Executive Summary

About This Recovery Plan

This is a plan for the recovery of Lower Columbia River Chinook salmon (*Oncorhynchus tshawytscha*), Lower Columbia River steelhead (*O. mykiss),* Lower Columbia River coho salmon (*O. kisutch*), and Columbia River chum salmon (*O. keta*), all of which spawn and rear in the lower Columbia River or its tributaries in Oregon and Washington. These salmon and steelhead were listed as threatened under the Endangered Species Act of 1973 (ESA) between 1998 and 2005. Each is considered an evolutionarily significant unit (ESU) or, for steelhead, a distinct population segment (DPS). An ESU or DPS is a group of Pacific salmon or steelhead that is discrete from other groups of the same species and that represents an important component of the evolutionary legacy of the species.[1] Under the Endangered Species Act, each ESU or DPS is treated as a species. For convenience this recovery plan frequently uses the term "ESU" to refer to both the salmon ESUs and the steelhead DPS.

The core of the plan is a set of goals and actions for each ESU that, if implemented, would reverse the ESU's decline and lead to recovery of the ESU. Biological recovery for an ESU means that it is naturally self-sustaining and no longer requires the protection of the ESA: enough fish spawn in the wild and return year after year that the ESU is likely to persist in the long run. A recovered ESU is resilient enough that it can survive typical variations in ocean conditions and productivity and has a high likelihood of withstanding catastrophic changes in the environment, such as floods, landslides, and earthquakes.

The ESA requires the National Marine Fisheries Service (NMFS) to develop recovery plans for all listed salmon and steelhead species. NMFS is a branch of the National Oceanic and Atmospheric Administration and is sometimes referred to as NOAA Fisheries. As the federal agency charged with stewardship of the nation's marine resources, NMFS has the responsibility for listing and delisting salmon and steelhead species under the ESA.

Although NMFS is directly responsible for ESA recovery planning for salmon and steelhead, the agency believes that ESA recovery plans for salmon and steelhead should be based on the many state, regional, tribal, local, and private conservation efforts already under way throughout the region, and that local support of recovery plans is essential to success. Accordingly, NMFS based this recovery plan on the information, analyses, and strategies in three locally developed recovery plans, which are referred to as management unit plans.

Each ESU is made up of multiple independent populations, and each management unit plan covers populations in a different portion of the ESU's range:

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

- *The Oregon Lower Columbia Conservation and Recovery Plan for Salmon and Steelhead* covers the Lower Columbia River salmon and steelhead populations that are within Oregon, including the Willamette River up to Willamette Falls. The Oregon Department of Fish and Wildlife (ODFW) developed this plan in collaboration with NMFS and numerous stakeholders, including governments, agencies, tribes, industry and environmental representatives, and the public (Oregon Department of Fish and Wildlife 2010).

- *ESA Salmon Recovery Plan for the White Salmon River Subbasin* covers Lower Columbia River salmon and steelhead populations in the White Salmon River basin in Washington. NMFS developed this plan in cooperation with stakeholders such as the Yakama Nation, Klickitat County, and Washington Department of Fish and Wildlife (National Marine Fisheries Service 2013).

- *Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan* covers Lower Columbia River salmon and steelhead populations in Southwest Washington, within the planning area of the Lower Columbia Fish Recovery Board (LCFRB). The LCFRB developed this plan using a collaborative process that involved multiple agencies (including NMFS), tribal and other governments, organizations, industry, and the public (Lower Columbia Fish Recovery Board 2010a).

Two other documents, both developed by NMFS, were key in development of this recovery plan: the *Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead* (NMFS 2011a) and the *Recovery Plan Module: Mainstem Columbia River Hydropower Projects* (NMFS 2008a). These documents, which address regional-scale issues affecting Lower Columbia River salmon and steelhead, as well as other listed salmon ESUs and steelhead DPSs, provide a consistent set of assumptions and recovery actions that management unit recovery planners incorporated into their management unit plans.

Recovery plans are not regulatory documents. Their implementation is voluntary, except when they incorporate actions required as part of a regulatory process, such as ESA section 7, 10, and 4(d). For this recovery plan, NMFS will rely, to a great extent, on local citizens and organizations, as well as on other federal and state agencies, local jurisdictions, and tribal governments, to voluntarily implement the recovery actions. In some cases, the plan puts forward new recovery efforts that are not part of existing processes. In other cases, the plan recommends coordinating existing programs, both regulatory and non-regulatory, in ways that enhance benefits to Lower Columbia River salmon and steelhead and their ecosystems. Some actions that are integrated into this recovery plan originate in regulatory processes; examples include actions associated with the 2008 Bull Run Water Supply Habitat Conservation Plan (HCP), the 2008 Federal Columbia River Power System Biological Opinion and its 2010 Supplement, Federal Energy Regulatory Commission relicensing agreements (for tributary hydroelectric projects), and the regulation of fisheries that may affect the Lower Columbia River ESUs.

This recovery plan lays out an overall road map for recovery. After the plan is adopted, additional work will be needed in some cases to identify and prioritize[2] site-specific projects, determine costs and time frames, and identify responsible parties, based on strategies and actions in the recovery plan. To address these needs, each entity that developed a management unit plan (i.e., ODFW, NMFS, and LCFRB) also will prepare an "implementation schedule" that spells out the details of implementation for its specific geographical area. Implementation schedules will be updated every 3 to 6 years.

Overall Goal

In general, the goal of this plan is for the Lower Columbia River coho salmon ESU, Lower Columbia River Chinook salmon ESU, Lower Columbia River steelhead DPS, and Columbia River chum salmon ESU to reach the point at which they no longer need the protection of the Endangered Species Act and can be delisted. The delisting decision is made by NMFS, using the best available science. NMFS' delisting criteria are presented later in this summary, after some basic technical information and the population-specific goals are explained.

Technical Foundation

NMFS appointed teams of scientists with expertise in salmonid species to provide scientific support for recovery planners in the Pacific Northwest. These technical recovery teams (TRTs) worked from a common scientific foundation to ensure that recovery plans would be scientifically sound and based on consistent biological principles. All the TRTs based their work on biological principles established by NMFS for salmon recovery planning.

The Willamette-Lower Columbia Technical Recovery Team (WLC TRT) included biologists from NMFS, other federal agencies, states, tribes, academic institutions, and the private sector. The WLC TRT and a subsequent work group consisting of NMFS staff, ODFW staff, and a private consultant produced a set of technical reports that, taken together, present recommended biological criteria and methodologies for determining whether the four Lower Columbia River salmon and steelhead ESUs are viable. A viable ESU is naturally self-sustaining over the long term.

Consistent with principles established by NMFS, the WLC TRT described salmon and steelhead viability in terms of four interrelated parameters:

- **Abundance and productivity.** Abundance refers to the number of adult fish on the spawning grounds. Productivity is the population's growth rate, which indicates whether the population can sustain itself or rebound from low numbers. Productivity can be measured as spawner-to-spawner ratios (i.e., returns per spawner or recruits per spawner), annual population growth rate, or trends in abundance. Abundance and productivity are closely linked, and a population needs both: abundance to maintain genetic health and respond to normal

[2] Some prioritization work already has been done, in that the management unit plans identify high-priority reaches for tributary habitat protection and restoration actions. In addition, the Oregon and White Salmon management unit plans offer some guidance on how actions might be prioritized.

environmental variation, and productivity to bounce back if population numbers drop for some reason.

- **Spatial structure.** Spatial structure refers to both the geographic distribution of individuals in the population and the processes or conditions that generate that distribution. Factors affecting spatial structure include the amount of habitat available, how connected the habitat is, and how much neighboring populations mix with each other. Spatial structure is important because a species that is not geographically spread out is at risk of extinction from a single catastrophic event, such as a landslide.

- **Diversity**. Diversity refers to the variety of life history, behavioral, and physiological traits within and among populations. Some traits are determined completely by genetics, while others, such as appearance, behavior, and life history, vary as a result of a combination of genetic and environmental factors. Diversity is important because it gives populations an edge in surviving (and eventually adapting to) environmental change.

To understand the WLC TRT's biological criteria, it helps to know something about the biological structure of salmon and steelhead species. The Lower Columbia River Chinook salmon, Lower Columbia River coho salmon, Lower Columbia River steelhead, and Columbia River chum salmon ESUs each consist of multiple independent populations that spawn in different watersheds throughout the ESU's range. Additionally, within an ESU, independent populations can be organized into larger groups, known as strata. Stratum designation is based on the combination of ecological zone and life history strategy (indicated by the time of year when adults return to fresh water to spawn). In the lower Columbia region there are three ecological zones—Coast, Cascade, and Gorge. Two ESUs—Chinook and steelhead—display more than one life history strategy. Thus, the strata in this recovery plan include Coast, Cascade, and Gorge coho, Coast fall Chinook, Cascade fall Chinook, Gorge fall Chinook, Cascade spring Chinook, Gorge spring Chinook, etc.

The WLC TRT developed biological criteria and methodologies at three different levels: ESU, stratum, and population. The following are the TRT's key points in defining a viable ESU:

- Every stratum that historically existed should have a high probability of persistence.

- Within each stratum, there should be at least two populations that have at least a 95 percent probability of persisting over a 100-year time frame.

- Within each stratum, the average viability of the populations should be 2.25 or higher, using the WLC TRT's scoring system. Functionally, this is equivalent to about half of the populations in the stratum being viable; a viable population is one whose persistence probability is high or very high.

- Populations targeted for viability should include those within the ESU that historically were the most productive ("core" populations) and that best represent the historical genetic diversity of the ESU ("genetic legacy" populations). In addition, viable populations should be geographically dispersed in a way that protects against the effects of catastrophic events.

- Viable populations should meet specific criteria for abundance, productivity, spatial structure, and diversity.

There are various ways to refer to extinction risk: as viability, persistence probability, extinction risk, or—at the population level—population status. This recovery plan frequently uses the terms "persistence probability" and "population status." Only populations with a persistence probability of 95 percent or higher over a 100-year time frame are considered viable. These populations have a population status of high or very high.

Table ES-1
Population-level Probability of Persistence, Extinction Risk, and Status*

Probability of Persistence	Probability of Extinction	Extinction Risk	Population Status
0 – 40%	60 – 100%	Extinct or at very high risk of extinction (VH)	Very low (VL)
40 – 75%	25 – 60%	Relatively high risk of extinction (H)	Low (L)
75 – 95%	5 – 25%	Moderate risk of extinction (M)	Medium (M)
95 – 99%	1 – 5%	Low/negligible risk of extinction (L)	High (H)
> 99%	< 1%	Very low risk of extinction (VL)	Very high (VH)

+ Probability over a 100-year time frame.
Shading indicates levels at which a population is considered viable.

Population-specific Goals: The Recovery Scenario

The WLC TRT defined viability at the ESU, stratum, and population levels, but it did not specify the target status for each population because (1) there are many different combinations of target statuses that would meet the TRT's viability criteria, and (2) the "best" combination is a function of the biological and ecological conditions on the ground and local community values and interests. Oregon, Washington, and White Salmon management unit planners collaborated to reach agreement on which populations to target for which levels of viability. In making these decisions, management unit planners considered the WLC TRT's viability criteria and the following questions:

- Which populations historically were the most productive?
- Which populations represent important historical genetic diversity?
- Are the populations targeted for viability dispersed in a way that minimizes risk from catastrophic events?
- Which populations can be expected to make significant progress toward recovery because of existing programs, the absence of apparent impediments to recovery, and other management considerations?

- Are there populations that are unlikely to make significant progress toward recovery because of other societal goals, such as maintaining harvest or development opportunities?

