Science, Service, Stewardship

5-Year Review: Summary & Evaluation of **Lower Columbia River Chinook Columbia River Chum Lower Columbia River Coho Lower Columbia River Steelhead**

National Marine Fisheries Service
Northwest Region
Portland, OR

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5-Year Review: Lower Columbia River Species

Species Reviewed	Evolutionarily Significant Unit or Distinct Population Segment
Chinook Salmon (*Oncorhynchus tshawytscha*)	*Lower Columbia River Chinook Salmon*
Chum Salmon (*O. keta*)	*Columbia River Chum Salmon*
Coho Salmon (*O. kisutch*)	*Lower Columbia River Coho Salmon*
Steelhead (*O. mykiss*)	*Lower Columbia River Steelhead*

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Table of Contents

1 ▪ General Information 1
1.1 Introduction 1
1.1.1 Background on Listing Determinations 1
1.2 Methodology Used to Complete the Review 2
1.3 Background – Summary of Previous Reviews, Statutory and Regulatory Actions, and Recovery Planning 4
1.3.1 Federal Register Notice Announcing initiation of this review 4
1.3.2 Listing history 4
1.3.3 Associated rulemakings 4
1.3.4 Review History 6
1.3.5 Species' Recovery Priority Number at Start of 5-year Review Process 7
1.3.6 Recovery Plan or Outline 8
2 · Review Analysis 11
2.1 Delineation of species under the Endangered Species Act 11
2.1.1 Summary of relevant new information regarding delineation of the LCR ESUs/DPS 12
2.2 Recovery Criteria 15
2.2.1 Do the species have final, approved recovery plans containing objective, measurable criteria 15
2.2.2 Adequacy of recovery criteria 15
2.2.3 List the recovery criteria as they appear in the recovery plan 16
2.3 Updated Information and Current Species' Status 18
2.3.1 LCR Chinook Salmon 20
2.3.2 Columbia River Chum Salmon 23
2.3.3 Lower Columbia River Coho Salmon 26
2.3.4 Lower Columbia River Steelhead 29
2.3.5 Five-Factor Analysis 30
2.4 Synthesis 41
2.4.1 ESU/DPS Delineation and Hatchery Membership 42
2.4.2 ESU/DPS Viability and Statutory Listing Factors 43
3 · Results 44
3.1 Classification 45
3.2 New Recovery Priority Number 46
4 · Recommendations for Future Actions 47
5 · References 49

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1 ▪ General Information

1.1 Introduction

Many West Coast salmon and steelhead (Oncorhynchus sp.) stocks have declined substantially from their historic numbers and now are at a fraction of their historical abundance. There are several factors that contribute to these declines, including: overfishing, loss of freshwater and estuarine habitat, hydropower development, poor ocean conditions, and hatchery practices. These factors collectively led to the National Marine Fisheries Service's (NMFS') listing of 28 salmon and steelhead stocks in California, Idaho, Oregon, and Washington under the Federal Endangered Species Act (ESA).

The ESA, under section 4(c)(2), directs the Secretary of Commerce to review the listing classification of threatened and endangered species at least once every five years. After completing this review, the Secretary must determine if any species should be: (1) removed from the list; (2) have its status changed from threatened to endangered; or (3) have its status changed from endangered to threatened. The most recent listing determinations for most salmon and steelhead occurred in 2005 and 2006. This document describes the results of the agency's five-year status review for ESA-listed Lower Columbia River (LCR) salmon and steelhead species. These include: Lower Columbia River Chinook salmon, Columbia River chum salmon, Lower Columbia River coho salmon, and Lower Columbia River steelhead.

1.1.1 Background on listing determinations

The ESA defines species to include subspecies and distinct population segments (DPS) of vertebrate species. A species may be listed as threatened or endangered. To identify distinct population segments of salmon species we apply the "Policy on Applying the Definition of Species under the ESA to Pacific Salmon" (56 FR 58612). Under this policy we identify population groups that are "evolutionarily significant units" (ESU) within their species. We consider a group of populations to be an ESU if it is substantially reproductively isolated from other populations, and represents an important component in the evolutionary legacy of the biological species. We consider an ESU as constituting a DPS and therefore a "species" under the ESA. To identify DPSs of steelhead, we apply the joint U.S. Fish and Wildlife Service-National Marine Fisheries Service DPS policy (61 FR 4722) rather than the ESU policy. Under this policy, a DPS of steelhead must be discrete from other populations, and it must be significant to its taxon.

