for the next 100 years.

Table ES-1. Middle Columbia Steelhead size categories (ICTRT 2007a).

Major Population Grouping	Population	Population Size	Abundance Threshold	Productivity Threshold
Cascades Eastern Slope Tributaries	White Salmon (functionally extirp.)	Basic	500	1.56
	Klickitat R.	Intermediate	1000	1.35
	Fifteenmile Cr.	Basic	500	1.56
	Deschutes R. East	Intermediate	1000	1.35
	Deschutes R. West	Large[2]	1500	1.26
	Rock Cr.	Basic	500	1.56
	Crooked River (Extirp.)	Very Large	2250	1.19
John Day River	Lower Mainstem JD	Very Large	2250	1.19
	North Fork John Day	Large	1500	1.26
	Middle Fork John Day	Intermediate	1000	1.35
	South Fork John Day	Basic	500	1.56
	Upper Mainstem JD	Intermediate	1000	1.35
Umatilla / Walla Walla Rivers	Umatilla R.	Large	1500	1.26
	Walla Walla R.	Intermediate	1000	1.35
	Touchet R.	Intermediate	1000	1.35
	Willow Crk. (Extirp.)	Intermediate	1000	1.35
Yakima River Group	Satus Cr.	Intermediate[3]	1000	1.35
	Toppenish Cr.	Basic	500	1.56
	Naches R.	Large	1500	1.26
	Upper Yakima	Large	1500	1.26

Abundance and productivity

The ICTRT defined abundance and productivity criteria for Middle Columbia steelhead populations (ICTRT 2005 and 2007) based on analyses of the intrinsic potential of the historically available habitat, the locations and sizes of major and minor spawning areas, and, within these areas, the abundance and productivity relationships that would result in a probability of low risk of extinction within 100 years (see Table ES-1 above). The abundance "thresholds" shown in the table 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.

[2] This population is treated as Intermediate in size with respect to abundance and productivity criteria because of constraints on currently accessible habitat (i.e. Pelton Dam).

[3] For the historical population analysis, the ICTRT included the mainstem Yakima habitat below the confluence of Satus Creek in the Satus Creek population, making it Intermediate in size. However, if the mainstem component is lumped instead with mainstem Yakima River habitat upstream of Satus, the Satus Creek population would drop to Basic size. The Yakima Steelhead Recovery Plan discusses this question in more detail.

Spatial structure and diversity

The spatial structure and diversity criteria are specific to each population, and are 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 2007a; McElhany et al. 2000).

Recovery Scenarios

The risk levels of the populations within the DPS collectively determine MPG viability and, in turn, the likely persistence of the DPS. The ICTRT recommended that all MPGs in a DPS should be viable; however, it may not be necessary for all of the populations to attain the lowest risk level. There may be more than one way for a DPS to meet the viability criteria.

The ICTRT, in a January 8, 2007 technical memorandum (ICTRT 2007a), offered a detailed discussion of possible recovery scenarios for each MPG. They cautioned against closing off the options for any population prematurely, however, because of the many uncertainties in predicting the biological response to recovery actions. The ICTRT concluded that "a low risk strategy will target more populations than the minimum for viability" (ICTRT 2007a).

The management unit plans include locally determined recovery goals as well as viability criteria for the individual steelhead populations and MPGs in each management unit. Most of the plans also provide targets or objectives to measure progress within specified time frames, e.g. 10 to 50 years.

Threats Criteria

At the time of a delisting decision for the Middle Columbia steelhead, NMFS will examine whether the section 4(a)(1) listing factors have been addressed. To assist in this examination, NMFS will use the listing factors (or threats) criteria described in Section 3.3 of this plan, in addition to evaluation of biological recovery criteria and other relevant data and policy considerations. It is possible that currently perceived threats will become insignificant in the future because of changes in the natural environment or changes in the way threats affect the entire life cycle of salmon. Consequently, NMFS expects that the relative priority of threats will change over time and that new threats may be identified. During the status reviews, NMFS will evaluate and review the listing factor criteria as they apply at that time. NMFS expects that if the proposed actions described in the Plan are implemented, they will make substantial progress toward meeting the listing factor (threats) criteria for the Middle Columbia steelhead.

Current Status Assessment

The status of a salmonid ESU or DPS is expressed in terms of likelihood of persistence over 100 years, or in terms of risk of extinction within 100 years. The ICTRT defines viability at two levels: less than 5 percent risk of extinction within 100 years (viable) and less than 1 percent risk of extinction within 100 years (highly viable). A third category, "maintained," represents a less than 25 percent risk. The risk level of the DPS is built up from the aggregate risk levels of the populations and MPGs. All four VSP parameters must be taken into account to determine the risk level.

Table ES-2 summarizes current status of the Middle Columbia steelhead populations, showing 10-year geometric mean abundance by population, estimated productivity, and the minimum abundance threshold needed for long-term viability. The table also includes the 10-year geometric mean proportion of hatchery spawners for the populations where data are available, and the risk ratings of high, moderate, low, and very low, for abundance and productivity combined, and spatial structure and diversity combined. Figure ES-5 is a matrix combining all four parameters to illustrate the overall current risk rating of each population.

Current Population Status

According to the ICTRT viability criteria, the majority of naturally spawning Middle Columbia steelhead populations are rated at moderate risk for all four VSP parameters – abundance, productivity, spatial structure, and diversity (Table ES-2 and Figure ES-5). This DPS includes one highly viable population (North Fork John Day), two viable (Fifteenmile Creek and Deschutes River Eastside), and three at high risk of extinction within 100 years (Deschutes Westside, Upper Yakima Mainstem, and Naches River).

MPG Status

The viability ratings of the component populations of each Middle Columbia steelhead MPG are shown in Figure ES-5. None of the MPGs as a whole reaches low risk status according to the ICTRT's MPG-level criteria.

DPS Status

The ICTRT's DPS-level viability criterion is that all extant MPGs and any extirpated MPGs critical for proper functioning of the DPS should be at low risk (ICTRT 2007). Thus, the Middle Columbia steelhead DPS does not currently meet viability criteria based on the determination that the four component MPGs are not at low risk.

Table ES-2. Middle Columbia River steelhead DPS populations: summary of abundance, productivity, risk ratings, and minimum abundance thresholds (Source: ICTRT 2007b and 2008). (Numbers subject to periodic updates as additional information becomes available.)

Population	*Abundance Threshold*[4]	*Size Category*	*Run Timing*	*10-year Geomean abundance*	*Abundance Range*	*10-yr Hatchery Fraction*[5]	*Produc-tivity*[6]	*Productivity Standard Error*	*A&P Risk*[7] *Rating*	*SS/DRisk Rating*
Cascades East Slope MPG										
Deschutes (Westside)	1000[8]	Large (Inter)	Summer	456	108-1283	0.26	1.05	0.15	H	M
Deschutes (Eastside)	1000	Intermed.	Summer	1599	299-8274	0.39	1.89	0.27	L	M
Klickitat River	1000	Intermed.	Wtr & Smr	Insufficient data					M	M
Fifteenmile Creek	500	Basic	Winter	703	231-1922	0	1.82	0.20	L	L
Rock Creek	500	Basic	Summer	Insufficient data					H	M
White Salmon	500	Basic		Functionally extirpated					N/A	N/A
Crooked River	2250	Very Large	Summer	Extirpated						
Yakima River MPG										
Upper Yakima River	1500	Large	Summer	85	34-283	0.02	1.12	0.22	H	H
Naches River	1500	Large	Summer	472	142-1454	0.06	1.12	0.22	H	M
Toppenish River	500	Basic	Summer	322	44-1252	0.06	1.60	0.30	M	M
Satus Creek (trib only)	1000	Intermed.	Summer	379	138-1000	0.06	1.73	0.14	M	M
John Day River MPG										
Lower Mainstem John Day	2250	Very Large	Summer	1800	563-6257	0.1	2.99	0.24	M	M
North Fork John Day	1500	Large	Summer	1740	369-10,235	0.08	2.41	0.22	VL	L
Upper Mainstem John Day	1000	Intermed.	Summer	524	185-5169	0.08	2.14	0.33	M	M
Middle Fork John Day	1000	Intermed.	Summer	756	195-3538	0.08	2.45	0.16	M	M
South Fork John Day	500	Basic	Summer	259	76-2729	0.08	2.06	0.27	M	M
Umatilla/Walla Walla MPG										
Umatilla River	1500	Large	Summer	1472	592-3542	0.36	1.50	0.15	M	M
Walla Walla Mainstem	1000	Intermed.	Summer	650	270-1746	0.02	1.34	0.12	M	M
Touchet River	1000	Intermed.	Summer	Insufficient data					H	M
Willow Creek	1000	Intermed.	Summer	Extirpated					N/A	N/A

[4] Abundance threshold for viability based on habitat intrinsic potential
[5] Average proportion of hatchery spawners over most recent 10 years in the data series.
[6] Geomean return per spawner calculated over most recent 20 years in data series.
[7] H = high risk, M= moderate risk, L = low risk, VL = very low risk
[8] The Deschutes Westside steelhead population is classified as Large in terms of spatial structure, but its abundance threshold may be considered 1000 or 1500 because of "currently accessible area" considerations. See ODFW 2009.