The resulting target statuses for each ESU are collectively referred to as the recovery scenario and served as the basis from which to calculate numerical abundance and productivity goals for each population. (Table 3-1 of the recovery plan shows the recovery scenario for each ESU.)

Under the recovery scenario not all populations are targeted for a high degree of improvement, but all of them will need recovery actions—even so-called "stabilizing" populations. These are populations that are expected to remain at or near their current status (usually low or very low) because the feasibility of restoration is low and the uncertainty of success is high. "Primary" populations, on the other hand, are targeted for viability, meaning high or very high persistence probability. "Contributing" populations fall in the middle; they are targeted for some improvement in status so that the stratum-wide average viability is 2.25 or higher.

The recovery scenarios in the management unit plans are largely consistent with the WLC TRT's recommendations at the stratum and ESU level. Exceptions are the Gorge fall Chinook, Gorge spring Chinook, and Gorge chum strata, where the recovery scenarios target only one population to achieve a high probability of persistence, instead of two. As a way of mitigating for this increased risk in the Gorge strata, the recovery scenarios exceed the WLC TRT criteria in the Cascade fall Chinook, Cascade spring Chinook, and Cascade chum strata (i.e., more populations are targeted for viability than are needed to meet the 2.25 average). In addition, management unit recovery planners raised questions about the historical role of the Gorge fall Chinook, spring Chinook, and chum populations: were the populations highly persistent historically, did they function as independent populations within their stratum in the same way that the Coast and Cascade populations did, and should the Gorge stratum be considered a separate stratum from the Cascade stratum? Oregon recovery planners suggested that the Gorge strata's historical status and population structure be reevaluated and that recovery goals be revised if modifications are made; NMFS agrees that the historical role of the Gorge populations and strata merits further examination.

NMFS Delisting Criteria

As described above, the overall goal of this recovery plan is for the four ESUs to reach the point at which they no longer need the protection of the ESA and can be delisted. In order to be delisted, the species must no longer be in danger of extinction or likely to become endangered within the foreseeable future, based on evaluation of the factors that caused the species to be listed in the first place. In accordance with the ESA, this recovery plan incorporates objective, measurable criteria for determining whether an ESU can be delisted.[3] These criteria are of two types: biological viability criteria and threats criteria.

---

[3] The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria that, when met, would result in a determination in accordance with the provisions of the

Biological Viability Criteria

NMFS has concluded that the WLC TRT's viability criteria, the recovery scenarios, and the population-level abundance and productivity goals in the management unit plans adequately describe the characteristics of an ESU that no longer needs the protections of the ESA. NMFS endorses the recovery scenarios and population-level goals in the management unit plans as one of multiple possible scenarios consistent with delisting. Therefore, NMFS has developed the following biological viability criteria:

- All strata that historically existed have a high probability of persistence or have a probability of persistence consistent with their historical condition.

- High probability of stratum persistence is defined as:

  A. At least two populations in the stratum have at least a 95 percent probability of persistence over a 100-year time frame (i.e., two populations with a score of 3.0 or higher based on the TRT's scoring system).

  B. Other populations in the stratum have persistence probabilities consistent with a high probability of stratum persistence (i.e., the average of all stratum population scores is 2.25 or higher, based on the TRT's scoring system). (See Section 2.6 of the recovery plan for a brief discussion of the TRT's scoring system.)

  C. Populations targeted for a high probability of persistence are distributed in a way that minimizes risk from catastrophic events, maintains migratory connections among populations, and protects within-stratum diversity.

- Probability of persistence consistent with historical condition refers to the concept that strata that historically were small or had complex population structures may not have met Criteria A through C, above, but could still be considered sufficiently viable if they provide a contribution to overall ESU viability similar to their historical contribution.

Threats Criteria

In addition, for a species to be delisted, the threats that brought it to its threatened or endangered condition must be ameliorated such that they do not keep the ESU from achieving the desired biological status. The ESA identifies five categories of threats (any one or a combination of which may be the basis for the initial listing):

A. Present or threatened destruction, modification, or curtailment of the species' habitat or range
B. Overutilization for commercial, recreational, scientific, or educational purposes
C. Disease or predation

ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12).

D. Inadequacy of existing regulatory mechanisms
E. Other natural or human-made factors affecting the species' continued existence

The threats criteria in this recovery plan define the conditions under which the threats can be considered to be addressed or mitigated. Threats criteria for measuring recovery of Lower Columbia River salmon and steelhead ESUs are detailed in Section 3.2.2 of the recovery plan. In general, the threats criteria for the Lower Columbia River ESUs are considered met once the recovery plan actions have been substantially implemented, population-specific threat reduction targets have been met (or threat impacts are otherwise consistent with the desired status of the ESU and its constituent populations), threats have been ameliorated such that the desired status will be maintained, and regulatory mechanisms are being implemented in a way that supports attainment and maintenance of the desired status.

Site-specific Recovery Actions and Cost Estimates

Site-specific recovery actions are discussed in detail in the management unit plans. The Federal Columbia River Power System (FCRPS) Biological Opinion and related recovery plan hydropower module describe site-specific actions related to passage at Bonneville Dam, predation, and flow that affects conditions in the lower Columbia River, estuary, and, potentially, the plume. Site-specific actions for the Columbia River estuary and plume are presented in the *Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead*.

The total estimated cost of recovery actions for the four threatened species in the lower Columbia River over the next 25 years is approximately $2.1 billion, of which about $614 million is expected to be needed in the first 5 years (see Table ES-2). These estimates include expenditures by local, tribal, state, and federal governments, private business, and individuals in implementing capital projects and non-capital work, as well as administrative costs for supervision and coordination. The total estimated cost includes $592 million ($164 in the first 5 years) for actions in the Columbia River estuary that are basinwide in scope and are expected to benefit all 13 listed ESUs and DPSs in the Columbia Basin.

The estimates are based on the best available information at the time the management unit plans were completed and are expected to change as implementation schedules are developed and actions are more clearly scoped and planned. Given that the costs for many actions could not be estimated at the time the management unit plans were completed, it is likely that actual costs will be substantially higher than the estimated costs in Table ES-2.

Table ES-2
Summary of Cost Estimates

Management Unit	5-Year Cost Estimate (millions)	25-Year Cost Estimate (millions)
Washington	$245	$738
Oregon	$189	$758
White Salmon	$16	$16
Columbia River Estuary	$164	$592
TOTAL	$614	$2,104

The remaining sections of this summary focus mostly on the results of the recovery analysis for each ESU. After briefly explaining the overall approach used to complete the ESU recovery analyses, the summary describes general categories of limiting factors that affect multiple ESUs throughout the Lower Columbia region and strategies for addressing those limiting factors at the regional or programmatic level. This is followed by an individual section for each ESU that highlights that ESU's baseline and target status, the factors that are limiting its viability, and the strategy for reducing limiting factors and threats and achieving recovery. The summary concludes with thoughts on the role of research, monitoring, evaluation, and adaptive management and how recovery actions will be coordinated and implemented. Key documents referred to in this summary are listed at the end.

Overall Approach to ESU Recovery Analyses

This recovery plan addresses the needs of each ESU individually, based on analyses in the three management unit plans. Although each recovery planning team used a slightly different process in developing its management unit plan, all of the teams worked from the same TRT recommendations and a consistent set of assumptions about what elements should be included in their plans. Thus, the different recovery planning teams followed the same overall approach in their recovery analyses. In general, the management unit recovery planners did the following:

1. Evaluated the baseline status of their respective populations using techniques based on those recommended by the WLC TRT.[4]

2. Identified limiting factors for each Lower Columbia River salmon and steelhead population.

3. For each population, quantified the estimated baseline impacts of six categories of threats—tributary habitat loss and degradation, estuary habitat loss and degradation, hydropower, harvest, hatcheries, and ecological interactions.

[4] Both Oregon and Washington management unit planners established a baseline period from which to assess population status, limiting factors, and threat impacts. For more discussion, see Sections 5.1 and 5.5.

4. Established a target status for each population, taking into consideration (1) each population's potential for improvement, in view of available habitat and historical production, (2) the degree of improvement needed in each stratum to meet WLC TRT guidelines for a viable ESU, and (3) for some ESUs, the desire to accommodate objectives such as maintaining opportunities to harvest hatchery-origin fish.

5. Calculated the improvements in abundance and productivity and, in some cases, spatial structure and diversity, that each population would need to achieve its target status (i.e., to close the "conservation gap," which is the difference between the baseline and target status for each population).

6. Identified a "threat reduction scenario" for each population, meaning a specific combination of reductions in threats that would lead to the population achieving its target status.

7. Identified and scaled recovery strategies and actions to reduce threats by the targeted amount in each category. Management unit planners identified recovery strategies and actions through workshops and meetings with stakeholders, including representatives of implementing and affected entities.

8. Considered the probable effects of actions, established benchmarks for implementation, and identified critical uncertainties and research, monitoring, and evaluation needs for each species.

9. Developed implementation frameworks that address organizational structures for implementation of the actions, prioritization methods, tracking systems, coordination needs and approaches, and stakeholder involvement.

Given the complexity of the salmonid life cycle and the fact that complete data were not available for every population, some elements of the recovery analyses are subject to significant levels of uncertainty and should be considered working hypotheses that are testable as part of recovery plan implementation. Despite this uncertainty, it is the expert judgment of NMFS and the management unit scientists that, based on the best available information at this time, the results of the management unit plan analyses provide reasonable estimates of the relative magnitude of different threats to each population and the improvements that need to be addressed through recovery actions. Thus, NMFS considers the management plan analyses an adequate basis for designing initial recovery actions. As more and better information is collected, it will be applied to recovery efforts in an adaptive management framework that involves action implementation, monitoring of results, and adjustment of actions as needed.

The management unit plans' recovery analyses indicate that no single factor, threat, or threat category accounts for the declines in the species addressed in this recovery plan. Instead, the status of Lower Columbia River salmon and steelhead and Columbia River chum is the result of the cumulative impact of multiple limiting factors and threats. Thus, recovery will be accomplished through improvements in every general threat category. Even small increments of improvement will play an important role. When the need for improvement for most ESUs is so large, the contribution of no population or threat reduction can be discounted.

Regional Limiting Factors and Strategies

The reasons for a species' decline are generally described in terms of limiting factors and threats. Limiting factors are biological, physical, or chemical conditions and associated ecological processes and interactions that limit a species' viability. Threats are human activities or natural events, such as floodplain development or drought, that cause or contribute to limiting factors. Although the management unit plans analyze limiting factors and threats for each population, it also can be helpful to view limiting factors and threats from a regional, multi-species perspective—to discern large-scale patterns in ecological conditions that are affecting all or most of the listed ESUs. This aids in identifying regional approaches to recovery that can provide high biological benefit while making effective use of limited resources. The sections below describe such regional strategies, which are general approaches that either benefit multiple ESUs or can be tailored to meet the specific needs of each species. However, implementation of the regional strategies alone will not necessarily lead to recovery. The regional strategies are intended to supplement ESU-specific strategies that provide greater specificity and address specific needs at the species, stratum, and population levels.

Tributary Habitat

Tributary habitat degradation from past and/or current land and water use is a limiting factor for all Lower Columbia River salmon and steelhead populations. Widespread development and other land use activities have disrupted watershed processes, reduced water quality, and diminished habitat quantity, quality, and complexity in most lower Columbia River subbasins. Past and/or current land use or water management activities have adversely affected stream and side channel structure, riparian conditions, floodplain function, sediment conditions, and water quality and quantity, as well as the watershed processes that create and maintain properly functioning conditions for salmon and steelhead.