Artificial propagation programs (hatcheries) are common throughout the range of ESA-listed West Coast salmon and steelhead. Prior to 2005, our policy was to include in the listed ESU or DPS only those hatchery fish deemed "essential for conservation" of the species. We revised that approach in response to a court decision and on June 28, 2005, announced a final policy addressing the role of artificially propagated Pacific salmon and steelhead in listing determinations under the ESA (70 FR 37204) (hatchery listing policy). This policy establishes criteria for including hatchery stocks in ESUs and DPSs. In addition, it: (1) provides direction for

considering hatchery fish in extinction risk assessments of ESUs and DPSs; (2) requires that hatchery fish determined to be part of an ESU or DPS be included in any listing of the ESU or DPS; (3) affirms our commitment to conserving natural salmon and steelhead populations and the ecosystems upon which they depend; and (4) affirms our commitment to fulfilling trust and treaty obligations with regard to the harvest of some Pacific salmon and steelhead populations, consistent with the conservation and recovery of listed salmon ESUs and steelhead DPSs.

To determine whether a hatchery program is part of an ESU or DPS and therefore must be included in the listing, we consider the origins of the hatchery stock, where the hatchery fish are released, and the extent to which the hatchery stock has diverged genetically from the donor stock. We include within the ESU or DPS (and therefore within the listing) hatchery fish that are derived from the population in the area where they are released, and that are no more than moderately diverged from the local population.

Because the new hatchery listing policy changed the way we considered hatchery fish in ESA listing determinations, we completed new status reviews and ESA listing determinations for West Coast salmon ESUs and steelhead DPSs. On June 28, 2005, we issued final listing determinations for 16 ESUs of Pacific salmon (70 FR 37160). On January 5, 2006 we issued final listing determinations for 10 DPSs of steelhead (71 FR 834).

1.2 Methodology used to complete the review

On March 18, 2010, we announced the initiation of five year reviews for 16 ESUs of salmon and 10 DPSs of steelhead in Oregon, California, Idaho, and Washington (75 FR 13082). We requested that the public submit new information on these species that has become available since our listing determinations in 2005 and 2006. In response to our request, we received information from Federal and state agencies, Native American Tribes, conservation groups, fishing groups, and individuals. We considered this information, as well as information routinely collected by our agency, to complete these five year reviews.

To complete the reviews, we first asked scientists from our Northwest Fisheries Science Center to collect and analyze new information about ESU and DPS viability. To evaluate viability, our scientists used the Viable Salmonid Population (VSP) concept developed by McElhany et al. (2000). The VSP concept evaluates four criteria – abundance, productivity, spatial structure, and diversity – to assess species viability. Through the application of this concept, the science center considered new information on the four salmon and steelhead population viability criteria. They also considered new information on ESU and DPS boundaries. At the end of this process, the science teams prepared reports detailing the results of their analyses (Ford et al. 2010).

To further inform the reviews, we also asked our Northwest Region salmon management biologists familiar with hatchery programs to consider new information available since the previous listing determinations. Among other things, they considered hatchery programs that have ended, new hatchery programs that have started, changes in the operation of existing programs, and scientific data relevant to the degree of divergence of hatchery fish from naturally

spawning fish in the same area. These biologists produced a report (Jones et al. 2011) describing their findings. Finally, we consulted with our Northwest Region salmon management biologists familiar with hatchery programs, habitat conditions, hydropower operations, and harvest management. In a series of structured meetings, by geographic area, these biologists identified relevant information and provided their insights on the degree to which circumstances have changed for each listed entity.

In preparing this report, we considered all relevant information, including the work of the Northwest Fisheries Science Center (Ford et al. 2010;); the report of the regional biologists regarding hatchery programs (Jones et al. 2011); recovery plans for the species in question; technical reports prepared in support of recovery plans for the species in question; the listing record (including designation of critical habitat and adoption of protective regulations); recent biological opinions issued for the Lower Columbia River species in question; information submitted by the public and other government agencies; and the information and views provided by the geographically based management teams. The present report describes the agency's findings based on all of the information considered.