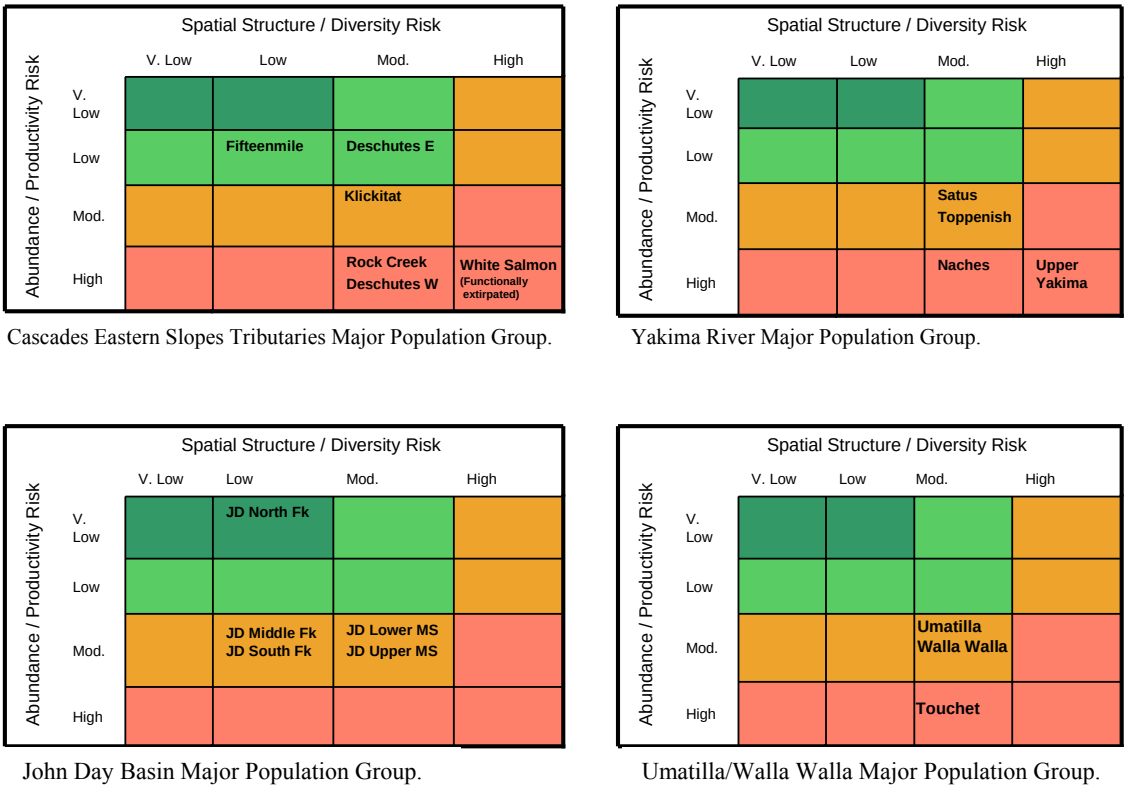


Figure ES-5. Viability Ratings for Middle Columbia Steelhead Populations by MPG (developed by NMFS based on ICTRT 2008).

Gap Analysis

The ICTRT assessed the difference between a listed species' or population's current status for abundance and productivity and the viability criteria. This difference is called the "gap." The gap, as used in this plan, is a measure, although it is inevitably imprecise, of the improvement in survival needed to meet viability criteria. As such, it is also an indicator of the level of effort needed to achieve recovery.

The ICTRT calculated the gap for each extant Middle Columbia steelhead population based on current abundance and productivity for the listed salmon and steelhead in the Interior Columbia Basin (ICTRT 2007b). They estimated the minimal survival rate changes needed for Middle Columbia steelhead populations to meet the abundance and productivity viability criteria for a 5 percent risk of extinction in a 100-year time frame.

In addition, the ICTRT (2007b) estimated gaps under three different early-ocean survival scenarios; historical ocean conditions (ocean conditions that fish experienced over the past 60 years), pessimistic ocean conditions (ocean conditions experienced by the 1975-1997 brood years), and recent ocean conditions (ocean conditions experienced by fish during the 20-year assessment period). The ICTRT also estimated gaps assuming three different hydropower scenarios. However, only the base hydro condition, which assumed that survival rates from the most recent 20 years would continue into the future, is reported here. (See NMFS 2008a for details on survival through the FCRPS under proposed improvements.)

A positive number, e.g. 21 percent gap for Cascades Eastern Slope MPG, means the populations's overall survival needs to increase 21 percent over current conditions to achieve viability criteria. A zero or negative number would mean there is no gap – the population currently meets viability criteria.

The analysis showed that none of the MPGs would be able to achieve a 5 percent or less risk of extinction over 100 years without recovery actions (Table ES-3). The Yakima Basin MPG shows the largest gap (77 percent) and also contains two historically large populations now at high risk of extinction, the Upper Yakima River and Naches River populations.

Table ES-3. Median survival gap for the major population groups of the Middle Columbia Steelhead DPS (assuming recent ocean and base hydrosystem conditions and 5 percent risk).

Cascades Eastern Slope MPG	21 percent
John Day MPG	9 percent
Umatilla/Walla Walla MPG Sufficient data for only two of the three populations: Umatilla Walla Walla	 9 percent 34 percent
Yakima MPG	77 percent

It is important to include measures to address spatial structure and diversity (SS/D) risks in recovery planning. As described in Section 4.3 of this Plan, the ICTRT analyzed a population's spatial structure and diversity in terms of two goals: maintaining natural rates and levels of spatially mediated processes, and maintaining natural patterns of variation. The team developed a scoring system to derive a composite spatial structure and diversity rating for each population (ICTRT 2008). Using this method, the ICTRT rated only the Fifteenmile Creek and North Fork John Day populations at low risk of extinction with regard to spatial structure and diversity. The Upper Yakima River is at high SS/D risk, and the 15 other populations are rated at moderate risk. The Middle Columbia River steelhead DPS cannot reach viable status without closing these gaps as well as those identified in terms of abundance and productivity.

Limiting Factors and Threats

The reasons for a species' decline are generally described in terms of limiting factors and threats. NMFS defines limiting factors as the biological and physical conditions that limit a species' viability – e.g., high water temperature – and defines threats as those human activities or natural processes that cause the limiting factors. For example, removing the vegetation along the banks of a stream can cause higher water temperatures, because the stream is no longer shaded. The threats contributing to the limiting factors and causes for a species' decline are often described in terms of the "four Hs" – habitat (usually relating to the effects of land use and tributary water use), hydropower, harvest, and hatcheries. While the term "threats" carries a negative connotation, it does not mean that activities identified as threats are inherently undesirable. They are typically legitimate and necessary human activities that may at times have unintended negative consequences on

fish populations—and that can also be managed in a manner that minimizes or eliminates the negative impacts.

Designing effective recovery strategies and actions requires understanding limiting factors and threats across the species' entire life cycle and across the four Hs. This plan describes limiting factors and threats for the Middle Columbia steelhead DPS as a whole at a general level, and notes the most salient specific conditions that affect individual populations and limit the viability of specific MPGs. More detail is available in the individual management unit plans (Appendices A through E).

Limiting Factors and Threats for the DPS

At a general level, based on information from the ICTRT and the four management unit plans, the major factors limiting the viability of Middle Columbia steelhead populations are *degraded tributary habitat*, *impaired fish passage in the mainstem Columbia River and tributaries, hatchery-related effects, and predation/competition/disease.* Two other factors, degradation of estuarine and nearshore marine habitat and harvest-related effects, pose some risk to steelhead viability for the entire DPS, but less than the other factors. Climate change represents a potentially significant threat to recovery of Middle Columbia steelhead populations (see ISAB 2007). In Section 6.3 of this Plan, the limiting factors and threats are described in more detail, addressing all the Hs and all life stages. Sources for this information include the management unit plans (Appendices A through E); the Biological Opinion for the Federal Columbia River Power System (FCRPS BiOp) (NMFS 2008a), particularly the BiOp's Supplemental Comprehensive Analysis and its appendices; the Hydro Module (NMFS 2008c) (Appendix F of this Plan), and the Estuary Module (NMFS 2007) (Appendix G of this Plan).