The regional tributary habitat strategy is directed toward habitat protection and restoration to achieve adequate quantities of high-quality, well-functioning salmon and steelhead habitat. This will be accomplished through a combination of (1) site-specific projects that will protect habitat or provide benefits relatively quickly, (2) watershed-based actions that will repair habitat-forming processes and provide benefits over the long term, and (3) landscape-scale programmatic actions that affect a class of activities (such as stormwater management or forest practices) over multiple watersheds. Although many habitat-related actions already have been undertaken, current activities do not reflect the scale of habitat improvements needed. Recovery of the listed species will require concerted efforts to protect remaining areas of favorable habitat and restore habitat quality in significant historical production areas. There is an immediate need to complete prioritization frameworks and get additional targeted, site-specific protection and restoration actions, as well as programmatic approaches, on the ground as soon as possible, especially because the benefits of some habitat actions will take years to accrue. Table ES-3 lists subbasins that will play a key role in recovery because they are targeted to support multiple primary populations, from different ESUs.

Table ES-3
Subbasins Targeted to Support Three or More Primary Populations

Ecozone	Subbasin	Primary Populations
Coast	Elochoman	Fall Chinook, chum, coho
	Clatskanie	Fall Chinook, chum, coho
	Scappoose	Fall Chinook, chum, coho
Cascade	Coweeman	Fall Chinook, winter steelhead, coho
	SF Toutle	Fall Chinook, winter steelhead, coho
	NF Toutle	Fall Chinook, winter steelhead, coho
	Cispus	Spring Chinook, winter steelhead, coho
	Upper Cowlitz	Spring Chinook, winter steelhead, coho
	NF Lewis	Fall Chinook, late-fall Chinook, spring Chinook, chum
	EF Lewis	Fall Chinook, chum, winter steelhead, summer steelhead, coho
	Washougal	Fall Chinook, chum, summer steelhead
	Sandy	Late-fall Chinook, spring Chinook, chum, winter steelhead, coho
Gorge	Lower Gorge tribs	Chum, winter steelhead, coho
	Hood	Fall Chinook, spring Chinook, winter steelhead, summer steelhead, coho

Estuary Habitat

Habitat conditions in the Columbia River estuary and plume are important to the survival of all Columbia River basin salmon and steelhead during critical rearing, migration, and saltwater acclimation periods in their life cycle. Yet the amount and accessibility of in-channel, off-channel, and plume habitat have been reduced as a result of habitat conversion for agricultural, urban, and industrial uses, hydroregulation and flood control, channelization, and higher bankfull elevations, which have been facilitated by diking, dredging, and filling. Sediment conditions and toxic contaminants also have been identified as limiting factors in the estuary, as have high water temperatures in late summer and fall, changes in the food web, and predation.

Estuary habitat strategies focus on providing adequate off-channel and intertidal habitats, such as tidal swamp and marsh; restoring habitat complexity in areas modified by agricultural or rural residential use; decreasing exposure to toxic contaminants; and lowering water temperatures. This will be accomplished over the long term by restoring hydrologic, sediment, and riparian processes that structure habitat in the estuary. An aggressive, strategic approach needs to be developed for implementation of estuary actions.

Hydropower

Bonneville Dam is the only mainstem hydropower facility within the geographic range of Lower Columbia River salmon and steelhead, but flow management at large storage reservoirs in the interior of the Columbia Basin affect habitat in the lower Columbia River mainstem and estuary, and potentially in the plume. In addition, significant tributary hydropower dams are located on the Cowlitz and Lewis rivers in Washington and on the Willamette, Clackamas, and Sandy rivers in Oregon.[5] The impacts of hydropower facility construction and operation on Lower Columbia salmon and steelhead occur both locally (at, above, and immediately below dams) and downstream, in the Columbia River estuary and, potentially, the plume. Impacts include habitat inundation, impaired fish passage, higher water temperatures during the late summer and fall, and alterations in the timing and magnitude of flow that affect downstream habitat conditions and habitat-forming processes.

The regional hydropower strategy focuses on (1) improving passage survival at Bonneville Dam for Lower Columbia River populations that spawn above the dam, (2) addressing impacts in tributaries by implementing actions prescribed in Federal Energy Regulatory Commission agreements regarding operation of individual tributary dams, and (3) implementing mainstem flow management operations designed to benefit spring migrants from the interior of the Columbia Basin; NMFS expects that these flow management operations will also improve survival in the estuary and, potentially, the plume for all Lower Columbia River salmon and steelhead populations. The regional hydropower strategy includes actions identified in the 2008 FCRPS Biological Opinion and its 2010 Supplement that will aid adults and juveniles from the Gorge populations in passing Bonneville Dam. For chum salmon, the strategy involves ensuring adequate flows in the Bonneville Dam tailrace and downstream habitats during chum salmon migration, spawning, incubation, and emergence.

Hatcheries

Hatchery practices such as broodstock collection and spawning protocols can cause genetic changes in hatchery fish. When hatchery-origin fish spawn with natural-origin fish, genetic changes can be transmitted to the naturally produced fish; the larger the proportion of hatchery-origin spawners, the larger the genetic effects to the natural population. These genetic effects can include domestication and loss of diversity within the population. For decades, high proportions of hatchery fish on the spawning grounds have been common among many Lower Columbia River salmon and steelhead populations, including the vast majority of Chinook and coho salmon populations. In addition, hatchery fish infected with pathogens or parasites have the potential to spread these organisms to natural-origin fish. Also, hatchery fish can sometimes prey directly on naturally produced juveniles, particularly chum salmon. Some scientists suspect that closely spaced releases of hatchery fish from Columbia Basin hatcheries may lead to increased competition with natural-origin fish for food and habitat space in the Columbia River estuary.

The overall goals of the hatchery recovery strategies for the Lower Columbia ESUs are to (1) reduce hatchery impacts on natural-origin populations as appropriate for each population, (2) ensure that some populations have no in-subbasin hatchery releases and are isolated from stray out-of-subbasin hatchery fish, (3) use hatchery stocks in the short term for reintroduction or supplementation programs to restore naturally spawning populations in some watersheds, and (4) ensure rigorous monitoring and evaluation to

---

[5] Powerdale Dam, on the Hood River, was removed in 2010; Condit Dam, on the White Salmon River, was breached in October 2011 and completely removed in September 2012.

better understand existing population status and the effects of hatchery strategies on natural populations.

Harvest

Lower Columbia River Chinook salmon, steelhead, and coho salmon are caught in commercial, recreational, and tribal fisheries along the West Coast of the United States and Canada as well as in the mainstem Columbia River and its tributaries. These various fisheries focus on different stocks and populations, taking fish to meet commercial, recreational, and tribal harvest allocations. Harvest affects the viability of Lower Columbia River salmon and steelhead populations by causing mortality to naturally produced adult fish, influencing population traits, and reducing nutrients in freshwater ecosystems. Harvest mortality can be either direct or indirect. Direct harvest mortality is associated with fisheries that target specific stocks. Indirect mortality includes mortality of fish harvested incidentally to the targeted species or stock, fish that die after being captured by fishing gear but not landed, and fish that die after being caught and released. Harvest managers have implemented substantial reductions in harvest for Lower Columbia River species since they were listed under the ESA.

The management unit plans include the societal goal of maintaining harvest opportunities created by hatchery fish and have prioritized ESA recovery strategies that allow for continued harvest opportunities while working toward recovery; these strategies have been incorporated into the recovery plan. In addition, as part of their broad sense goals, the management unit plans envision eventual harvest of naturally produced salmon and steelhead from healthy, self-sustaining populations.[6]

Although each species' harvest management requirements are unique, in general the harvest strategy focuses on refining harvest management and reducing impacts to naturally produced fish where needed while maintaining harvest opportunities that target hatchery-produced fish. The recovery plan calls for the use of six general approaches as appropriate and feasible: abundance-based harvest management, weak-stock management, mark-selective harvest, filling information needs, ancillary and precautionary actions, and adaptive management.

Local recovery planners believe that for Lower Columbia River spring Chinook salmon, steelhead, and chum salmon, current harvest impacts are generally consistent with long-term recovery goals, at least in the near term. For these species the recovery plan recommends measures to ensure that harvest does not adversely affect future conservation and recovery. For Lower Columbia fall Chinook and coho salmon, efforts will focus on (1) refinements in harvest management (including abundance-based management) to reduce risk to naturally produced fish, and (2) continued review of overall harvest rates.

Ecological Interactions

Anthropogenic changes to habitat in the lower Columbia River region have altered the

[6] Currently, targeted harvest on naturally produced North Fork Lewis late-fall Chinook salmon is occurring when returns are above the escapement goal. The baseline persistence probability of this population, which has remained largely uninfluenced by hatchery production and has not experienced the population bottlenecks common among tule fall Chinook salmon populations, is estimated to be high.

relationships between salmonids and other fish and wildlife species, leaving Lower Columbia River salmon and steelhead more vulnerable to predation by piscivorous fish, birds, and marine mammals (i.e., seals and sea lions) and subject to competition with introduced fish species and possibly hatchery-origin fish for limited food and habitat.

The regional ecological interactions strategy involves reducing predation on all Lower Columbia River salmon and steelhead populations by redistributing Caspian terns and cormorants, increasing the pikeminnow bounty program in the Columbia River mainstem, and reducing marine mammal predation at Bonneville Dam using non-lethal or lethal measures. Managing predation by sea lions at Bonneville Dam is expected to benefit Gorge-stratum populations of Lower Columbia River salmon and steelhead ESUs. To reduce the risk of adverse ecological interactions between hatchery-origin and naturally produced salmon and steelhead, the recovery plan proposes a combination of critical uncertainties research and near-term precautionary measures, such as restoring estuary habitat and managing hatchery releases to prevent large numbers of hatchery-origin fish from accumulating in the estuary.

Climate Change

The warming rate for the Pacific Northwest over the next century is projected to be in the range of 0.1 to 0.6 °C per decade. Although total precipitation changes are predicted to be minor (+ 1 to 2 percent), increasing air temperature will alter snowpack, stream flow timing and volume, and water temperature in the Columbia Basin.

Changes in air temperatures, river temperatures, and river flows in the Pacific Northwest are expected to affect salmon and steelhead distribution, behavior, growth, and survival. The magnitude and timing of the changes are poorly understood, and specific effects are likely to vary among populations. However, likely effects on listed salmon and steelhead in fresh water include winter flooding of redds (i.e., salmon nests), earlier emergence of salmon fry, decreased parr-to-smolt survival, reductions in the quantity and quality of juvenile rearing habitat and possibly overwintering habitat, changes in the timing of smolt migration, and increased adult mortality or reduced spawning success as a result of higher water temperatures.

Possible effects on salmon and steelhead in estuaries include altered growth and disease susceptibility, reduced quality of rearing habitat, and changes in the distribution of salmonid prey and predators, including possible extension of the range of non-native species adapted to warm water.

Climate-related changes in the marine environment are expected to alter primary and secondary productivity, the structure of marine communities, and, in turn, the growth, productivity, survival, and migrations of salmonids, although the degree of impact on listed salmonids currently is poorly understood. A mismatch between earlier smolt migrations (because of earlier peak spring freshwater flows and shorter incubation periods) and altered coastal upwelling may reduce marine survival rates. Ocean warming also may change migration patterns, increasing distances to feeding areas.

In addition, rising atmospheric carbon dioxide concentrations drive changes in seawater chemistry, increasing the acidification of seawater and thus reducing the availability of carbonate for shell-forming invertebrates, including some that are prey items for juvenile salmonids. Ocean acidification has the potential to reduce survival of many marine organisms, including salmon and steelhead. However, because there is currently a paucity of research directly related to the effects of ocean acidification on salmon and steelhead and their prey, potential effects are uncertain.