1.3 Background – Summary of Previous Reviews, Statutory and Regulatory Actions, and Recovery Planning

1.3.1 Federal Register Notice announcing initiation of this review

75 FR 13082; March 18, 2010

1.3.2 Listing history

Beginning in 1998, NMFS began listing salmonid species in the LCR under the ESA. Over the next several years, four species of salmonids in this area were listed as threatened (Table 1).

Table 1. Summary of the listing history under the Endangered Species Act for ESUs and DPS in the Lower Columbia River.

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
Chinook Salmon (*O. tshawytscha*)	Lower Columbia River Chinook Salmon	**FR Notice:** 64 FR 14308 **Date:** 3/24/1999 **Classification:** Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 **Classification:** Threatened
Chum Salmon (*O. keta*)	Columbia River Chum Salmon	**FR Notice:** 64 FR 14508 **Date:** 3/25/1999 **Classification:** Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 **Classification:** Threatened
Coho Salmon (*O. kisutch*)	Lower Columbia River Coho Salmon	**FR Notice:** 70 FR3 7160 **Date:** 6/28/2005 **Classification:** Threatened	NA
Steelhead (*O. mykiss*)	Lower Columbia River Steelhead	**FR Notice:** 63 FR 13347 **Date:** 3/19/1998 **Classification:** Threatened	**FR Notice:** 71 FR 834 **Date:** 1/5/2006 **Classification:** Threatened

1.3.3 Associated rulemakings

The ESA requires NMFS to designate critical habitat, to the maximum extent prudent and determinable, for any species it lists under the ESA. Critical habitat is defined as: (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time of listing if the agency determines that the area itself is essential for conservation. We designated critical habitat for LCR Chinook salmon, LCR steelhead, and Columbia River chum salmon in 2005 (70 FR 52630, September 2, 2005). We currently are preparing a critical habitat designation for LCR coho salmon (76 FR 1392, January 10, 2011).

Section 9 of the ESA prohibits the take of species listed as endangered. The ESA defines take to mean harass, harm, pursue, hunt, shoot, wound, trap, capture, or collect, or attempt to engage in any such conduct. For threatened species, the ESA does not automatically prohibit take, but instead authorizes the agency to adopt regulations it deems necessary and advisable for species conservation including regulations that prohibit take (ESA section 4(d)). For threatened salmonids, NMFS has adopted 4(d) regulations that prohibit take except in specific circumstances. In 2005, we revised the 4(d) protective regulations for the three listed salmonid species in the Lower Columbia River, and again in 2006, for the LCR steelhead DPS, to take into account our hatchery listing policy.

Table 2. Summary of rulemaking for 4(d) protective regulations and critical habitat for ESUs and DPS in the Lower Columbia River.

Salmonid Species	ESU/DPS Name	4(d) Protective Regulations	Critical Habitat Designations
Chinook Salmon (*O. tshawytscha*)	Lower Columbia River Chinook Salmon	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Chum Salmon (*O. keta*)	Columbia River Chum Salmon	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Coho Salmon (*O. kisutch*)	Lower Columbia River Coho Salmon	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005	Under development **FR Notice:** 76 FR 1392 **Date:** 1/10/2011
Steelhead (*O. mykiss*)	Lower Columbia River Steelhead	**FR Notice:** 71 FR 834 **Date:** 1/5/2006	**FR notice:** 70 FR 52630 **Date:** 9/2/2005

1.3.4 Review History

Numerous scientific assessments have been conducted to assess the status of the LCR salmon ESUs and steelhead DPS. A list of these assessments is found in Table 3.

Table 3. Summary of previous scientific assessments for the ESUs and DPS in the Lower Columbia River.