Degraded tributary habitat. Tributary habitat degradation from past and/or present land use remains a key concern for all of the populations. Today, nearly all historical habitat lies in areas modified by human settlement and activities. In many areas, the contemporary watershed conditions created by past and current land use practices are so different from those under which native fish species evolved that they now pose a significant impediment to achieving recovery. The management unit plans contain detailed descriptions of tributary habitat threats and limiting factors.

Impaired fish passage. Impaired fish passage is identified as a key or secondary limiting factor for all populations of Middle Columbia steelhead. Dams, culverts, seasonal pushup dams, and unscreened diversions can directly prevent migration; seasonal areas of high water temperature, low flow, or dewatering can also function as barriers. There are various kinds of dams and other barriers in tributaries throughout the basin, and all populations of Middle Columbia steelhead use the mainstem Columbia River to migrate to and from the ocean. All are affected by the mainstem Federal dams. Development and operation of the mainstem Columbia River hydropower system significantly alters travel conditions in the mainstem Columbia River, resulting in direct mortality of both upstream migrating adults and downstream migrating steelhead kelts, and direct and indirect mortality for downstream migrants (juveniles). The hydro system also changes the hydrograph, depleting historically available nutrients, changing water temperatures, and degrading rearing and food resources for both presmolts and smolts in the Columbia.

Changes in the hydrograph leave steelhead more vulnerable to bird and fish predation in the Columbia River estuary and mainstem. In addition, broad deltas have been created at the mouths of tributaries where fine sediment has been deposited. These conditions have resulted in increased non-native piscivorous and avian predation on juveniles. All these impacts increase somewhat for each population in direct relation to the number of dams that fish must pass during their migration to and from the Pacific Ocean. Middle Columbia River steelhead populations pass from one to four Federal dams. Survival is estimated at 90, 73, 54, and 48 percent, respectively, for juvenile steelhead passage through one to four dams (see Table 6-2). Adult steelhead survival is relatively high through the lower Columbia River dams and reservoirs – estimated at 98.5 to 95 percent for one to four dams (Table 6-3) – as a result of dam operations and effective fish ladders.

Hatchery effects. Hatchery fish that stray into Middle Columbia tributaries and spawn naturally may represent a serious threat to steelhead recovery. More than 100 hatchery programs operate in the Columbia Basin above Bonneville Dam, mostly for the purpose of providing fish for harvest to mitigate losses caused by the FCRPS. Some hatchery programs may provide conservation benefits; however, hatchery programs also pose threats to natural-origin steelhead in some Middle Columbia watersheds. Hatchery-induced genetic change can reduce the fitness of both hatchery and natural-origin fish in the wild, and hatchery-induced ecological effects (competition for food and space) can reduce population productivity and abundance. In particular, hatchery programs designed to return summer steelhead to upstream Columbia River tributaries result in substantial numbers of stray hatchery steelhead spawning naturally among several Middle Columbia populations. Concern exists regarding the continuing detrimental impact of these stray out-of-DPS hatchery fish in natural spawning areas on the genetic diversity and productivity of naturally produced Middle Columbia River steelhead populations.

Predation, competition, disease. Anthropogenic changes in the Columbia River have altered the relationships between salmonids and other fish, bird, and pinniped species, resulting in changed opportunities for predation by non-native piscivorous fish, avian species such as terns and cormorants, and California sea lions below Bonneville Dam. Hatchery releases of juvenile steelhead may result in competition with natural-origin steelhead for food and other resources. Steelhead can be infected by a variety of bacterial, viral, fungal, and microparasitic pathogens. Numerous diseases may result from pathogens that occur naturally in the wild or that may be transmitted to wild fish via infected hatchery fish. However, studies have shown that naturally spawned fish tend to be less susceptible to pathogens than hatchery-reared fish (Buchanon et al., 1983; Sanders et al., 1992). Habitat conditions such as low water flows and high temperatures can exacerbate susceptibility to infectious diseases. Fish weakened by disease are more sensitive to other environmental stresses, and may become more vulnerable to predation or less able to compete with other species.

Climate change. Climate change may adversely affect steelhead in freshwater habitats across the DPS by exacerbating existing problems with water quantity (lower summer stream flows) and water quality (higher summer water temperatures). These changes may affect steelhead more than other salmonids because of their long rearing period in

freshwater. More detailed information on specific effects that climate change may have on Mid-Columbia steelhead at all their life stages is available in Section 8.8 of the Oregon Steelhead Recovery Plan (ODFW 2009).

Limiting Factors and Threats for the MPGs

The MPG-level summaries of limiting factors are based on population-level summaries compiled from the relevant management unit plans.

Cascades Eastern Slope Tributaries MPG

The following are major limiting factors for the Cascades Eastern Slope Tributaries MPG (see also the Oregon Steelhead Recovery Plan [Appendix A] and the Klickitat Recovery Plan [Appendix B]):

Tributary habitat. Degraded tributary habitat is a limiting factor to a greater or lesser degree throughout the area, including degraded riparian areas, reduced recruitment of large woody debris (LWD), altered sediment routing, low or altered stream flows, degraded water quality (especially high water temperatures), impaired floodplain connectivity/function, altered channel structure/complexity, and impaired fish passage.

Mainstem passage. Mainstem Columbia River hydro system effects are least for the Fifteenmile Creek and Klickitat River populations, which pass only one mainstem dam. The Deschutes River populations pass two mainstem dams, and the Rock Creek population passes three. Effects, to varying degrees, include direct mortality of pre-smolts and smolts at the dams; delayed upstream migration of returning adults; and cumulative impact of hydropower system on mainstem and estuary habitat.

Hatchery related effects. Influence from hatchery fish could be a significant factor for this MPG because of out-of-subbasin hatchery fish straying onto natural spawning grounds in the Deschutes River and also because of potential effects of hatchery releases on naturally produced steelhead in the Klickitat River. The Oregon Mid-C Expert Panel considered out-of-subbasin (and out-of-DPS) hatchery strays a primary threat to genetic traits and productivity of naturally produced Deschutes river steelhead populations. Out-of-DPS hatchery strays comprised an estimated average of 29 percent of the Eastside population and 15.2 percent of the Westside population since 1990 (ICTRT 2008). This high fraction resulted in moderate risk ratings for spawner composition for both populations.

Blocked migration to historically accessible habitat. Historically, summer steelhead had free access to most of the Deschutes watershed. Currently the Pelton-Round Butte Hydroelectric Project (Project), constructed at river mile (RM) 100 on the mainstem Deschutes River, creates the primary barrier to anadromous fish attempting to reach spawning and rearing areas in the upper basin. Plans are underway to reinitiate fish passage facilities at the Pelton-Round Butte complex (details in Section 9.4.2 of the Oregon Steelhead Recovery Plan) and reintroduce steelhead to the upper basin, including the Crooked River.

Predation/competition/disease. Anthropogenic changes in the Columbia River have altered the relationships between salmonids and other fish, bird, and pinniped species. Predation, competition, and disease issues in mainstem and estuary affect all of the Middle Columbia steelhead populations (see Section 6.3.5 of this plan). In addition, the Oregon Steelhead Recovery Plan hypothesizes that the abundance of the Deschutes River Westside population may be limited by competition with a large resident population of rainbow trout.

John Day River MPG

The following are major limiting factors for the John Day River MPG (see also the Oregon Steelhead Recovery Plan [Appendix A]):

Mainstem passage. These populations must pass three dams; thus, limiting factors include direct mortality of pre-smolts and smolts at John Day, The Dalles, and Bonneville dams; delayed upstream migration of returning adults; false attraction of returning adults over McNary Dam; and cumulative impact of hydropower system on mainstem and estuary habitat.

Hatchery related effects. Hatchery fish straying into natural spawning areas pose risks to genetic traits and productivity of naturally produced steelhead. Concern over competition for resources with wild fish and potential hybridization with natural-origin fish resulted in termination of all hatchery stocking of *O. mykiss* in the John Day River basin in 1997. Most hatchery stray recoveries occur in the lower mainstem John Day River below the North Fork; however, strays have been observed in all populations.

Tributary habitat. For all five John Day populations, degraded floodplain and degraded channel structure, altered sediment routing, degraded water quality (temperature), and altered hydrology are limiting factors. For the Lower and Upper Mainstem and South Fork populations, passage obstructions in some of the smaller tributaries are also significant.

Predation/competition/disease. Predation, competition, and disease issues in mainstem and estuary affect all of the Middle Columbia steelhead populations.