The regional climate change strategy has two parts: (1) implementation of greenhouse gas reduction strategies, such as through the West Coast Governors' Global Warming Initiative[7] and the Oregon Global Warming Commission's recommendations,[8] and (2) adaptation, to reduce the impacts of climate change on Pacific Northwest salmon and steelhead. Adaptation commonly involves the following:

- Conserving adequate habitat to support healthy fish populations and ecosystem functions in a changing climate
- Managing species and habitats to protect ecosystem functions in a changing climate
- Reducing stresses not caused by climate change
- Supporting adaptive management through integrated observation and monitoring and improved decision support tools

The management unit plans and estuary recovery plan module present specific actions that are responsive to these general strategies. The following documents also are relevant to adaptation:

- *Climate Change Impacts on Columbia River Basin Fish and Wildlife* (Independent Scientific Advisory Board 2007a)
- *Oregon Climate Change Adaptation Framework* (Oregon Department of Land Conservation and Development 2010)
- *Washington State Integrated Climate Change Response Strategy* (interim document) (Washington Department of Ecology 2011)
- *Draft National Fish, Wildlife, and Plants Climate Adaptation Strategy* (U.S. Fish and Wildlife Service et al. 2012)

Human Population Growth

The Oregon and White Salmon management unit plans identify human population growth as a future threat to Lower Columbia River salmon and steelhead, based in part on work done by the Independent Scientific Advisory Board (ISAB), which provides independent scientific advice and recommendations related to the fish and wildlife management responsibilities of the Northwest Power and Conservation Council, Columbia River Basin Indian tribes, and NMFS. Expected population growth rates will vary throughout the lower Columbia region; however, the ISAB expects that human population growth in the Columbia Basin will increase the demand for water, land, and

---

[7] For the West Coast Governors' Global Warming Initiative, go to http://www.ef.org/westcoastclimate/.
[8] For the Oregon Global Warming Commission's recommendations, see Oregon Department of Energy (2009) or go to http://www.oregon.gov/ENERGY/GBLWRM/GWC/docs/09CommissionReport.pdf.

forests that are key to fish and wildlife populations. This demand for resources will increase threats to and extinction risks for fish and wildlife—including salmon and steelhead—through such mechanisms as loss, degradation, and fragmentation of habitat; increased stormwater runoff; and reduced groundwater recharge and thus base stream flows.

The recovery plan includes actions that will lessen the impacts of human population growth. The focus is on protecting existing high-quality habitat through acquisition and conservation; using land use planning to guide future development away from ecologically sensitive areas, such as wetlands and floodplains; implementing best management practices; protecting and restoring instream flows, runoff processes, and water quality; and educating landowners and others.

Recovery Analysis: Lower Columbia River Coho Salmon

This recovery plan covers all naturally spawned coho salmon (*Oncorhynchus kisutch*) populations in the lower Columbia River and its tributaries, from the mouth of the Columbia upstream to the Hood River (in Oregon) and the White Salmon River (in Washington), including the Willamette River up to Willamette Falls. Twenty-three coho salmon hatchery programs also are part of the ESU.

Historically, the Lower Columbia River coho salmon ESU consisted of a total of 24 independent populations that spawned in almost every accessible stream system in the lower Columbia River basin. Coho salmon typically spawn in small to medium, low-to-moderate elevation streams from valley bottoms to stream headwaters. Coho salmon particularly favor small, rain-driven, lower elevation streams characterized by (1) relatively low flows during late summer and early fall, and (2) increased river flows and decreased water temperatures in winter.

Baseline and Target Status: Coho Salmon

Today, 21 of the 24 Lower Columbia River coho salmon populations are considered to have a very low probability of persisting over the next 100 years, and none is considered viable. All three strata in the ESU fall significantly short of the WLC TRT criteria for viability.

Table ES-4
Baseline and Target Status of LCR Coho Salmon Populations*

Stratum	Population	Contribution to Recovery	Baseline Status	Target Status
Coast	Youngs Bay (OR)	Stabilizing	VL	VL
	Grays/Chinook (WA)	Primary	VL	H
	Big Creek (OR)	Stabilizing	VL	VL
	Elochoman/Skamokawa (WA)	Primary	VL	H
	Clatskanie (OR)	Primary	L	VH
	Mill/Abernathy/Germany (WA)	Contributing	VL	M
	Scappoose (OR)	Primary	M	VH
Cascade	Lower Cowlitz (WA)	Primary	VL	H
	Upper Cowlitz (WA)	Primary	VL	H
	Cispus (WA)	Primary	VL	H

Stratum	Population	Contribution to Recovery	Baseline Status	Target Status
	Tilton (WA)	Stabilizing	VL	VL
	Toutle SF (WA)	Primary	VL	H
	Toutle NF (WA)	Primary	VL	H
	Coweeman (WA)	Primary	VL	H
	Kalama (WA)	Contributing	VL	L
	NF Lewis (WA)	Contributing	VL	L
	EF Lewis (WA)	Primary	VL	H
	Salmon Creek (WA)	Stabilizing	VL	VL
	Clackamas (OR)	Primary	M	VH
	Sandy (OR)	Primary	VL	H
	Washougal (WA)	Contributing	VL	M+
Gorge	Lower Gorge (WA & OR)	Primary	VL	H
	Upper Gorge/White Salmon (WA)	Primary	VL	H
	Upper Gorge/Hood (OR)	Primary	VL	H*

*Status is equivalent to persistence probability. VL = very low, L = low, M = moderate, H = high, VH = very high.

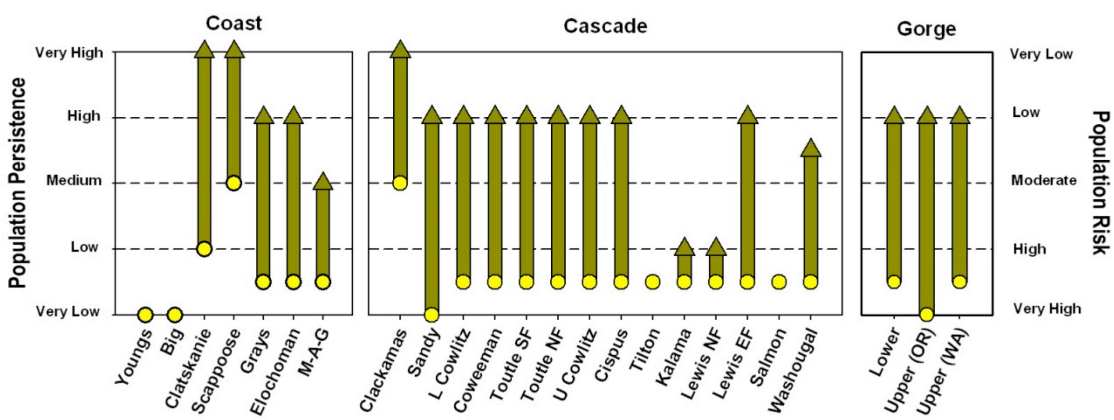

Figure ES-1. *Conservation Gaps for LCR Coho Salmon Populations (i.e., Difference between Baseline and Target Status)*

Prevalent Limiting Factors: Coho Salmon

Lower Columbia River coho salmon's poor status is due to a host of limiting factors that have affected the ESU for decades, or longer. Table ES-5 lists prevalent limiting factors that the management unit plans identified as having the greatest impact during the baseline period.

In addition, tributary hydropower dams are a primary limiting factor for the Upper Cowlitz, North Fork Lewis, Cispus, Tilton, and Upper Gorge/White Salmon populations.

Table ES-5
Prevalent Primary Limiting Factors for Coho Salmon during Baseline Period

Limiting Factor	Populations for Which This Is a Primary Limiting Factor
Degraded riparian conditions along tributaries	Almost all*
Impaired side channel and wetland conditions in tributaries	Almost all
Loss/degradation of floodplain habitat in tributaries	Almost all
Channel structure and form issues[9] in tributaries and the Columbia River estuary	Almost all
Sediment conditions in the estuary	Almost all
Water quantity issues (i.e., altered hydrology) in the estuary	Almost all
Direct mortality from fisheries	Almost all
Reduction in population diversity as a result of stray hatchery fish interbreeding with natural-origin fish	All except Clatskanie, Scappoose, Coweeman, NF Lewis, and Sandy

* "Almost all" means every population except one in each stratum.

Recovery Strategy: Coho Salmon

The ESU recovery strategy for coho salmon involves improvements in all threat categories to increase abundance, productivity, diversity, and spatial structure to the point that the Coast, Cascade, and Gorge strata are restored to a high probability of persistence. The ESU recovery strategy has seven main elements:

1. Protect and improve populations that have a clear record of continuous natural spawning and are likely to retain local adaptation (the Clackamas and Sandy), along with populations where there is documented natural production (the Clatskanie, Scappoose, and Mill/Abernathy/Germany).

2. Fill information gaps regarding the extent of natural production in other populations, and focus additional recovery efforts on populations that have the greatest prospects for improvement.

3. Protect existing high-functioning habitat for all populations.

4. Restore tributary habitat (particularly overwintering habitat) to the point that each subbasin can support coho salmon at the target status for that population. In most subbasins, this will mean having adequate habitat to support a viable population.

5. Reduce hatchery impacts on natural-origin fish so that impacts are consistent with the target status of each population. (The Grays/Chinook, Elochoman/Skamokawa, Mill/Abernathy/Germany, Clatskanie, Clackamas, Washougal, and Gorge-stratum populations are targeted for large reductions in hatchery impacts.)

[9] Includes conditions such as channelization, reduced instream habitat complexity, fill and scour, and associated loss of spawning habitat.

6. Refine harvest management so that impacts are consistent with population and overall ESU recovery goals.

7. Reestablish naturally spawning populations above tributary dams on the Cowlitz and North Fork Lewis rivers by improving passage at dams and continuing to reintroduce coho salmon in these mid- to high-elevation habitats.

For most coho salmon populations, loss and degradation of tributary habitat are the single largest threat—and where the greatest gains in viability are expected to be achieved. Notable exceptions are the Clackamas, Upper Cowlitz, and Cispus populations. For the Clackamas population, protection of existing well-functioning habitat and reductions in hatchery impacts will play a key role in achieving the target status. The Upper Cowlitz and Cispus populations are projected to benefit greatly from hatchery reintroduction programs and dam passage improvements designed to restore their access to key historical spawning and rearing habitats. However, significant tributary habitat protection and restoration efforts also will be necessary for these populations. In most cases, population recovery objectives cannot be achieved without substantial improvements in habitat, even when the impacts of other, non-habitat threats are practically eliminated.

Although recent actions have substantially reduced coho salmon harvest levels from baseline conditions, further refinements in harvest management are still needed. Reductions in hatchery impacts are called for in all strata because hatchery impacts remain significant for many populations.

Recovery Analysis: Lower Columbia River Chinook Salmon

This recovery plan covers all naturally spawned Chinook salmon (*Oncorhynchus tshawytscha*) populations in the lower Columbia River and its tributaries, from the mouth of the Columbia upstream to the Hood River (in Oregon) and the White Salmon River (in Washington), including the Willamette River up to Willamette Falls but excluding Clackamas River spring-run Chinook salmon.[10] Chinook salmon from 20 hatchery programs also are part of the ESU.[11]

Historically, the Lower Columbia River Chinook salmon ESU consisted of a total of 32 independent populations: 21 fall populations, two late-fall populations, and nine spring populations. These classifications are based on when adults return to fresh water. Spring and late-fall Chinook salmon are "stream-type" salmon, meaning that they generally rear in the river for a full year before emigrating to the ocean. Returning spring Chinook salmon adults spawn primarily in upstream, higher elevation portions of large subbasins. Fall Chinook display an "ocean-type" life history, meaning that juveniles begin emigrating downstream at 1 to 4 months old and make extensive use of

[10] Clackamas River spring Chinook salmon are part of the Upper Willamette River Chinook ESU.