Salmonid Species	ESU/DPS Name	Document Citation
Chinook Salmon (*O. tshawytscha*)	Lower Columbia River Chinook Salmon	LCFRB 2010 ODFW 2010 McElhany et al. 2007 Myers et al. 2006 WLCTRT and ODFW 2006 Good et al. 2005 Maher et al. 2005 NMFS 2005 LCFRB 2004 WLCTRT 2004 WLCTRT 2003 NMFS 1999b NMFS 1998b NMFS 1998c
Chum Salmon (*O. keta*)	Columbia River Chum Salmon	LCFRB 2010 ODFW 2010 McElhany et al. 2007 Myers et al. 2006 WLCTRT and ODFW 2006 Good et al. 2005 Maher et al. 2005 NMFS 2005 LCFRB 2004 WLCTRT 2004 WLCTRT 2003 NMFS 1999a NMFS 1999b NMFS 1997c

Coho Salmon (*O. kisutch*)	Lower Columbia River Coho Salmon	LCFRB 2010 ODFW 2010 McElhany et al. 2007 Myers et al. 2006 WLCTRT and ODFW 2006 Good et al. 2005 Maher et al. 2005 NMFS 2005 LCFRB 2004 WLCTRT 2004 WLCTRT 2003 NMFS 1996b NMFS 1995 NMFS 1991
Steelhead (*O. mykiss*)	Lower Columbia River Steelhead	LCFRB 2010 ODFW 2010 McElhany et al. 2007 Myers et al. 2006 WLCTRT and ODFW 2006 Good et al. 2005 Maher et al. 2005 NMFS 2005 LCFRB 2004 WLCTRT 2004 WLCTRT 2003 NMFS 1998a NMFS 1997a NMFS 1997b NMFS 1996a

1.3.5 Species' Recovery Priority Number at Start of 5-year Review Process

On June 15, 1990, NMFS issued guidelines (55 FR 24296) for assigning listing and recovery priorities. We assess three criteria to determine a species' priority for recovery plan development, implementation, and resource allocation: (1) magnitude of threat; (2) recovery potential; and (3) existing conflict with activities such as construction and development. Table 4 lists the recovery priority numbers for the subject species, as reported in the 2006-2008 Biennial Report to Congress on the Recovery Program for Threatened and Endangered Species (available at: http://www.nmfs.noaa.gov/pr/pdfs/laws/esabiennial2008.pdf).

1.3.6 Recovery Plan or Outline

Table 4. Recovery Priority Number and Endangered Species Act Recovery Plans for the ESUs and DPSs in the Lower Columbia River[1].

Salmonid Species	ESU/DPS Name	Recovery Priority Number	Recovery Plans/Outline
Chinook Salmon (*O. tshawytscha*)	Lower Columbia River Chinook Salmon	**1**	**Author:** National Marine Fisheries Service **Title:** ESA Recovery Planning for Salmon and Steelhead in the Willamette and Lower Columbia River Basins Status of Planning Effort and Strategy for Completing Plans **Date:** 2005 **Type:** Strategy **Author:** Lower Columbia Fish Recovery Board **Title:** Lower Columbia Salmon Recovery And Fish & Wildlife Subbasin Plan **Date:** 2004 **Type:** Interim **Author:** Lower Columbia Fish Recovery Board **Title:** Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan **Date:** 2010 **Type:** Locally developed plan addressing part of the ESU. Basis of NMFS ESU-level plan currently in development. (Update/revision of LCFRB 2004.) **Author:** Oregon Department of Fish and Wildlife **Title:** Lower Columbia River Conservation & Recovery Plan for Oregon Populations of Salmon and Steelhead. **Date:** 2010 **Type:** Locally developed plan addressing part of ESU. Basis of ESU-level plan currently in development. **Author:** National Marine Fisheries Service **Title:** ESA Recovery Plan for the White Salmon River Subbasin. **Date:** 2010 **Type:** Draft plan addressing part of ESU. Basis of ESU-level plan currently in development.