Umatilla/Walla Walla MPG

The following are the major limiting factors for the Umatilla/Walla Walla MPG (see also the Oregon Steelhead Recovery Plan [Appendix A] and the Southeast Washington Plan [Appendix D]):

Mainstem passage. The Walla Walla and Touchet populations must pass four major dams; the Umatilla population must pass three. Thus, limiting factors include direct mortality of pre-smolts and smolts at John Day, The Dalles, and Bonneville dams; delayed upstream migration of returning adults; false attraction of returning adults over McNary Dam; and cumulative impact of hydropower system on mainstem and estuary habitat.

Tributary habitat. For all three populations, degradedwater quality (temperature), altered sediment routing, blocked and impaired fish passage, degraded floodplain and channel structure and hydrologic alterations are limiting factors.

Hatchery related effects. The hatchery program on the Umatilla River uses endemic (native) stock and is not currently considered a threat to wild steelhead; however, out-of-DPS strays pose a risk to spawner composition. Non-endemic hatchery fish are considered a potential threat to the Walla Walla wild steelhead population. Currently, data are insufficient to determine whether hatchery effects are a problem for the Touchet River population. An endemic stock program is under development for the Walla Walla and Touchet.

Predation/competition/disease. Predation, competition, and disease issues in mainstem and estuary affect all of the Middle Columbia steelhead populations.

Yakima Basin MPG

The following are primary limiting factors for the Yakima MPG (see also the Yakima Steelhead Recovery Plan [Appendix E]):

Mainstem passage. As the farthest upstream populations in the DPS, the Yakima populations must pass four dams and undergo higher exposure to altered habitat and avian and piscine predators in the mainstem Columbia. Limiting factors include direct mortality of pre-smolts and smolts at John Day, The Dalles, and Bonneville dams; delayed upstream migration of returning adults; false attraction of returning adults over McNary Dam; and cumulative impact of hydropower system on mainstem and estuary habitat.

Tributary habitat. Fish habitat in the Yakima subbasin is substantially influenced by the development of irrigation systems. Limiting factors include altered hydrology (low summer flow because of withdrawals in tributaries and the lower Yakima, scouring peak flows because of degraded watershed conditions, high summer delivery flows in mainstem Yakima and Naches rivers, reduced winter and spring flows due to irrigation storage, delivery, and withdrawals); degraded riparian area and LWD recruitment; blocked and impaired fish passage (primarily due to storage and diversion dams, as well as entrainment in unscreened diversions); altered sediment routing; degraded water quality; loss of historical habitat because of blocked or impaired fish passage; degraded floodplain connectivity and function (loss of off-channel habitat, side channels and connected hyporheic zone); degraded channel structure and complexity; reduced outmigrant survival in the mainstem Yakima.

Hatchery related effects. The Yakima populations have the lowest rates of hatchery strays in the DPS, and hatchery effects are not considered a significant limiting factor.

Predation/competition/disease. Of the Middle Columbia steelhead populations, the Yakima basin populations have the longest migration through the mainstem Columbia

River. They may therefore be more vulnerable to some factors such as avian and piscivorous fish predation. For example, Yakima steelhead, but not the others, are consumed by Caspian tern and double-crested cormorants nesting on islands at the mouth of the Snake River.

DPS Recovery Strategy

NMFS' overall goal for DPS viability, as formulated by the ICTRT and described in Chapter 3 of this plan, is to have all four extant MPGs at viable (low risk) status, with representation of all the major life history strategies present historically, and with the abundance, productivity, spatial structure and diversity attributes required for long-term persistence.

The ICTRT's current status assessment for the Middle Columbia steelhead DPS and the gaps analysis show that for this DPS, the outlook is optimistic. One population, North Fork John Day, is currently at very low risk or "highly viable." Two populations are currently viable (Deschutes Eastside, Fifteenmile); eleven are at moderate risk, with good prospects for improving. However, the three large populations at high risk (Deschutes Westside, Naches, and Upper Yakima), are important to DPS viability; as a minimum, Deschutes Westside and one of the two large Yakima populations should also reach viable status, with the other large Yakima population at least reaching "maintained" status. These present significant, though not insuperable, challenges.

If, as we believe, the decline of the Middle Columbia River steelhead DPS is caused by widespread habitat degradation, impaired mainstem and tributary passage, hatchery effects, and predation/ competition/ disease, then actions taken to improve, change, mitigate, reduce those factors will result in reduced risks and increased survival. Because of the steelhead's complex life cycle and the many changes that have taken place in its environment, the factors limiting its survival must be addressed in concert, and in an integrated way. The work needs to occur at a regional level, in terms of commitment to actions and funding, and at the local level, population by population and site by site. Significant investments of research, planning, regional coordination, actions, and political will are already underway. The intent for the DPS plan is to build upon, help to coordinate, and add to the ongoing efforts.

NMFS' 2006 listing decision called upon Federal, state, and tribal entities to do their best to manage land, hydropower, hatchery, and harvest activities in a manner that would support steelhead recovery. This plan reaffirms those recommendations and adds to them the contributions of updated science, basinwide programs, and consensus building among stakeholders.

The recovery strategy for the Middle Columbia steelhead DPS addresses both the basin-wide issues that affect all populations, such as conditions in the migratory corridor, and the subbasin and site-specific issues that are the focus of the management unit plans. The DPS Plan describes the overall strategy, summarizes the MPG-level strategies, and refers to Appendices A-G for more site-specific, population level actions.

The DPS-level recovery strategy for the Middle Columbia steelhead is made up of the following elements:

- Affirm and address the 2006 listing decision recommendations to address the limiting factors for the DPS and populations.
- Protect and restore tributary habitat and Columbia River mainstem habitat, through strategies and actions at both the Basin/programmatic level and at the local level as detailed in the management unit plans.
- Address impaired fish passage through strategies and actions in the mainstem Columbia River, as detailed in the 2008 FCRPS Biological Opinion (as summarized in the Hydro Module) and in the tributaries as detailed in the management unit plans
- Implement hatchery reforms at the population and site specific level through Hatchery and Genetic Management Plans (HGMPs) as required by the 2008 FCRPS Biological Opinion and as described in Appendix C of the Supplemental Comprehensive Analysis, (NMFS 2008a).
- Address ecosystem imbalances in predation, competition, and disease through the strategies and actions in the management unit plans, estuary module and FCRPS Biop.
- Maintain current low harvest levels, through fishery management planning for mainstem fisheries through the *U.S. v. Ore*gon 10-year agreement, updated Fisheries Management Evaluation Plans and Tribal Resource Management Plans for tributary fisheries, and Pacific Salmon Treaty and Pacific Fishery Management Council processes.
- Protect and restore the estuary and Columbia River plume as detailed in the Columbia River Estuary module.
- Respond to climate change threats with a strategy based on the principle of preserving biodiversity.
- Implement the Plan through effective coordination and governance.
- Research critical uncertainties, monitor and evaluate implementation and effectiveness and adjust course, as appropriate through adaptive management.

NMFS believes that if this strategy is implemented and the biological response is as expected, the Middle Columbia steelhead DPS is likely to achieve viable status within 25 to 50 years.

Degraded tributary and mainstem Columbia River habitat
Measures to improve tributary habitat are contained in the management unit plans and are summarized above by MPG. Relatively little information is available concerning Middle Columbia River steelhead use of mainstem Columbia River habitat above Bonneville, aside from passage through the dams. NMFS believes it is important to assess nearshore habitat and cold water refugia in the mainstem and to explore opportunities for, and potential benefits from, restoration and protection of these areas.

Impaired fish passage in the mainstem Columbia River
Passage for juvenile steelhead migrating to the ocean and adult steelhead returning to their natal streams is limited primarily by the four Federal dams on the Lower Columbia River mainstem – Bonneville, John Day, The Dalles, and McNary dams – which are part of the Federal Columbia River Power System (FCRPS). NMFS recently issued a new biological opinion on the effects of FCRPS operations on salmonids, including Middle Columbia River steelhead, and on the predicted results of current and planned improvements to the system that are intended to improve fish survival (NMFS 2008a). These improvements are expected to increase the in-river survival of Middle Columbia River juvenile steelhead by 0.3 percent, 5.1 percent, 8.2 percent, and 10.2 percent, depending on the number of dams they must pass. The survival of steelhead adults through the four dams is thought to be relatively high at the present time (about 98.5 percent per project from Bonneville to McNary), and is expected to be maintained or improved.

The plan for current mainstem hydro operations, as summarized in the Hydro Module (NMFS 2008c), and any further improvements for fish survival that may result from the ongoing FCRPS collaborative process, represent the hydropower recovery strategy for all listed salmonids that migrate through the mainstem Columbia River, including the Middle Columbia steelhead populations.