[11] One of these programs—the Elochoman tule fall Chinook salmon program—was discontinued in 2009. In its 2011 5-year review, NMFS recommended that this program be removed from the ESU and that four new fall Chinook salmon programs be added. The new programs are changes in release locations for fish produced at—and previously released from—hatchery programs that are currently part of the ESU.

the Columbia River estuary before entering the ocean. Returning fall Chinook spawn in moderate-sized streams and large river mainstems.

Fall Chinook are commonly referred to as "tule" stock, while late-fall Chinook are referred to as "brights."

Baseline and Target Status: Chinook Salmon

Today, only two of 32 historical populations—the North Fork Lewis and Sandy late-fall populations—are considered viable. Most populations (26 out of 32) have a very low probability of persistence over the next 100 years, and some populations are extirpated or nearly so. Five of the six strata fall significantly short of the WLC TRT criteria for viability. One stratum—Cascade late fall—meets the WLC TRT criteria.

Table ES-6
Baseline and Target Status of LCR Chinook Salmon Populations*

Stratum	Population	Core or Genetic Legacy?**	Contribution to Recovery	Baseline Status	Target Status
Cascade spring	Upper Cowlitz (WA)	C, GL	Primary	VL	H+
	Cispus (WA)	C	Primary	VL	H+
	Tilton (WA)		Stabilizing	VL	VL
	Toutle (WA)		Contributing	VL	M
	Kalama (WA)		Contributing	VL	L
	NF Lewis (WA)	C	Primary	VL	H
	Sandy (OR)	C, GL	Primary	M	H
Gorge spring	White Salmon (WA)	C	Contributing	VL	L+
	Hood (OR)		Primary	VL	VH
Coast fall	Youngs Bay (OR)		Stabilizing	L	L
	Grays/Chinook (WA)		Contributing	VL	M+
	Big Creek (OR)	C	Contributing	VL	L
	Elochoman/Skamokawa (WA)	C	Primary	VL	H
	Clatskanie (OR)		Primary	VL	H
	Mill/Abernathy/Germany (WA)		Primary	VL	H
	Scappoose (OR)		Primary	L	H
Cascade fall	Lower Cowlitz (WA)	C	Contributing	VL	M+
	Upper Cowlitz (WA)		Stabilizing	VL	VL
	Toutle (WA)	C	Primary	VL	H+
	Coweeman (WA)	GL	Primary	L	H+
	Kalama (WA)		Contributing	VL	M
	Lewis (WA)	GL	Primary	VL	H+
	Salmon Creek (WA)		Stabilizing	VL	VL
	Clackamas (OR)	C	Contributing	VL	M
	Sandy (OR)		Contributing	VL	M
	Washougal (WA)		Primary	VL	H+
Gorge fall	Lower Gorge (WA & OR)		Contributing	VL	M
	Upper Gorge (WA & OR)	C	Contributing	VL	M
	White Salmon (WA)	C	Contributing	VL	M
	Hood (OR)		Primary	VL	H

Stratum	Population	Core or Genetic Legacy?**	Contribution to Recovery	Baseline Status	Target Status
Cascade	NF Lewis (WA)	C, GL	Primary	VH	VH
late fall	Sandy (OR)	C, GL	Primary	H	VH

* Status is equivalent to persistence probability. VL = very low, L = low, M = moderate, H = high, VH = very high.

** C = Core populations, meaning those that historically were the most productive. G = Genetic legacy populations, which best represent historical genetic diversity.

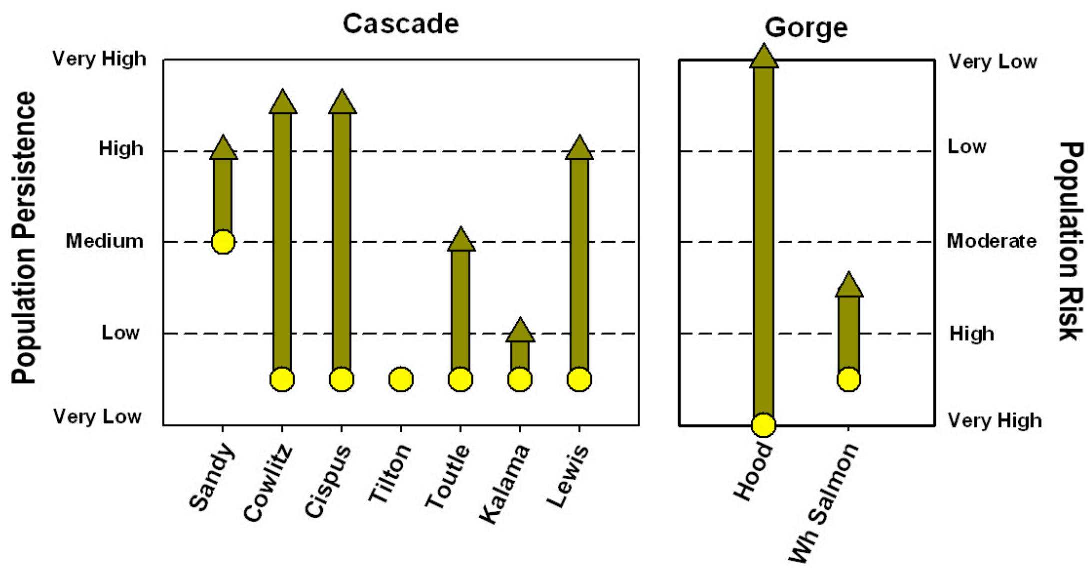

Figure ES-2. *Conservation Gaps for LCR Spring Chinook Salmon Populations (i.e., Difference between Baseline and Target Status)*

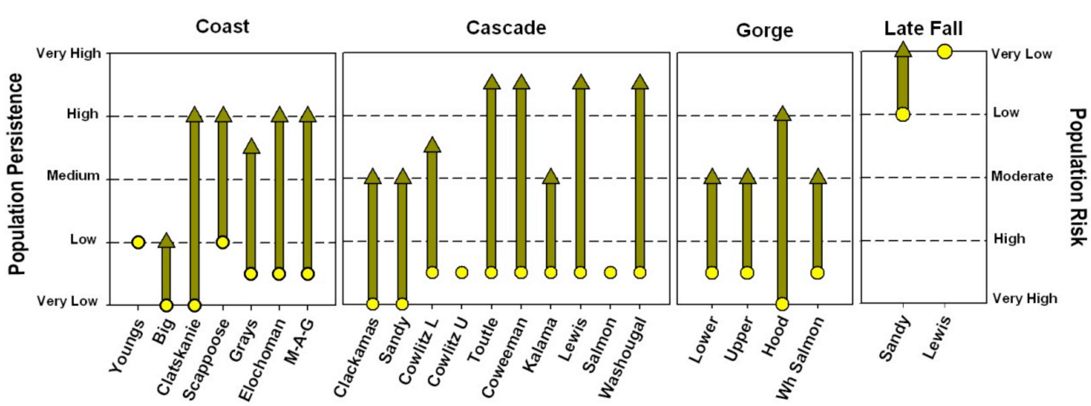

Figure ES-3. *Conservation Gaps for LCR Fall and Late-Fall Chinook Salmon Populations (i.e., Difference between Baseline and Target Status)*

Spring Chinook Recovery Analysis

Prevalent Limiting Factors: Spring Chinook Salmon

Lower Columbia River spring Chinook salmon's poor status is due to a host of limiting factors that have affected the ESU for decades, or longer. Table ES-7 lists prevalent limiting factors that the management unit plans identified as having the greatest impact during the baseline period.

Table ES-7
Prevalent Primary Limiting Factors for Spring Chinook Salmon during Baseline Period

Limiting Factor	Populations for Which This Is a Primary Limiting Factor
Channel structure and form issues[12] in the Columbia River estuary	Almost all*
Sediment conditions in the estuary	Almost all
Water quantity issues (i.e., altered hydrology) in the estuary	Almost all
Reduction in population diversity as a result of stray hatchery fish interbreeding with natural-origin fish	Almost all
Tributary hydropower dams	Upper Cowlitz, Cispus, Tilton, NF Lewis, and White Salmon
Direct mortality from fisheries	Upper Cowlitz, Cispus Tilton, Toutle, Kalama, NF Lewis, and Hood
Degraded riparian conditions in tributaries	All Cascade-stratum populations
Channel structure and form issues in tributaries	All Cascade-stratum populations
Impaired side channel and wetland conditions in tributaries	All Cascade-stratum populations
Loss/degradation of floodplain habitat in tributaries	All Cascade-stratum populations

* "Almost all" means every population except one in each stratum.

Recovery Strategy: Spring Chinook Salmon

The recovery strategy for spring Chinook salmon is aimed at restoring the Cascade spring stratum to a high probability of persistence and improving the persistence probability of the two Gorge spring populations. Although the strategy involves threat reductions in all categories, the most crucial elements are as follows:

1. Protect and improve the Sandy spring Chinook salmon population, which is the best-performing population and the only Lower Columbia River spring Chinook salmon population with appreciable natural production. This will be accomplished by protecting high-quality, well-functioning spawning and rearing

12 Includes channelization, reduced instream habitat complexity, fill and scour, and associated loss of spawning habitat.

habitat, reducing the proportion of hatchery-origin spawners (pHOS), managing predation, and restoring tributary and estuarine habitat.[13]

2. Reestablish naturally spawning populations above dams on the Cowlitz and North Fork Lewis rivers, in areas that historically were highly productive, by improving adult and juvenile dam passage and developing hatchery reintroduction programs using broodstock from within-subbasin hatchery programs. Reestablishing populations in mid- to upper-elevation habitats is key to recovering the spring component of the Lower Columbia River Chinook salmon ESU.

3. Protect favorable tributary habitat and restore degraded but potentially productive habitat, particularly in the upper subbasins where spring Chinook salmon hold, spawn, and rear. Tributary habitat improvements are crucial for all populations.

4. Reestablish spring Chinook salmon in the White Salmon subbasin (now that Condit Dam has been removed) and in the Hood River subbasin.

Almost every spring Chinook salmon population is greatly affected by the loss and degradation of tributary habitat, and five populations—the Upper Cowlitz, Cispus, Tilton, North Fork Lewis, and White Salmon—have experienced impacts from tributary dams that are comparable to or even greater than those associated with degraded tributary habitat. Accordingly, for most populations, the greatest gains in viability are expected from tributary habitat and dam passage improvements (combined with hatchery reintroduction programs). Exceptions are the Tilton—a stabilizing population that is expected to remain at its baseline status—and the Sandy and Hood populations, for which reductions in hatchery impacts are targeted to provide the greatest benefit.

Although recent actions have substantially reduced harvest of spring Chinook salmon from baseline conditions, ancillary and precautionary actions are needed to ensure that harvest does not adversely affect conservation and recovery in the future. For all but the Tilton population, hatchery-related impacts are targeted to be reduced by half or more, with the largest reductions in the Sandy and Hood populations.

Fall Chinook Recovery Analysis

Prevalent Limiting Factors: Fall Chinook Salmon

Lower Columbia River fall Chinook salmon's poor status is due to a host of limiting factors that have affected the ESU for decades, or longer. Table ES-8 lists prevalent limiting factors that the management unit plans identified as having the greatest impact during the baseline period.

In addition, tributary hydropower dams are a primary limiting factor for the Upper Cowlitz and White Salmon populations, and inundation of historical spawning habitat by Bonneville Reservoir is a primary limiting factor for the Upper Gorge population.