[1] Recovery planning documents for the Lower Columbia River ESUs and DPS can be found at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/LC/interim.cfm

Chum Salmon (*O. keta*)	Columbia River Chum Salmon	**1**	**Author:** National Marine Fisheries Service **Title:** ESA Recovery Planning for Salmon and Steelhead in the Willamette and Lower Columbia River Basins Status of Planning Effort and Strategy for Completing Plans **Date:** 2005 **Type:** Strategy **Author:** Lower Columbia Fish Recovery Board **Title:** Lower Columbia Salmon Recovery And Fish & Wildlife Subbasin Plan **Date:** 2004 **Type:** Interim **Author:** Lower Columbia Fish Recovery Board **Title:** Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan. **Date:** 2010 **Type:** Locally developed plan addressing part of ESU. Basis of NMFS ESU-level plan currently in development.(Update/revision of LCFRB 2004.) **Author:** Oregon Department of Fish and Wildlife **Title:** Lower Columbia River Conservation & Recovery Plan for Oregon Populations of Salmon and Steelhead **Date:** 2010 **Type:** Locally developed plan addressing part of ESU. Basis of ESU-level plan currently in development **Author:** National Marine Fisheries Service **Title:** ESA Recovery Plan for the White Salmon River Subbasin **Date:** 2010 **Type:** Draft plan addressing part of ESU. Basis
Coho Salmon (*O. kisutch*)	Lower Columbia River Coho Salmon	**1**	**Author:** National Marine Fisheries Service **Title:** ESA Recovery Planning for Salmon and Steelhead in the Willamette and Lower Columbia River Basins Status of Planning Effort and Strategy for Completing Plans **Date:** 2005 **Type:** Strategy **Author:** Lower Columbia Fish Recovery Board **Title:** Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan **Date:** 2010 **Type:** Locally developed plan addressing part of ESU. Basis of NMFS ESU-level plan currently in development. **Author:** Oregon Department of Fish and Wildlife **Title:** Lower Columbia River Conservation & Recovery Plan for Oregon Populations of Salmon and Steelhead **Date:** 2010 **Type:** Locally developed plan addressing part of ESU. Basis of ESU-level plan currently in development. **Author:** National Marine Fisheries Service **Title:** ESA Recovery Plan for the White Salmon River Subbasin **Date:** 2010

			Type: Draft plan addressing part of ESU. Basis of ESU-level plan currently in development
Steelhead (*O. mykiss*)	Lower Columbia River Steelhead	**1**	**Author:** National Marine Fisheries Service **Title:** ESA Recovery Planning for Salmon and Steelhead in the Willamette and Lower Columbia River Basins Status of Planning Effort and Strategy for Completing Plans **Date:** 2005 **Type:** Strategy **Author:** Lower Columbia Fish Recovery Board **Title:** Lower Columbia Salmon Recovery And Fish & Wildlife Subbasin Plan **Date:** 2004 **Type:** Interim **Author:** Lower Columbia Fish Recovery Board **Title:** Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan **Date:** 2010 **Type:** Locally developed plan addressing part of ESU. Basis of NMFS ESU-level plan currently in development. (Update/revision of LCFRB 2004.) **Author:** Oregon Department of Fish and Wildlife **Title:** Lower Columbia River Conservation & Recovery Plan for Oregon Populations of Salmon and Steelhead **Date:** 2010 **Type:** Locally developed plan addressing part of ESU. Basis of ESU-level plan currently in development

2 · Review Analysis

In this section we review new information to determine whether the LCR listed species' delineations remain appropriate.

2.1 Delineation of species under the Endangered Species Act

Is the species under review a vertebrate?

ESU/DPS Name	YES	NO
Lower Columbia River Chinook Salmon	X	
Columbia River Chum Salmon	X	
Lower Columbia River Coho Salmon	X	
Lower Columbia River Steelhead	X	

Is the species under review listed as an ESU/DPS?

ESU/DPS Name	YES	NO
Lower Columbia River Chinook Salmon	X	
Columbia River Chum Salmon	X	
Lower Columbia River Coho Salmon	X	
Lower Columbia River Steelhead	X	

Was the ESU/DPS listed prior to 1996?

ESU/DPS Name	YES	NO	Date Listed if Prior to 1996
Lower Columbia River Chinook Salmon		X	N/A
Columbia River Chum Salmon		X	N/A
Lower Columbia River Coho Salmon		X	N/A
Lower Columbia River Steelhead		X	N/A

Prior to this 5-year review, was the ESU/DPS classification reviewed to ensure it meets the 1996 policy standards?