The Reasonable and Prudent Alternative (RPA) for the FCRPS takes a comprehensive approach to ESA protection that includes hydro, habitat, hatchery, harvest and predation measures to address the biological needs of salmon and steelhead in every life stage. The RPA is the product of the collaboration between NMFS and the action agencies ordered by the court. It is based on a comprehensive analysis of the salmon life cycle conducted down to the level of the populations that make up the listed species. Section 8.8 and the "Reasonable and Prudent Alternative Table" in the 2008 FCRPS Biological Opinion describe actions that should positively affect Middle Columbia River steelhead.

The current plan for operation of the FCRPS through 2018 (NMFS 2008a) contains the following actions intended to address the needs for survival and recovery of ESA-listed salmon and steelhead:

- Continue adult fish passage operations that have resulted in improved survival.
- Improve juvenile fish passage: install removable spillway weirs or similar surface bypass devices at John Day and McNary dams, an extended tailrace spill wall at The Dalles Dam, and various modifications at Bonneville Dam. Passage for steelhead smolts at each of the four Lower Columbia River mainstem projects must reach 96 percent survival.
- Continue and enhance spill for juvenile fish passage.
- Continue reservoir operations and river flows to benefit spring migrating juveniles.
- Develop dry water year operations to better protect migrating juveniles.
- Develop and implement a kelt management plan.

Dissenting View of State of Oregon Regarding Mainstem Operations

At the time the proposed recovery plan was finalized, August 2008, it was the position of the State of Oregon that additional or alternative actions should be taken in mainstem operations of the FCRPS for ESA-listed salmon and steelhead. Some additional or alternative actions recommended by Oregon, while considered, were not included in NOAA's FCRPS Biological Opinion. At this time, Oregon is a plaintiff in litigation against various federal agencies, including NOAA, challenging the adequacy of the measures contained in the current FCRPS Biological Opinion. NOAA is not in agreement with Oregon regarding the need for or efficacy of Oregon's additional or alternative actions. The actions sought by Oregon include:

- Draft storage reservoirs to help meet weekly and seasonal flow and velocity equivalent objectives for the lower Columbia and Snake rivers.
- Operate reservoirs at rule curves and seek additional flow augmentation volumes from Snake River and Canadian reservoirs for spring and summer flow and velocity objectives.
- Operate John Day reservoir at minimum operating pool (MOP) during spring and summer as long as barge transport and irrigation needs are met.
- Provide spill to total dissolved gas limits of water quality waivers or biological constraints at all dams, except maximize transportation at Snake River collector projects during lowest (10th percentile) flow years.
- Maintain approximately 50/50 in-river and transportation proportions for spring and summer migrants in the Snake River by optimizing spill and surface-oriented routes of dam passage and transporting fish collected in the turbine screen bypass systems. Continue to provide spill and bypass all fish at McNary Dam at all flows during the spring migration period.
- Test removable spillway weirs and temporary spillway weirs to ensure they provide equal or better benefits of full spill before reducing spill.
- Establish more rigorous research, monitoring and evaluation to assure that fish survival is increasing and to inform adaptive management.
- Identify and prepare contingency actions for implementation if necessary to meet fish performance standards linked to the survival and recovery requirements of listed fish.

Impaired fish passage in the tributaries

Actions to address fish passage in tributaries include:

- Implement locally developed management unit plans to improve fish passage in tributaries.
- Implement recovery plan recommendations regarding improved passage and flow management by the U.S. Bureau of Reclamation below all its facilities in the Yakima River and the Umatilla River subbasins, provision of fish passage into significant tributaries, and provision of passage over at least two of its storage dams in the Yakima Basin.[9]
- Implement recovery plan recommendations regarding improvement of fish passage, screening, and flow management in the Walla Walla River subbasin by

[9] The conservation measures in NOAA's 2006 listing decision specifically identify the need for passage at two or more of the storage dams in the Yakima Basin. The Yakima Steelhead Recovery Plan strongly recommends the provision of passage at the storage dams, but notes that the geographic distribution criteria detailed in the plan do provide for combinations of spawning areas that would meet de-listing and short-term recovery thresholds without provision of access above the storage dams (See Appendix E, Section 4.3.7).

the U.S. Army Corps of Engineers, and alteration of the flood operating rule for Mill Creek, or alternatively screening the diversion into Bennington Lake.
- Provide passage into the upper Deschutes River above Round Butte/Pelton complex and into the White Salmon River above Condit Dam.

Hatchery Reform
The hatchery programs in the Middle Columbia are managed under the Mitchell Act and the *U.S. v. Oregon* process, involving the fisheries co-managers and regulated by NMFS. NMFS is working with the funding agencies and hatchery operators to update and complete Hatchery and Genetic Management Plans (HGMPs) for every hatchery program in the Middle Columbia region as a means of organizing hatchery review and reform. The HGMPs are the basis for NMFS' biological opinions on hatchery programs under ESA sections 7 and 10 and the 4(d) rule, which relate to incidental and direct take of listed species. The HGMPs describe each hatchery's operations and the actions taken to support recovery and minimize ecological or genetic impacts, such as straying and other forms of competition with naturally produced fish.

Evaluating the factors that influence interactions between hatchery fish and naturally produced fish under varying freshwater conditions and ocean conditions is an important area of future research as well as ESA consultations and NEPA review. This is dealt with in more detail in Appendix C of the 2008 FCRPS Biological Opinion (NMFS 2008a) and in the final report of the HSRG.

The management unit plans propose various actions to reduce deleterious effects of hatcheries on natural production. For example, The Oregon Steelhead Recovery Plan proposes increased marking of Columbia Basin hatchery steelhead with coded-wire tags, and requiring mass marking of all hatchery steelhead releases with, at a minimum, an adipose fin-clip. Regional consensus has not been reached on these strategies, and the Mid-Columbia Forum will continue to pursue agreement on appropriate site-specific strategies. The Klickitat subbasin plan recommends a targeted monitoring program to determine abundance and productivity of natural spawners, determine the proportion of hatchery and wild spawners in the Klickitat subbasin, and determine the adverse effects of Skamania broodstock on the Klickitat population, if any. Further details are available in each management unit plan.

Predation, Competition and Disease
Predation, competition and disease are grouped together as a category of concern because ultimately these factors relate to balance and imbalance in the ecosystem. Improving habitat for salmonids throughout the life cycle is the best strategy for addressing these potential limiting factors (ISAB 2007). Specific measures can also be taken; these are summarized in Section 7.1.5.

The Plan addresses major avian, marine mammal and piscivorous fish predation issues in the mainstem Columbia River and tributaries and recommends immediate actions as well as research and monitoring to track trends in predator populations, understand their impacts on steelhead, and develop appropriate management techniques to reduce

predation. Competition of hatchery fish with naturally produced fish, for food, spawning areas, or other habitat resources, can be an issue at any life stage. The Plan recommends actions, research and monitoring in areas where competition may be a problem, particularly in the Klickitat, John Day, and Deschutes populations. Disease in salmonids is caused by multiple factors and probably 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 that improve spawning, rearing, and passage conditions for steelhead and increase the survival, abundance, and productivity of naturally produced fish will result in decreasing incidence of disease.

Harvest
Although in general harvest is not considered a major threat for the Middle Columbia steelhead DPS, it is important to ensure that impacts from fisheries do not impede recovery, and to perform monitoring and evaluation to verify impacts and reduce existing uncertainties.

Columbia River Estuary and Plume
Because juvenile steelhead spend less residence time in the shallow parts of the estuary than other salmonids, the characteristics of the Columbia River plume and the deeper channels of the estuary are more important to their survival. NMFS' Estuary Module (NMFS 2007) identifies 23 types of management actions that would improve conditions in estuary and plume for all salmonids.

Climate Change
A strategy for addressing the effects of climate change on Middle Columbia River steelhead needs to be based, broadly, on the principle of preserving biodiversity. Diversity in terms of both location and biological characteristics gives any species resilience in the face of environmental change. This principle underlies the viability criteria presented in Chapter 3 of this plan, as well as the strategies described in this chapter to address the factors limiting steelhead viability, as these are currently understood. NMFS supports the ISAB's recommendations for mitigating the effects of climate change (ISAB 2007), most of which are encompassed in Chapter 7 of this Plan.

The ISAB notes that "As climate and streams warm, tributary habitats will become increasingly important because they usually provide the cool waters for salmonids and other cool-water species in a watershed" (ISAB 2007). It follows that water temperature and stream flow are factors that will remain important throughout steelhead freshwater habitat. All strategies and actions that help to lower water temperature or prevent further increase will help to mitigate climate change. Protecting and/or restoring riparian areas to increase shade, as recommended in Chapter 7 and the management unit plans, is an important strategy for minimizing water temperature increases. Additional actions include purchasing water rights to leave more water in streams and restoration actions to improve channel complexity and establish side-channel rearing (FCRPS BiOp, NMFS 2008a).