[13] Some reduction in impacts on the Sandy population already have been achieved through removal of Marmot Dam and the Little Sandy River diversion in 2008 and protection of associated instream water rights for fish.

Table ES-8
Prevalent Primary Limiting Factors for Fall Chinook Salmon during Baseline Period

Limiting Factor	Populations for Which This Is a Primary Limiting Factor
Degraded riparian conditions along tributaries	Almost all*
Channel structure and form issues[14] in tributaries and the estuary	Almost all
Impaired side channel and wetland conditions in tributaries	Almost all
Loss/degradation of floodplain habitat in tributaries	Almost all
Loss/degradation of peripheral and transitional habitats[15] in the estuary	Almost all
Sediment conditions in the estuary	Almost all
Water quantity issues (i.e., altered hydrology) in the estuary	Almost all
Direct mortality from fisheries	Almost all
Reduction in population diversity as a result of stray hatchery fish interbreeding with natural-origin fish	Almost all

* "Almost all" means every population except one in each stratum.

Recovery Strategy: Fall Chinook Salmon

The recovery strategy for the tule fall component of the Lower Columbia River Chinook salmon ESU is designed to restore the Coast and Cascade tule strata to a high probability of persistence and to improve the persistence probability of all four Gorge stratum populations. The strategy involves transitioning from decades of management that allowed habitat degradation and emphasized hatchery production of fish for harvest (without adequate regard to effects on natural production) to management that supports a naturally self-sustaining ESU. This transition will be accomplished by addressing all threat categories and sharing the burden of recovery across categories. The most crucial elements are as follows:

1. Protect and improve the Coweeman and Lewis populations, which are currently performing the best, by ensuring that habitat is protected and restored, that the proportion of hatchery-origin spawners (pHOS) is reduced, and that harvest rates allow for gains in productivity to translate into continued progress toward recovery.

2. Fill information gaps regarding the extent of natural production and the extent of hatchery-origin spawners.

---

[14] Includes conditions such as channelization, reduced instream habitat complexity, fill and scour, and associated loss of spawning habitat.
[15] Peripheral and transitional habitats are sloughs, side channels, wetlands, and similar features that are periodically inundated during high flows.

3. Focus recovery efforts on populations that have the greatest prospects for improvement; determine whether efforts to reestablish populations are needed.

4. Protect existing high-functioning habitat for all populations.

5. Implement aggressive efforts to improve the quality and quantity of both tributary and estuarine habitat.

6. Implement aggressive efforts to reduce the influence of hatchery fish on natural-origin fish.

7. Adjust harvest as needed to ensure appropriate increases in natural-origin abundance.

8. Assess habitat quantity, quality, and distribution.

In the Coast and Cascade strata, much of the gains in fall Chinook salmon viability are targeted to be achieved through reductions in harvest, hatchery, and habitat impacts. This is the case for the Grays/Chinook, Elochoman/Skamokawa, Toutle, East Fork Lewis, Sandy, and Washougal populations. For the Scappoose population, target status is expected to be achieved primarily through reductions in hatchery and harvest impacts. In the Gorge stratum, some threat reductions are also targeted from hydropower actions, as the Upper Gorge, White Salmon, and Hood populations have been affected by dam passage issues at Bonneville, Powerdale, and Condit dams. (Powerdale Dam, on the Hood River, was removed in 2010; Condit Dam was breached in October 2011 and completely removed in September 2012).

Impacts from multiple threat categories will need to be reduced for most populations if they are to achieve their target status. Exceptions are the Youngs Bay, Big Creek, Upper Cowlitz, and Salmon Creek populations. As stabilizing populations, the Youngs Bay, Upper Cowlitz, and Salmon Creek populations are not targeted for reductions in any threat impacts. (However, recovery actions will still be needed for these populations to remain at their baseline status of low [for Youngs Bay] or very low persistence probability.) The Salmon Creek population is not targeted for threat reductions because of the highly urbanized nature of the subbasin and the extent of habitat degradation there. Both the Youngs Bay and Big Creek populations will be used to provide harvest opportunity through terminal fisheries targeting hatchery fish; consequently, the proportion of hatchery-origin spawners (pHOS) and harvest impacts in these populations are expected to remain high.

Late-Fall Chinook Recovery Strategy

Prevalent Limiting Factors: Late-Fall Chinook Salmon

Table ES-9 lists prevalent limiting factors that the management unit plans identified as having the greatest impact on both late-fall Chinook populations during the baseline period.

Table ES-9
Prevalent Primary Limiting Factors for Late-fall Chinook Salmon during Baseline Period

Limiting Factor	Populations for Which This Is a Primary Limiting Factor
Sediment conditions in tributaries and the Columbia River estuary	Both populations
Water quantity issues (i.e., altered hydrology) in the estuary	Both populations
Direct mortality from fisheries	Both populations

In addition, primary limiting factors that affect the Sandy population only are degraded riparian conditions, channel structure and form issues, impaired side channel and wetland conditions, and loss/degradation of floodplain habitat in tributaries, along with reduction in population diversity as a result of stray hatchery fish interbreeding with natural-origin fish.

Recovery Strategy: Late-Fall Chinook Salmon

The recovery strategy for the late-fall component of the Lower Columbia River Chinook salmon ESU is designed to maintain the two healthy populations (North Fork Lewis and Sandy) and raise the persistence probability of the Sandy population from high to very high. Key elements of the strategy are as follows:

1. Implement the regional hatchery strategy. Minimize the impacts of hatchery releases of steelhead, coho, and spring Chinook salmon on late-fall Chinook salmon. Continue the current practice of not releasing hatchery fall Chinook salmon into the North Fork Lewis River.

2. Reduce harvest impacts on the Sandy late-fall population by using the same harvest strategies identified for tule fall Chinook salmon. Continue to manage fisheries to meet the spawning escapement goal for the Lewis River late-fall population and consider reassessing the goal as new data are acquired.

3. Implement actions in the regional tributary and estuary habitat strategy designed to benefit tule fall Chinook salmon. Implement the stratum-level tributary habitat strategies designated for tule fall Chinook.

Improving the persistence of the Sandy population will be accomplished primarily through reductions in harvest and hatchery impacts. As with spring and tule fall Chinook salmon, recent actions have substantially reduced harvest impacts on late-fall Chinook salmon over baseline conditions, but additional reductions in harvest impacts are identified to achieve the target status for the Sandy population. More modest reductions in the tributary and estuarine habitat, hydropower, and predation threat categories are expected to support the gains achieved through reductions in harvest and hatchery impacts.

Recovery Analysis: Columbia River Chum

This recovery plan covers all naturally spawned Columbia River chum salmon (*Oncorhynchus keta*) populations in the lower Columbia River and its tributaries. Chum salmon from three hatchery programs also are part of the ESU.[16]

Historically, the Columbia River chum salmon ESU consisted of 17 independent populations. Of these, 16 were fall-run populations and one was a summer-run population that returned to the Cowlitz River. Columbia River chum display an "ocean-type" life history, meaning that fry emigrate downstream shortly after emerging and rear in the Columbia River estuary before entering the ocean. Although chum salmon are strong swimmers, they rarely pass river blockages and waterfalls that pose no hindrance to other salmon or steelhead; thus, they spawn in low-gradient, low-elevation reaches and side channels. Spawning today is restricted largely to tributary and mainstem areas downstream of Bonneville Dam. Chum salmon need clean gravel for spawning, and spawning sites typically are associated with areas of upwelling water.

Baseline and Target Status: Chum Salmon

Today, 15 of the 17 populations that historically made up this ESU are so depleted that either their baseline probability of persistence is very low or they are extirpated or nearly so; this is the case for all six of the Oregon populations. Currently almost all natural production occurs in just two populations: the Grays/Chinook and the Lower Gorge. All three strata in the ESU fall significantly short of the WLC TRT criteria for viability.

Table ES-10
Baseline and Target Status of Columbia River Chum Salmon Populations*

Stratum	Population	Core or Genetic Legacy?**	Contribution to Recovery	Baseline Status	Target Status
Coast	Youngs Bay (OR)	C	Stabilizing	VL	VL
	Grays/Chinook (WA)	C, GL	Primary	M	VH
	Big Creek (OR)	C	Stabilizing	VL	VL
	Elochoman/Skamakowa (WA)	C	Primary	VL	H
	Clatskanie (OR)		Primary	VL	H
	Mill/Abernathy/Germany (WA)		Primary	VL	H
	Scappoose (OR)		Primary	VL	H
Cascade	Cowlitz - fall (WA)	C	Contributing	VL	M
	Cowlitz - Summer (WA)	C	Contributing	VL	M
	Kalama (WA)		Contributing	VL	M
	Lewis (WA)	C	Primary	VL	H
	Salmon Creek (WA)		Stabilizing	VL	VL
	Clackamas (OR)	C	Contributing	VL	M
	Sandy (OR)		Primary	VL	H
	Washougal (WA)		Primary	VL	H+

[16] In 2010, the Oregon Department of Fish and Wildlife initiated a new chum salmon hatchery program at Big Creek Hatchery to develop chum salmon for reintroduction into Lower Columbia River tributaries in Oregon. NMFS has not yet evaluated this hatchery program for inclusion in the ESU.

Stratum	Population	Core or Genetic Legacy?**	Contribution to Recovery	Baseline Status	Target Status
Gorge	Lower Gorge (WA & OR)	C, GL	Primary	H	VH
	Upper Gorge (WA & OR)		Contributing	VL	M

* Status is equivalent to persistence probability. VL = very low, L = low, M = moderate, H = high, VH = very high.

** C = Core populations, meaning those that historically were the most productive. G = Genetic legacy populations, which best represent historical genetic diversity.

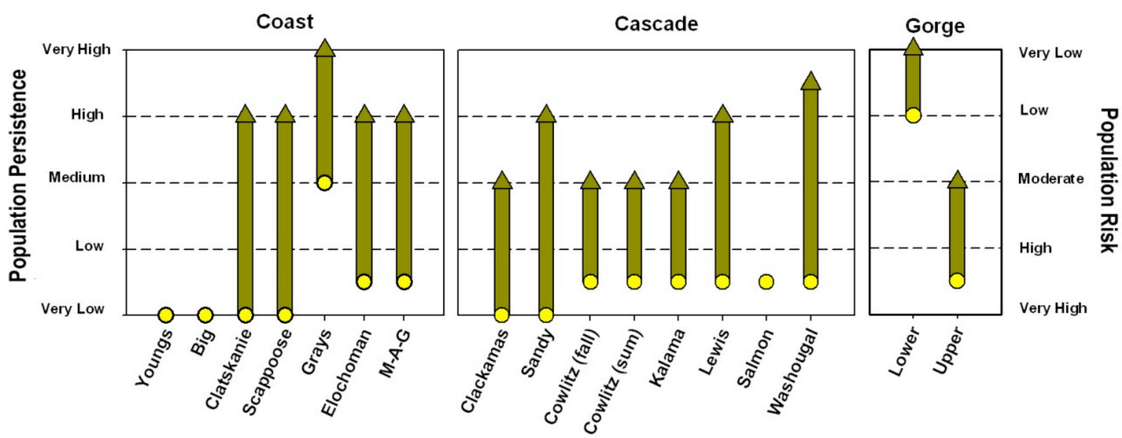

Figure ES-4. *Conservation Gaps for Columbia River Chum Salmon Populations (i.e., Difference between Baseline and Target Status)*

Prevalent Limiting Factors: Chum Salmon

Columbia River chum salmon's poor status is due to a host of limiting factors that have affected the ESU for decades, or longer. Table ES-11 lists prevalent limiting factors that the management unit plans identified as having the greatest impact during the baseline period.