Not Applicable

2.1.1 Summary of relevant new information regarding delineation of the LCR ESUs/DPS

This section provides a summary of information presented in Ford et al. 2010—Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Northwest.

ESU/DPS Boundaries

In the Columbia River basin, the boundary between coastal and interior populations of Chinook salmon, coho salmon, and steelhead coincides with a major biogeographical barrier that lies along the crest of the Cascade Mountains and that may have been delineated by Celilo Falls. Life history, genetic, and ecological information indicate that the White Salmon and Klickitat River basins form part of a transitional zone between these two regions. At the time of the coastwide status reviews in the mid-1990s, there was considerable debate among NMFS' scientists about whether to recommend assigning populations within this transitional zone to the Lower Columbia or Mid-Columbia ESUs or DPSs.

New information, primarily DNA microsatellite variation, underscores the transitional nature of populations in this area and the uncertainty associated with the ESU and DPS boundaries there. The extirpation and potential alteration (via hatchery transfers) of some populations further complicate the issue. Within the transitional zone, it is relatively clear that Hood River steelhead remain closely associated with populations of the Lower Columbia River steelhead DPS. The mouths of the Hood, White Salmon, and Klickitat Rivers are in close geographic proximity, and genetic information indicating that the populations are discrete is lacking. Meanwhile, the Fifteenmile Creek population appears to be clearly associated with the Interior Columbia steelhead lineage. Given all this information, it might be reasonable either to reassign White Salmon and Klickitat River steelhead from the Mid-Columbia River DPS to the Lower Columbia River DPS or to maintain the existing DPS boundary. Likewise, given the transitional nature of the Klickitat River Chinook salmon population, it might be reasonable to reassign that population from the Mid-Columbia to the Lower Columbia River Chinook salmon ESU or to maintain the existing ESU boundary.

Coho salmon populations in the Columbia River gorge and interior Columbia regions have been largely extirpated, so there are no genetic analyses of coho salmon in this region. The original Lower Columbia River coho salmon ESU boundary was assigned based largely on extrapolation from information about the boundaries for Chinook salmon and steelhead. Again, it might also be reasonable to assign any coho salmon in the Klickitat River basin to the Lower Columbia coho salmon ESU. This would establish a common boundary for Chinook salmon, coho salmon, chum salmon, and steelhead at Celilo Falls (approximated by the location of The Dalles Dam). However, since it is unlikely that the Klickitat basin historically supported many coho salmon, the boundary change would have little effect on that ESU's conservation status.

Membership of Hatchery Programs

In preparing this report, our management biologists reviewed the available information regarding hatchery membership of the ESUs and DPS (Jones et al. 2011). They considered changes in hatchery programs that occurred since the last status review (e.g., some have been terminated

while others are new) and made recommendations about the inclusion or exclusion of specific programs. They also noted any errors and omissions in the existing descriptions of hatchery population membership. NMFS intends to address any needed changes and corrections via separate rulemaking subsequent to the completion of these five-year status reviews.

LCR Chinook Salmon ESU

The LCR Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River (64 FR 14208; March 24, 1999). Seventeen artificial propagation programs are considered to be part of the ESU: The Sea Resources Tule Chinook Program, Big Creek Tule Chinook Program, Astoria High School (STEP) Tule Chinook Program, Warrenton High School (STEP) Tule Chinook Program, Elochoman River Tule Chinook Program, Cowlitz Tule Chinook Program, North Fork Toutle Tule Chinook Program, Kalama Tule Chinook Program, Washougal River Tule Chinook Program, Spring Creek NFH Tule Chinook Program, Cowlitz spring Chinook Program in the Upper Cowlitz River and the Cispus River, Friends of the Cowlitz Spring Chinook Program, Kalama River Spring Chinook Program, Lewis River Spring Chinook Program, Fish First Spring Chinook Program, and the Sandy River Hatchery (ODFW stock #11) Chinook Salmon Hatchery programs. We determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (70 FR 37160).

The Elochoman Hatchery Fall Chinook Salmon Program was terminated in 2009. The last adults from this program will return to the Elochoman River in 2013.