Recovery Strategies for the Four Major Population Groups

These summaries of recovery strategies for the four major population groups are drawn from the management unit plans and the ICTRT's status assessment (ICTRT 2008).

Cascades Eastern Slope Tributaries MPG

Population	Current Risk Status
Fifteenmile Creek (Oregon)	Viable
Deschutes Eastside (Oregon)	Viable
Klickitat (Washington)	(provisional) Moderate risk – insufficient data, hatchery influence
Rock Creek (Washington)	(provisional) High risk – insufficient data
Deschutes Westside (Oregon)	High risk
White Salmon (Washington)	Functionally extirpated
Crooked River (Oregon)	Extirpated

Primary limiting factors and threats (Section 6.4.1):

- Degraded tributary habitat
- Mainstem passage
- Hatchery related effects
- Blocked migration to historically accessible habitat
- Predation, competition, disease – in mainstem and estuary; possibly also in Deschutes Westside as competition with resident rainbow trout.

Recovery Scenario: For the Cascades Eastern Slope Tributaries MPG to be considered viable based on the currently extant populations, the Klickitat, Fifteenmile, and both the Deschutes Eastside and Westside populations should reach viable status, with one highly viable. The Rock Creek population should reach "maintained" status (25 percent or less risk level). MPG viability could be further bolstered if reintroduction of steelhead into the Crooked River succeeds and if the White Salmon population is successfully reintroduced to its historical habitat.

Gap: The median survival gap (assuming recent ocean and base hydrosystem conditions and 5 percent risk) for the Cascades Eastern Slope MPG is 0.21 (meaning that a 21 percent increase in average life-cycle survival is required to achieve 5 percent risk in a 100-year time period). The gap ranges from –0.34 (Deschutes Eastside) (no gap) to 0.78 (Deschutes Westside) (needs 78 percent improvement). There was not enough information to estimate gaps for the Klickitat or Rock Creek populations.

Key actions proposed (Section 7.2.1):

- Protect, improve, and increase freshwater habitat for steelhead production. Improvements to freshwater habitat should be targeted to address specific limiting factors in specific areas as described in the Oregon Steelhead Recovery Plan and the Washington Gorge plans.

- Reduce straying of out-of-DPS hatchery fish onto natural spawning grounds within the Deschutes subbasin.
- Restore historical passage to the upper Deschutes subbasin including the Westside tributaries and Crooked River above Pelton Round Butte dam complex and the White Salmon River above Condit Dam.
- Improve survival in mainstem and estuary through actions detailed in NMFS Estuary Module (NMFS 2007 and Appendix G of this Plan) and FCRPS Biological Opinion (NMFS 2008a) (as summarized in the Hydro Module (NMFS 2008c and Appendix F of this Plan).
- Improve hatchery management to minimize impacts from hatchery releases on naturally produced steelhead within the Deschutes West and East and Klickitat subbasins.
- Fill data gaps for better assessment of Klickitat and Rock Creek steelhead populations.
- Coordinate between scientists, planners, and implementers of recovery actions on both sides of the Columbia River for sequencing of recovery actions and monitoring for adaptive management.

John Day River MPG

Population	**Current Risk Status**
North Fork John Day	Highly viable
Upper Mainstem John Day	Moderate risk
Lower Mainstem John Day	Moderate risk
Middle Fork John Day	Moderate risk
South Fork John Day	Moderate risk

Main limiting factors and threats (Section 6.4.2):

- Degraded tributary habitat
- Mainstem passage
- Hatchery related effects
- Predation/competition/disease in mainstem and estuary

Recovery Scenario: For the John Day River MPG to reach viable status, the Lower Mainstem John Day River, North Fork John Day River, and either the Middle Fork John Day River or Upper Mainstem John Day River populations should achieve viable status, with one highly viable.

Gap: The median survival gap for the John Day MPG is 0.09, ranging from –0.49 (North Fork) (no gap) to 0.34 (South Fork) (needs 34 percent improvement in average survival over the life cycle).

Key Actions proposed (7.3.2):

- Protect and improve freshwater habitat conditions and connectivity for steelhead production. Improvements to freshwater habitat should be targeted to address specific factors in specific areas as described in the Oregon Steelhead Recovery Plan.

- Improve hatchery management to reduce straying from out-of-DPS hatchery fish onto natural spawning grounds within the John Day subbasin.
- Improve survival in mainstem and estuary through actions detailed in NMFS Estuary Module (NMFS 2007 and Appendix G of this Plan) and FCRPS Biological Opinion (NMFS 2008a)

Umatilla/Walla Walla MPG

Population	Current Risk Status
Umatilla River	Moderate Risk
Walla Walla River	Moderate Risk
Touchet River	High Risk (provisional because of insufficient data)

Main limiting factors and threats (Section 6.4.3):

- Mainstem passage (Touchet and Walla Walla populations pass four major dams: the Umatilla population must pass three.)
- Tributary habitat
- Hatchery related effects
- Predation/competition/disease

Recovery Scenario: For the Umatilla/Walla Walla MPG to be viable, two populations should meet viability criteria, and one should be highly viable. The Umatilla River population is the only large population, and therefore should be viable. Either the Walla Walla River or Touchet River population also should be viable.

Gap: There was sufficient information available to estimate gaps for only two of the three populations within the Umatilla/Walla Walla MPG. Assuming base hydrosystem and recent ocean conditions, the survival gaps for the Umatilla and Walla Walla populations are 0.09 and 0.34, respectively.

Key actions proposed (Section 7.2.3):

- Coordinate between planners, scientists and those implementing recovery actions in Washington and Oregon for sequencing, monitoring, and adaptive management.
- Protect and improve freshwater habitat conditions and access for steelhead production. Improvements to freshwater habitat should be targeted to address specific factors in specific areas as described in the Southeast Washington Plan and the Oregon Steelhead Recovery Plan.
- Improve hatchery management to reduce straying by out-of-DPS hatchery fish onto natural spawning grounds within the Umatilla/Walla Walla subbasins.
- Improve survival in mainstem and estuary through actions detailed in NMFS Estuary Module (NMFS 2007 and Appendix G of this Plan) and FCRPS Biological Opinion (NMFS 2008a) (as summarized in the Hydro Module, NMFS 2008 and Appendix F of this Plan).

Yakima River MPG

Population	Current Risk Status
Upper Yakima River	High Risk
Naches River	High Risk
Satus Creek	Moderate Risk
Toppenish Creek	Moderate Risk

Main limiting factors and threats (Section 6.4.4):

- Tributary habitat: Influence of major irrigation system development. Altered hydrology; degraded habitat; loss of habitat; impaired fish passage; reduced outmigrant survival in Yakima mainstem.
- Mainstem passage (four dams).

Status: The Yakima MPG is currently rated at High Risk. The two largest populations in the drainage (Naches and Upper Yakima) are rated at High Risk; the Satus Creek and Toppenish Creek populations are rated as Maintained.

Recovery Scenario: For the Yakima River MPG to achieve viable status, two populations should be rated as viable, including at least one of the two classified as Large – either the Naches River or the Upper Yakima River. The remaining two populations should, at a minimum, meet the Maintained criteria.

Gap: The median survival gap (assuming recent ocean and base hydrosystem conditions) for the Yakima MPG is 0.77 (needs 77 percent improvement in average survival over the life cycle), ranging from 0.22 (Satus—tributary only) to 1.15 (Upper Yakima). This is the highest median survival gap of the four MPGs in the Middle Columbia steelhead DPS.

Key actions proposed (Section 7.2.4):

- Protect and enhance habitat in key tributary watersheds in the Yakima Basin.
- Restore passage to blocked areas in the Naches and Upper Yakima population areas.
- Alter irrigation delivery and storage operations in the Yakima Basin to improve flow conditions for Middle Columbia steelhead and use managed high flows to maintain floodplain habitat.
- Improve channel and floodplain function and reduce predation through the mainstem Yakima and Naches Rivers.
    - Improve survival in the mainstem Columbia and its estuary through actions detailed in NMFS Estuary Module (NMFS 2007 and Appendix G of this Plan) and FCRPS Biological Opinion (NMFS 2008a) (as summarized in the Hydro Module, NMFS 2008 and Appendix F of this Plan).

Time Required and Cost Estimates

Estimating time and cost for salmon and steelhead recovery, given the complex relationship of these fish to the environment and to human activities on land, poses unique challenges. NMFS estimates that recovery of the Middle Columbia steelhead DPS

could take 25 to 50 years. The management unit plans (Appendices A through E) contain extensive lists of actions to recover the Middle Columbia steelhead DPS populations. These projects were developed using the most up-to-date assessment of Middle Columbia steelhead recovery needs. The management unit plans focus, for the most part, on actions ranging from 5 to 15 years. There are many uncertainties involved in predicting the course of recovery and in estimating total costs. Such uncertainties include biological and ecosystem responses to recovery actions as well as long-term and future funding.