Table ES-11
Prevalent Primary Limiting Factors for Chum Salmon during Baseline Period

Limiting Factor	Populations for Which This Is a Primary Limiting Factor
Channel structure and form issues[17] in the Columbia River estuary	Almost all*
Loss/degradation of peripheral and transitional habitats[18] in the estuary	Almost all
Sediment conditions in the estuary	Almost all
Water quantity issues (i.e., altered hydrology) in the estuary	Almost all

[17] Includes conditions such as channelization, reduced instream habitat complexity, fill and scour, and associated loss of spawning habitat.
[18] Peripheral and transitional habitats are sloughs, side channels, wetlands, and similar features that are periodically inundated during high flows.

Limiting Factor	Populations for Which This Is a Primary Limiting Factor
Degraded riparian conditions in tributaries	Almost all Washington** populations
Channel structure and form issues in tributaries	Almost all Washington populations
Impaired side channel and wetland conditions in tributaries	Almost all Washington populations
Loss/degradation of floodplain habitat in tributaries	Almost all Washington populations

* "Almost all" means every population except one in each stratum.
** Tributary habitat factors in this table are for Washington populations only because of differences in how Oregon and Washington recovery planners categorized limiting factors occurring in areas of tidal influence in the lower reaches of tributaries; see Table 8-3 of the recovery plan.

In addition, passage issues at Bonneville Dam and inundation of historical spawning habitat by Bonneville Reservoir are identified as primary limiting factors for the Upper Gorge population.

Recovery Strategy: Chum Salmon

The ESU recovery strategy for Columbia River chum salmon focuses on improving tributary and estuarine habitat conditions, reducing or mitigating hydropower impacts, and reestablishing chum salmon populations where they may have been extirpated. The goal of the strategy is to increase the abundance, productivity, diversity, and spatial structure of chum salmon populations such that the Coast and Cascade chum salmon strata are restored to a high probability of persistence and the persistence probability of the two Gorge populations improves. The ESU recovery strategy has the following main elements:

1. Protect and improve the Grays/Chinook and Lower Gorge populations, which together produce the majority of Columbia River chum salmon and are the only populations in the ESU not currently at very high risk of extinction.

2. Identify, protect, and restore chum salmon spawning habitat in lower mainstem and off-channel areas of large rivers and streams that are fed by upwelling from intergravel flows or springs. Restore hydrologic, riparian, and sediment processes (e.g., large woody debris recruitment) that support the accumulation of spawning gravel and reduce inputs of fine sediment.

3. Restore off-channel and side-channel habitats (alcoves, wetlands, floodplains, etc.) in the Columbia River estuary, where chum salmon fry rely on peripheral and transitional habitats for extended estuarine rearing.

4. Use hatchery reintroduction as appropriate in reestablishing chum salmon populations and continue using supplementation to enhance the abundance of the Grays/Chinook and Lower Gorge populations.

Restoring tributary spawning and estuary rearing habitat is essential in the recovery of Columbia River chum salmon. Although the recovery strategy includes other components, no other factor can effectively bring about recovery.

Most of the gains in the viability of Washington chum salmon populations are targeted to be achieved by improving tributary and estuarine habitat. Because potentially manageable harvest, hatchery, and predation impacts on chum salmon already are relatively low, there is little opportunity to further reduce threats in these sectors. Hydropower actions are projected to benefit the Upper Gorge population, which is affected by Bonneville Dam and its reservoir.

Oregon recovery planners developed a chum salmon recovery strategy that involves identifying specific habitat needs and proceeding with reintroduction, initially in the Coast stratum.

Recovery Analysis: Lower Columbia River Steelhead

This recovery plan addresses steelhead in the Cascade and Gorge ecozones only, excluding the White Salmon population and populations in the Coast ecozone. This is because the White Salmon population is part of the Middle Columbia steelhead DPS (and thus is addressed in a separate recovery plan), and the Coast populations are part of the Southwest Washington DPS, which is not listed under the ESA. Also excluded is the resident, freshwater form of *Oncorhynchus mykiss*, which usually is called "rainbow" or "redband" trout. In contrast, steelhead are the anadromous form of *O. mykiss*, meaning that they spend a portion of their life cycle in the ocean but return to fresh water to breed. Thus, this recovery plan covers all naturally spawned anadromous *O. mykiss* populations in streams and tributaries to the Columbia River between and including the Cowlitz and Wind rivers in Washington and, in Oregon, between and including (1) the Willamette River up to Willamette Falls, and (2) the Hood River in Oregon. Steelhead from eight hatchery programs also are part of the DPS.[19]

Historically, the Lower Columbia River steelhead DPS consisted of 23 independent populations: 17 winter-run populations and six summer-run populations. Winter and summer steelhead differ in spawning timing, degree of sexual maturity when returning to fresh water, and other characteristics. Both winter steelhead and summer steelhead spawn in a wide range of conditions, from large streams and rivers to small streams and side channels. Within the same watershed, winter and summer steelhead generally spawn in geographically distinct areas. Summer steelhead can often reach headwater areas above waterfalls that are impassable to winter steelhead during the high-velocity flows common during the winter-run migration. Steelhead are iteroparous, meaning they can spawn more than once.

Baseline and Target Status: Steelhead

Today, 16 of the 23 Lower Columbia River steelhead populations have a low or very low probability of persisting over the next 100 years, and six populations have a moderate

[19] The release of Cowlitz Hatchery winter steelhead into the Tilton River was discontinued in 2007, the Hood River winter steelhead program was discontinued in 2009, and the release of hatchery winter steelhead into the Upper Cowlitz and Cispus rivers was discontinued in 2010. In its 2011 5-year review, NMFS recommended removing these programs from the DPS and adding a Lewis River winter steelhead program that was initiated in 2009.

probability of persistence. Only the summer-run Wind population is considered viable. All four strata in the DPS fall short of the WLC TRT criteria for viability.

Table ES-12
Baseline and Target Status of LCR Steelhead Populations*

Stratum	Population	Core or Genetic Legacy?**	Contribution to Recovery	Baseline Status	Target Status
Cascade summer	Kalama (WA)	C	Primary	M	H
	NF Lewis (WA)		Stabilizing	VL	VL
	EF Lewis (WA)		Primary	VL	H
	Washougal (WA)	C	Primary	M	H
Gorge summer	Wind (WA)	C	Primary	H	VH
	Hood (OR)		Primary	VL	H
Cascade winter	Lower Cowlitz (WA)		Contributing	L	M
	Upper Cowlitz (WA)	C, GL	Primary	VL	H
	Cispus (WA	C, GL	Primary	VL	H
	Tilton (WA)		Contributing	VL	L
	SF Toutle (WA)		Primary	M	H+
	NF Toutle (WA)	C	Primary	VL	H
	Coweeman (WA)		Primary	L	H
	Kalama (WA)		Primary	L	H+
	NF Lewis (WA)	C	Contributing	VL	M
	EF Lewis (WA)		Primary	M	H
	Salmon Creek (WA)		Stabilizing	VL	VL
	Washougal (WA)		Contributing	L	M
	Clackamas (OR)	C	Primary	M	H
	Sandy (OR)	C	Primary	L	VH
Gorge winter	L. Gorge (OR & WA)		Primary	L	H
	U. Gorge (OR & WA)		Stabilizing	L	L
	Hood (OR)	C, GL	Primary	M	H

* Status is equivalent to persistence probability. VL = very low, L = low, M = moderate, H = high, VH = very high.

** C = Core populations, meaning those that historically were the most productive. G = Genetic legacy populations, which best represent historical genetic diversity.

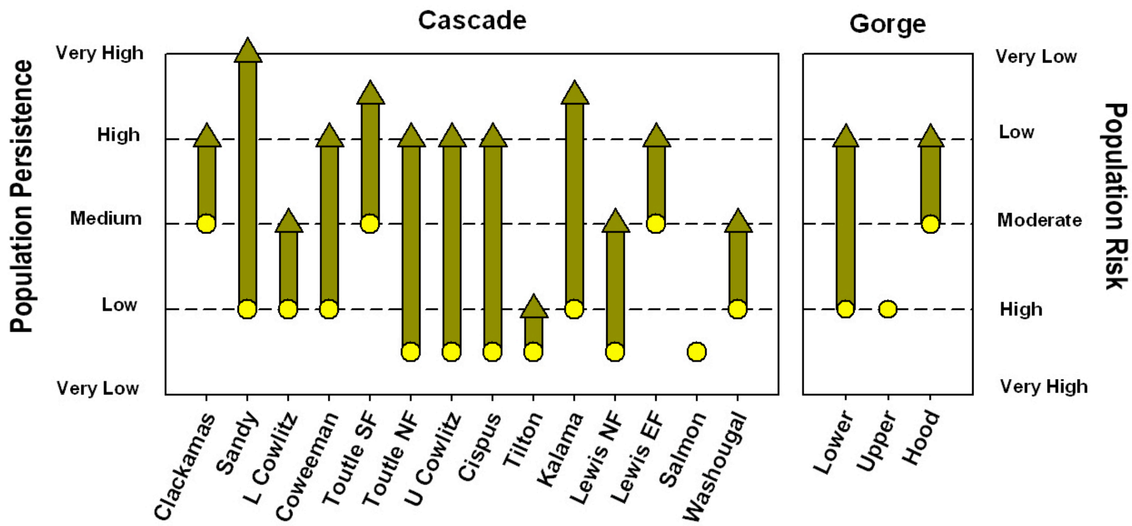

Figure ES-5. *Conservation Gaps for LCR Winter Steelhead Populations (i.e., Difference between Baseline and Target Status)*

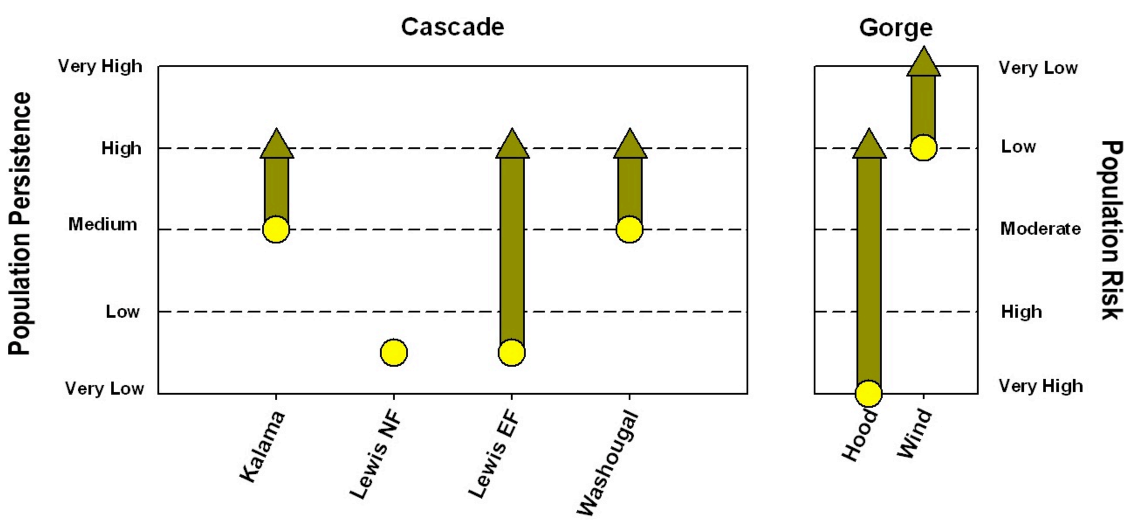

Figure ES-6. *Conservation Gaps for LCR Summer Steelhead Populations (i.e., Difference between Baseline and Target Status)*

Prevalent Limiting Factors: Steelhead

Lower Columbia River steelhead's poor status is due to a host of limiting factors that have affected the ESU for decades, or longer. Tables ES-13 and ES-14 list prevalent limiting factors that the management unit plans identified as having the greatest impact during the baseline period.