There are four new fall Chinook salmon hatchery programs—the Deep River Net-Pen, Klaskanine Hatchery, Bonneville Hatchery, and Little White Salmon National Fish Hatchery tule fall Chinook salmon programs. These programs utilize broodstock from existing hatchery programs that are part of the ESU and warrant consideration for inclusion in the ESU (Jones et al. 2011).

LCR Coho Salmon ESU

Originally part of a larger Lower Columbia River/Southwest Washington ESU, LCR coho salmon were identified as a separate ESU and listed as threatened on June 28, 2005 (70 FR 37160). This ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, and includes the Willamette River to Willamette Falls, Oregon, as well as twenty-five artificial propagation programs: the Grays River, Sea Resources Hatchery, Peterson Coho Project, Big Creek Hatchery, Astoria High School (STEP) Coho Program, Warrenton High School (STEP) Coho Program, Elochoman Type-S Coho Program, Elochoman Type-N Coho Program, Cathlamet High School FFA Type-N

Coho Program, Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the Cowlitz Coho Program, North Fork Toutle River Hatchery, Kalama River Type-N Coho Program, Kalama River Type-S Coho Program, Washougal Hatchery Type-N Coho Program, Lewis River Type-N Coho Program, Lewis River Type-S Coho Program, Fish First Wild Coho Program, Fish First Type-N Coho Program, Syverson Project Type-N Coho Program, Eagle Creek National Fish Hatchery, Sandy Hatchery, and the Bonneville/Cascade/Oxbow Complex Coho Hatchery Programs.

The Elochoman Hatchery Type-S and Type-N coho salmon programs were eliminated in 2008. The last adults from these two programs returned to the Elochoman in 2010 (Jones et al. 2011). These programs should be removed from the ESU.

LCR Steelhead

The LCR steelhead DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington (inclusive), and the Willamette and Hood Rivers, Oregon (inclusive), as well as ten artificial propagation programs: the Cowlitz Trout Hatchery (in the Cispus, Upper Cowlitz, Lower Cowlitz, and Tilton Rivers), Kalama River Wild (winter- and summer-run), Clackamas Hatchery, Sandy Hatchery, and Hood River (winter- and summer-run) Steelhead Hatchery Programs. Excluded are O. mykiss populations in the upper Willamette River Basin above Willamette Falls, Oregon, and from the Little and Big White Salmon Rivers, Washington.

Releases of Cowlitz Hatchery late-run winter steelhead into the Upper Cowlitz and Cispus rivers were terminated in 2010, with the last returns expected in 2012. The release of Cowlitz Hatchery late-run winter steelhead into the Tilton River was terminated in 2007, and the last returns were in 2009. Releases from the Hood River Summer Steelhead Program ended in 2009, with the last returns expected in 2011 (Jones et al. 2011). These programs should be removed from the DPS.

Broodstock collection for the new Lewis River Late-Run Winter Steelhead Program began in 2009. This program uses natural-origin late-run winter steelhead that are genetically representative of the North Fork Lewis River natural-origin winter steelhead population for broodstock and warrants consideration for inclusion in the DPS (Jones et al. 2011).

Columbia River Chum Salmon

The Columbia River chum salmon ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon, as well as three artificial propagation programs: the Chinook River (Sea Resources Hatchery), Grays River, and Washougal River/Duncan Creek Chum Hatchery Programs.

A new chum hatchery program was initiated in 2010 at Big Creek Hatchery in Oregon to develop chum salmon for reintroduction into Lower Columbia River tributaries. This program will use broodstock collected in the Grays River, Washington, with the goal of developing a localized

broodstock using returns to the Big Creek Hatchery and will be evaluated for membership in the ESU in the future.

Programs Needing Further Review

Many other hatchery programs included in the Lower Columbia River ESUs/DPSs are trending toward divergence from the local, natural populations because they use only hatchery fish for broodstock and allow too many hatchery fish to spawn naturally. Even with this trend, the levels of divergence relative to the local populations for these programs have not changed substantially from the last status review (Jones et al. 2011). They may warrant additional evaluation in the future, however.