Cost Estimates

Cost estimates for recovery projects were provided by the management unit entities where available information was sufficient to do so, using the methods described in each management unit plan. No cost estimates are provided for (1) baseline actions (programs that are already in existence), which are listed as Not Applicable (N/A); or (2) actions for which costs, unit costs, or project-scale estimates are yet to be developed. These are listed as To Be Determined. Cost figures will be updated as improved information becomes available.

The total estimated cost of restoring habitat for the Middle Columbia steelhead DPS is approximately $235 million over the initial 5-year period, and approximately $996 million over 20 to 50 years for all DPS-wide recovery actions for which sufficient information exists upon which to base an estimate (Table ES-4). However, they do not include costs associated with implementing actions within the lower Columbia River, estuary or Federal Columbia River Power System (FCRPS).

This estimate includes expenditures by local, tribal, state, and Federal governments, private business, and individuals, in implementing both capital projects and non-capital work. Administrative costs are embedded in the total management unit cost estimates in Table ES-4. Preliminary research, monitoring and evaluation costs have, in some cases, been estimated at the management unit level; however, these costs are not included at this time pending completion of research and monitoring plans and further development of each project.

Table ES-4 Summary of Cost Estimates for Habitat Projects for Middle Columbia Steelhead DPS.

Recovery Plan	First 5 Years ($M)	Project/Program Total ($M)
Oregon	$ 103.5	$ 512.8
Yakima Steelhead[10]	$ 91.9	$ 269.3
SE Washington[11]	$ 25.5	$ 76.4
Klickitat[12],[13]	$ 12.9	$ 129.4
Rock Creek[14]	$ 0.9	$ 1.8
White Salmon Steelhead	N/A	$ 6.5
DPS Totals	**$ 234.7**	**$ 996.2**

These cost estimates do not include expenses associated with implementing actions within the lower Columbia River, estuary, or Federal Columbia River Power System (FCRPS), first, because of the basin-wide scope and applicability of these actions to all 13 Columbia Basin salmonid species listed as threatened or endangered, and second, because they are considered "baseline actions" that are required through other processes such as section 7 consultations, FERC licensing agreements, and Habitat Conservation Plans. Cost estimates for estuary actions are included in a module that is incorporated into the Plan as Appendix G, and is available on the NMFS website: www.nwr.noaa.gov/Salmon Recovery Planning/ESA Recovery Plans/Other Documents.cfm. The estuary recovery costs could be further refined following public comment on the module and on the ESA recovery plan for the three listed lower Columbia River ESUs and one listed lower Columbia River steelhead DPS in 2009. Costs for hatchery actions required through other processes such as consultations, permits, and 4(d) Rule implementation are not part of recovery costs reported here because the programs are already in existence or are undergoing required modifications. 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. In the event that 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.

[10] The Yakima steelhead plan estimates costs for the first 6 years, and includes preliminary RME cost estimate of $300K/year. The 5-year estimate is extrapolated from the 6-year cost data .
[11] The SE Washington plan estimates annual steelhead implementation costs at about $5 million per year. The 5-year estimate is extrapolated by multiplying the annual amount by five.
[12] The Klickitat plan estimates costs for the first 10 years. Five-year estimate extrapolated by dividing the 10-year amount in half.
[13] The Klickitat plan uses a 50-year period to estimate its total project costs.
[14] The Rock Creek plan estimates cost for first 3 years and 10 years. The 5-year estimate is extrapolated from the 3-year value.

Cost estimates from the draft cost chapters in the individual management plans were developed as consistently as possible, in that they all applied guidance provided by NMFS. However, the approaches vary to some degree given the local and independent nature of the planning groups. Costs developed in the management unit plans were estimated using several basic assumptions (i.e., neither baseline costs nor out-of-basin costs were included in the estimates) and used similar cost calculation methodologies. There are, however, differences in the timeframes for cost estimates.

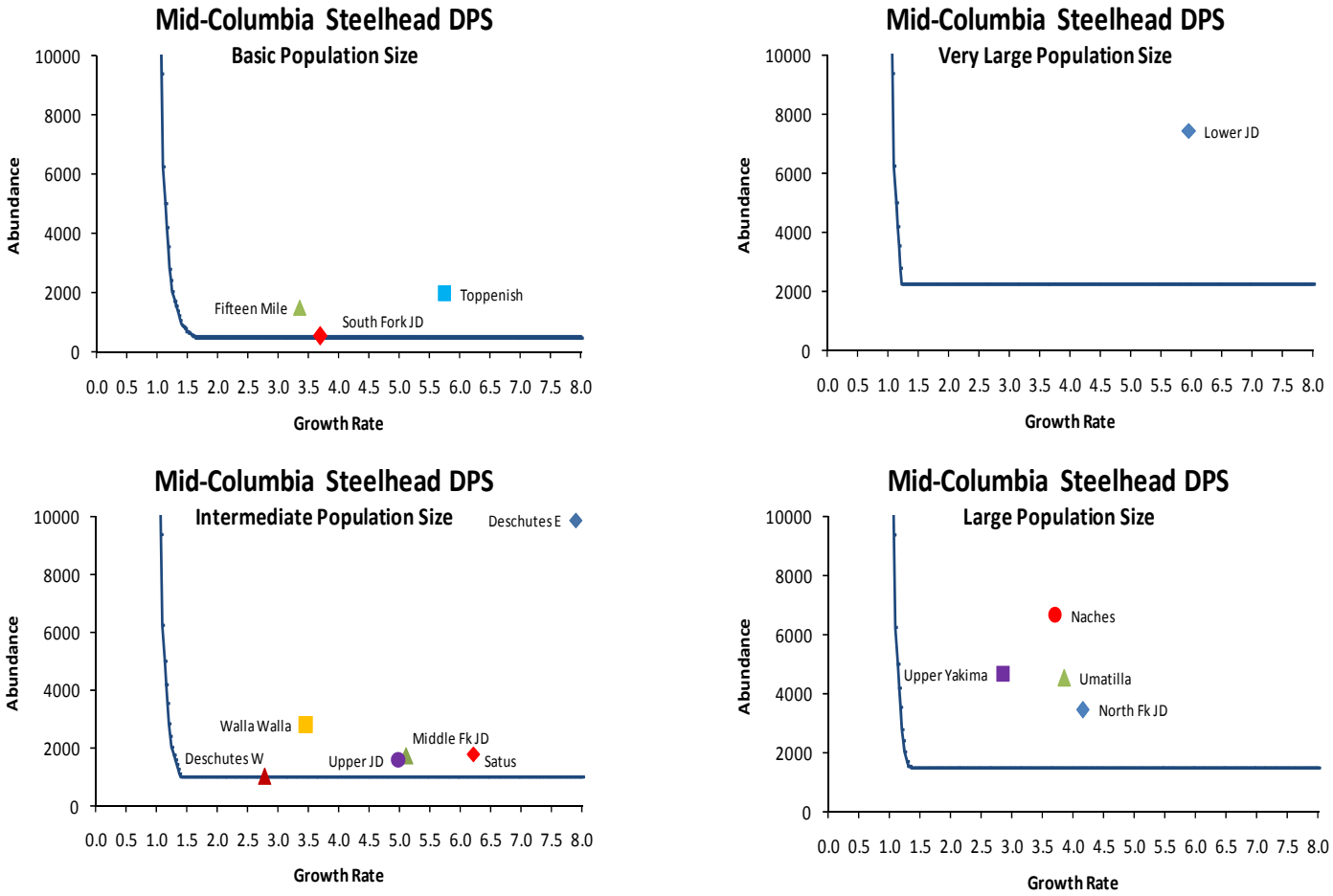
Potential Effects of Proposed Recovery Actions

Chapter 9 in this plan presents an analysis of the potential effects of implementing all the proposed recovery actions – in all the "H" sectors – on the abundance and productivity of Middle Columbia River steelhead. This quantitative analysis provides an opportunity to evaluate the efficacy of proposed recovery strategies in light of current knowledge regarding population functioning, including relationships with habitat conditions. Equally important, the quantitative models used in the assessment provide a framework for productively targeting evaluation efforts as well as for revisiting key assumptions in the future as more information becomes available (e.g., from monitoring responses to initial implementation or from evaluation efforts targeting key uncertainties). Two models were used: Ecosystem Diagnosis and Treatment (EDT) and the All-H-Analyzer (AHA). Methods of analysis are explained in detail in Chapter 9 of this Plan.