Table ES-13
Prevalent Primary Limiting Factors for Winter Steelhead during Baseline Period

Limiting Factor	Populations for Which This Is a Primary Limiting Factor
Degraded riparian conditions along tributaries	Almost all*
Channel structure and form issues[20] in tributaries and the Columbia River estuary	Almost all
Impaired side channel and wetland conditions in tributaries	Almost all
Loss/degradation of floodplain habitat in tributaries	Almost all
Sediment conditions in the estuary	Almost all
Water quantity issues (i.e., altered hydrology) in the estuary	Almost all

* "Almost all" means every population except one in each stratum.

Table ES-14
Prevalent Primary Limiting Factors for Summer Steelhead during Baseline Period

Limiting Factor	Populations for Which This Is a Primary Limiting Factor
Degraded riparian conditions along tributaries	Almost all*
Channel structure and form issues[21] in tributaries	Almost all
Impaired side channel and wetland conditions in tributaries	Almost all
Loss/degradation of floodplain habitat in tributaries	Almost all
Sediment conditions in tributaries and the Columbia River estuary	Almost all
Water quantity issues (i.e., altered hydrology) in the estuary	Almost all

* "Almost all" means every population except one in each stratum.

In addition, tributary hydropower development is a primary limiting factor for the North Fork Lewis summer steelhead population and several populations in the Cascade winter steelhead stratum, as is reduction in population diversity as a result of stray hatchery fish interbreeding with natural-origin fish.

Recovery Strategy: Steelhead

The recovery strategy for the Lower Columbia River steelhead DPS is aimed at restoring the Cascade and Gorge winter and summer strata to a high probability of persistence. Although the strategy involves threat reductions in all categories, the most crucial elements are as follows:

1. Protect favorable tributary habitat and restore degraded but potentially productive habitat, especially in subbasins where large improvements in

[20] Includes conditions such as channelization, reduced instream habitat complexity, fill and scour, and associated loss of spawning habitat.
[21] Includes conditions such as channelization, reduced instream habitat complexity, fill and scour, and associated loss of spawning habitat.

population abundance and productivity are needed to achieve recovery goals. This is the case in the Upper Cowlitz, Cispus, North Fork Toutle, Kalama, and Sandy subbasins for winter steelhead and in the East Fork Lewis and Hood subbasins for summer steelhead.

2. Protect and improve the South Fork Toutle, East Fork Lewis, Clackamas, and Hood winter steelhead populations, which currently are the best-performing winter populations, to a high probability of persistence. This will be accomplished through population-specific combinations of threat reductions, to include protection and restoration of tributary habitat (crucial for all except the Hood population), reductions in hatchery strays on the spawning grounds, and—for the Hood population—removal of Powerdale Dam (this was completed in 2010).

3. Significantly reduce hatchery impacts on the Hood summer steelhead population[22] and, to a lesser degree, on many other populations, especially the Upper Cowlitz, Cispus, Tilton, North Fork Lewis, and Clackamas winter populations and the East Fork summer population. Continue to limit hatchery impacts on the Kalama and Wind summer steelhead populations to improve population diversity.

4. Reestablish naturally spawning winter steelhead populations above tributary dams in the Cowlitz system (Upper Cowlitz and Cispus populations) and improve the status of the Tilton winter steelhead population through hatchery reintroductions and comprehensive threat reductions; reintroduce winter steelhead above dams on the North Fork Lewis River.

5. Reduce predation by birds, non-salmonid fish, and marine mammals.

Loss and degradation of tributary habitat, hatchery effects, and predation are pervasive threats that affect most steelhead populations, but the types of recovery actions that will be of most benefit vary by population. For the Upper Cowlitz, Cispus, Tilton, and North Fork Lewis winter populations, the greatest gains are expected to be achieved by reestablishing natural populations above tributary dams, but reductions in hatchery- and tributary habitat-related threats also will contribute significantly. For the East Fork Lewis summer population, improvements in tributary habitat are projected to provide the greatest benefit. The Sandy winter steelhead population is targeted for significant reductions in hatchery-related threats, but because of fairly recent changes in the management of the hatchery steelhead program, current stray rates in this population already are lower than the 10 percent called for for delisting. Hatchery- and tributary habitat-related actions will be of greatest benefit to Clackamas winter steelhead.

In the Gorge strata, reductions in tributary habitat-related threats will be significant for the Lower and Upper Gorge winter populations, especially in Oregon. For the Hood

[22] The Sandy winter steelhead population was also targeted for a significant reduction in hatchery impacts (i.e., 80 percent). However, the Oregon management unit plan states that, because of fairly recent changes in the management of the hatchery steelhead program, current stray rates in the Sandy winter steelhead population already are lower than the 10 percent called for in the threat reduction targets (ODFW 2010 p. 196).

winter population, the greatest gains in persistence probability are expected from reductions in hatchery- and hydropower-related threats. The Hood summer steelhead population is targeted for significant reductions in multiple threat categories, with particularly large reductions in tributary habitat- and hydropower-related threats and a complete elimination of hatchery threats (summer steelhead will no longer be released in the Hood River subbasin).

With harvest impacts on natural-origin winter steelhead having dropped substantially from historical highs, further reductions in harvest impacts do not figure prominently in the threat reduction scenarios for most steelhead populations. The recovery strategy involves continued management of fisheries to limit impacts to baseline levels.

Adaptive Management and Research, Monitoring, and Evaluation

The life cycles of salmon and steelhead are complex, and there is much we do not know about the range of factors that affect these species and how specific actions influence their characteristics and survival. For this recovery plan to be successful, we must do more than implement the strategies and actions the plan calls for. We also must learn during implementation, continually check our progress in reaching recovery goals, and make adjustments as necessary. Thus, the recovery plan calls for data gathering on the status and trends of populations, their habitats, and sources of threats; resolution of the many unknowns (which are referred to as critical uncertainties); and new or continued research, monitoring, and evaluation (RME) to assess the effectiveness of actions once they are implemented.

The recovery plan also incorporates adaptive management, which is the process of adjusting management actions and/or the overall approach to recovery based on new information, such as information derived from RME activities. Adaptive management works by offering a process for explicitly proposing, prioritizing, implementing, and evaluating alternative approaches and actions. This ensures that the best and most effective means of achieving recovery goals are used, even while scientific understanding of fish populations' needs and the benefits of specific actions continues to change and improve.

Local recovery planners have or will develop specific RME plans—for their respective geographic areas—that are based on regional guidance for adaptive management and RME. These RME plans will guide recovery planning RME efforts and funding in each management unit, within a context of ongoing regional guidance and coordination.

Implementation

Recovery actions will be implemented over a 25-year period, as specified in the management unit plans and estuary recovery plan module. Effective implementation will require that the recovery efforts of diverse private, local, state, tribal, and federal parties across two states be coordinated at multiple levels.

At the management unit level, Washington's Lower Columbia Fish Recovery Board will lead implementation of actions in southwest Washington, and the Oregon Department of Fish and Wildlife implementation coordinator and stakeholder team will lead recovery plan implementation in Oregon, supported by the governance structure of the Oregon Plan for Salmon and Watersheds. In the White Salmon, NMFS, in coordination with the Washington Gorge Implementation Team (WAGIT), has taken the lead in coordinating implementation. Each of the lead implementing organizations will develop a series of 3-year or 6-year implementation schedules for their respective management unit. Implementation schedules will identify and prioritize[23] site-specific projects, determine costs and time frames, and identify responsible parties, based on strategies and actions in the recovery plan. Thus, the implementation schedules will provide more detail, clarity, and accountability for implementation than this recovery plan does.

At a higher level than the management units, the Lower Columbia Recovery Planning Steering Committee (which NMFS convened to guide development of this recovery plan) will lead efforts to coordinate the actions of the many entities that will play a role in implementation. For example, there is a need for coordination among the management units and the entities implementing Columbia River estuary recovery actions because the lower, tidal portions of the tributaries, which are within the management unit planning areas, overlap with the planning area of the *Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead*. The steering committee will perform its coordination functions by working with subcommittees and other regional forums as needed.

Finally, NMFS has a unique role in recovery plan implementation. In addition to ensuring that its statutory responsibilities for recovery under the ESA are met, NMFS will support local recovery efforts by (1) helping to coordinate and encourage recovery plan implementation, (2) using recovery plans to guide regulatory decision making, (3) providing leadership in regional research, monitoring, and evaluation forums, and (4) providing periodic reports on species status and trends, limiting factors, threats, and plan implementation status.

The good news is that some recovery actions already are taking place. Harvest rates have dropped significantly since the first Lower Columbia River species were listed under the Endangered Species Act. Reforms of hatchery practices and programs are being implemented throughout the Columbia Basin. Dams have been removed or breached on the Sandy, Hood, and White Salmon rivers, and improvements in passage and operations to benefit salmon and steelhead are under way at other tributary hydropower facilities and in the Federal Columbia River hydropower system. Tributary and estuary habitat protection and restoration projects are under way. However, considerable additional work is needed to meet the goals of this plan. Habitat activities in particular need to be scaled up if they are to provide the needed benefits.

Conclusion

Recovery of ESA-listed Lower Columbia River salmon and steelhead will require actions that conserve and restore the key biological, ecological, and landscape processes that support the ecosystems that salmonid species depend on. These measures will require

[23] Some prioritization work already has been done, in that the management unit plans identify high-priority reaches for tributary habitat protection and restoration actions. In addition, the Oregon and White Salmon management unit plans offer some guidance on how actions might be prioritized across threat categories.

implementation of specific tributary and estuary habitat protection and restoration actions; changes in management of harvest, hatchery, and hydropower programs; and predation control. Development of an effective implementation framework, coupled with a responsive RME and adaptive management plan, provides the best assurance that this recovery plan will be fully implemented and effective. The plan's identification of target statuses, primary and secondary limiting factors that have caused gaps between baseline and target status, and actions to close those gaps is intended to aid implementing entities as they take actions that will lead to delisting and, eventually, achievement of broad sense recovery goals. The keys to long-term success will be full funding and implementation of this recovery plan and voluntary participation of residents of the Lower Columbia region. It is only through the involvement of all of those who live and work in this region that recovery will be achieved.

Key Documents

Oregon Lower Columbia Conservation and Recovery for Salmon and Steelhead
Oregon Department of Fish and Wildlife, 2010
http://www.dfw.state.or.us/fish/CRP/lower_columbia_plan.asp

ESA Recovery Plan for the White Salmon River Watershed
National Marine Fisheries Service, 2013
http://www.nwr.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/lower_columbia_river/lower_columbia_river_recovery_plan_for_salmon_steelhead.html

Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan
Lower Columbia Fish Recovery Board, 2010
http://www.lcfrb.gen.wa.us/Recovery%20Plans/RP%20Frontpage.htm

Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead
National Marine Fisheries Service, 2011
http://www.nwr.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/recovery_plans_supporting_documents.html

Recovery Plan Module: Mainstem Columbia River Hydropower Projects
National Marine Fisheries Service, 2008
http://www.nwr.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/recovery_plans_supporting_documents.html

2008 Federal Columbia River Power System Biological Opinion and 2010 Supplement
National Marine Fisheries Service, 2008 and 2010
http://www.nwr.noaa.gov/hydropower/fcrps_opinion/federal_columbia_river_power_system.html