The analysis indicates, based on the suites of proposed actions in all the sectors, that all Middle Columbia River steelhead populations for which there are adequate data are expected to achieve 95 percent probability of survival (less than 5 percent risk of extinction within 100 years) for abundance/productivity if the most intensive (major) restoration scenarios are implemented and the projected habitat changes are realized after 25 years of implementation. Under minimum restoration scenarios, three populations (Deschutes Westside, Satus, and Upper Yakima) may not achieve less than 5 percent risk for abundance/productivity. However, the Satus population would meet the recovery criteria identified in the Yakima Steelhead Recovery Plan, and even under poor ocean conditions and minimum restoration actions, the abundance and productivity of the other two populations are expected to increase considerably over the baseline.

Figure ES-6 shows the projected (modeled) abundance and productivity of the 14 populations for which there are adequate data (excluding the Rock Creek, Klickitat, and Touchet populations) after 25 years and major restoration actions. The curve represents the abundance and productivity needed to achieve 95 percent probability of survival for the next 100 years.

Figure ES-6. Predicted viability results for Middle Columbia Steelhead Populations after 25 years of major restoration efforts.



Research, Monitoring, and Evaluation

An important part of the strategy for achieving recovery is the development of a DPS-wide monitoring plan that will support implementation of the recovery plan and long-term adaptive management in response to changes and trends in the data. Two keys to effective implementation are targeting actions to specific areas and monitoring the results of the actions. To achieve these goals, a scientific technical team made up of local scientists, former ICTRT members, and managers will be necessary. The monitoring plan is discussed in more detail in Chapter 10. It is also important to explicitly address the many unknowns in salmon recovery – the "critical uncertainties" that make management decisions much harder. Critical uncertainty research will, in the long run, reduce monitoring and implementation costs. Critical uncertainties and data gaps are described in more detail in Sections 10.3 and 10.4.

Adaptive Management

Adaptive management in salmon recovery planning is a method of decision making in the face of uncertainty. A plan for monitoring, evaluation, and feedback is incorporated into an overall implementation plan so that the results of actions can become feedback on design and implementation of future actions. Adaptive management works by coupling the decision-making process with collection of performance data and its evaluation. Most importantly, it works by offering an explicit process through which alternative strategies to achieve the same ends can be considered.

Within the Middle Columbia Basin, many different organizations, including Federal, state, tribal, local, and private entities, currently conduct programs and actions that could improve Middle Columbia steelhead survival. Development of Middle Columbia regional coordination will be essential for NMFS' future status reviews of the steelhead DPS. Establishing stable funding and staff for reporting data is also important. Management unit planners are developing detailed research, monitoring, evaluation, and adaptive management plans for each management unit based on the principles and concepts laid out in the NMFS draft guidance document, Adaptive Management for Salmon Recovery: Evaluation Framework and Monitoring Guidance (http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf). The individual RM&E and adaptive management plans will then be combined into a DPS RM&E and adaptive management plan by the Middle Columbia Science Team. This will ensure that, taken together, the monitoring and evaluation programs for each management unit, combined with monitoring components of the modules incorporated into the plans, address the needs of the entire DPS. The Mid-C Forum and others will use the RM&E and adaptive management plans to inform and guide projects and programs.

Setting Priorities

Priorities for recovery actions should be guided by DPS-, MPG-, and population-level recovery criteria and best available scientific information concerning DPS status, the role of the independent populations in meeting DPS and MPG viability, limiting factors and threats, and likelihood of effectiveness of actions. Protection of existing habitat is essential. Issues of funding and local, state, or national support for implementation will also inevitably come into play.

The management unit plans all address these issues in their implementation sections. For recovery actions in the tributaries, priorities will be settled largely at the local level. However, there should be ongoing technical review and support from DPS-level and management unit

science and technical committees. Coordination and communication in "out-of-subbasin" forums will be necessary for actions in the Columbia mainstem, estuary, and/or ocean.

Coordination/Governance

Coordination of actions and information-sharing among fisheries biologists, Tribes, local governments, citizen groups, and state and Federal agencies based in both Oregon and Washington is a key component of recovery for this DPS. Benefits of coordination include:

- Dealing with shared migration areas consistently
- Developing coherent MPG-level strategies where populations are in two states (Cascades Eastern Slope MPG; Umatilla/Walla Walla MPG), or the same population is in both states (Walla Walla population)
- Promoting consistent methods for setting recovery objectives, evaluating strategies, and monitoring progress across populations, MPGs, and the DPS

Such coordination is underway through the Middle Columbia Recovery Forum (Mid-C Forum), a group convened by NMFS to provide input on the DPS recovery plan.

Middle Columbia Recovery Forum

The recent creation of the Middle Columbia Recovery Forum (Mid-C Forum), to be convened regularly by NMFS, is intended to facilitate collaboration between scientists and recovery planners on both sides of the Columbia River. Figure ES-7 gives an overview of the relationships between these entities. Chapter 11 of this plan describes in more detail the proposed roles and responsibilities.

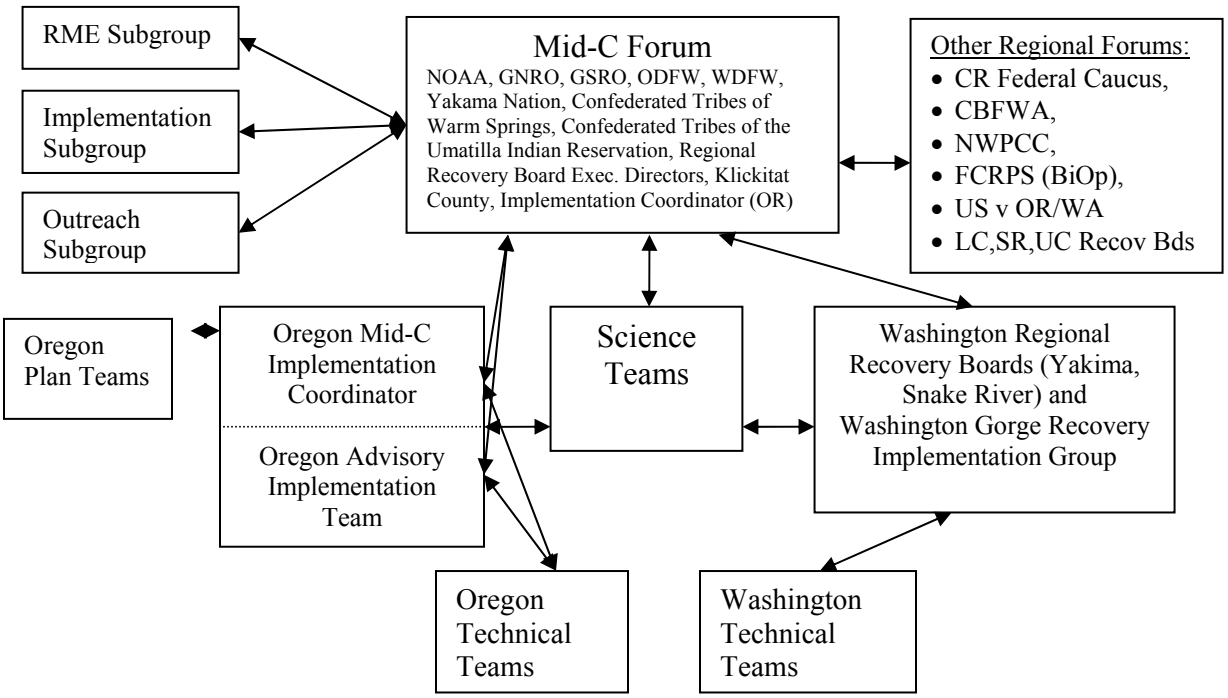


Figure ES-7. Mid-C Recovery Plan Implementation Organizational Structure.

Implementation Funding

Funding for project implementation is currently available from a variety of sources, but it will be an ongoing challenge. The role of the Mid-C Forum is to ensure that management unit plan implementers are aware of potential sources of funds and to advocate for the funding and implementation of actions that benefit all populations in the DPS. The Forum will not supersede decisions made by the individual management unit boards but will provide assistance and may promote funding of their projects and programs if requested. Sources of implementation funding include:

- Congressional appropriations to Federal agencies and to Pacific Coastal Salmon Recovery Fund (PCSRF) (through states and tribes)
- Salmon Recovery Funding Board (SRFB) (Washington)
- Oregon Watershed Enhancement Board (OWEB) (Oregon)
- State appropriations (state agencies)
- Northwest Power and Conservation Council Fish and Wildlife Program (states and tribes)
- Federal/state grants
- Non-profit organization programs and grants

How NMFS Intends to Use the Plan

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

- 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 take recovery plans under serious consideration as they make the following sorts of decisions and allocate their resources:

- Actions carried out to meet 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, within the action area, their proposed actions will affect individuals of specific populations and limiting factors identified in the recovery plans, and to describe any mitigating measures and voluntary recovery activities in the action area.