2.2 Recovery Criteria

The ESA requires that NMFS develop recovery plans for each listed species. Recovery plans must contain, to the maximum extent practicable, objective measureable criteria for delisting the species, site-specific management actions necessary to recover the species, and time and cost estimates for implementing the recovery plan.

2.2.1 Do the species have final, approved recovery plans containing objective, measurable criteria? *

ESU/DPS Name	YES	NO
Lower Columbia River Chinook Salmon		X
Columbia River Chum Salmon		X
Lower Columbia River Coho Salmon		X
Lower Columbia River Steelhead		X

*The recovery plan for these species is in development.

2.2.2 Adequacy of recovery criteria

Based on new information considered during this review, are the recovery criteria still appropriate?*

ESU/DPS Name	YES	NO
Lower Columbia River Chinook Salmon	X	
Columbia River Chum Salmon	X	
Lower Columbia River Coho Salmon	X	
Lower Columbia River Steelhead	X	

*The recovery criteria reflect the best available information, but are recommendations only at this point, as they have not yet been adopted in a final recovery plan

Are all of the listing factors that are relevant to the species addressed in the recovery criteria?

ESU/DPS Name	YES	NO
Lower Columbia River Chinook Salmon	N/A	N/A
Columbia River Chum Salmon	N/A	N/A
Lower Columbia River Coho Salmon	N/A	N/A
Lower Columbia River Steelhead	N/A	N/A

2.2.3 List the recovery criteria as they appear in the recovery plan

A recovery plan for the LCR salmon ESUs and steelhead DPS is in development. NMFS expects to make the plan available for public review and comment as a proposed recovery plan in 2011. The plan will summarize (and incorporate as appendices) locally developed recovery plans (ODFW 2010; LCFRB 2010) that address the Oregon portion and most of the Washington portion of the Lower Columbia ESUs and DPS; and a plan that NMFS developed, with participation from local stakeholders, for the White Salmon subbasin (which was excluded from the LCFRB planning area). The plan will also establish recovery criteria, based on recommendations from the Willamette-Lower Columbia Technical Recovery Team (WLC TRT) and the locally developed plans.

For the purposes of reproduction, salmon ESUs and steelhead DPSs typically display a metapopulation structure (Schtickzelle and Quinn 2007, McElhany et al. 2000). Rather than interbreeding as one large aggregation, ESUs and DPSs function as a group of demographically independent populations separated by areas of unsuitable spawning habitat. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For recovery planning and development of recovery criteria, the WLC TRT developed recommendations at the scale of independent populations, strata, and ESUs. The TRT defined a stratum as a combination of life history type (e.g., spring run, fall run, winter run) and ecological zone (Coast, Cascade, Gorge). Each ESU or DPS comprises multiple strata, and each stratum comprises multiple populations. Multiple specific combinations of populations in each ESU or DPS could achieve WLC TRT's criteria. The proposed recovery plan will contain more detail on recovery criteria.

The Willamette-Lower Columbia Technical Recovery Team's recommendations for recovery criteria are as follows (McElhany et al. 2003):

ESU-Level Criteria

1. Every stratum (life history and ecological zone combination) that historically existed should have a high probability of persistence. For a stratum to have a high probability of persistence, at least two populations must be at least 95 percent likely to persist for 100 years, and the average viability of all the populations in the stratum must be 2.25 or higher using a scoring system developed by the TRT. (This is roughly equivalent to requiring that at least 50 percent of the populations in a stratum be viable, but using the average population persistence score

recognizes that population status is a continuum and not a simple dichotomy of viable or not viable.)

2. Until all ESU viability criteria have been achieved, no population should be allowed to deteriorate in its probability of persistence.

3. High levels of recovery should be attempted in more populations than identified in the stratum viability criteria because not all attempts will be successful.

Stratum-Level Criteria

1. Individual populations within a stratum should have persistence probabilities consistent with a high probability of stratum persistence.

2. Within a stratum, the populations restored/maintained to viable status or above should be selected to:

- Allow for normative meta-population processes, including the viability of "core" populations, which are defined as the historically most productive populations.

- Allow for normative evolutionary processes, including the retention of the genetic diversity represented in relatively unmodified historical gene pools.

- Minimize susceptibility to catastrophic events.

Population-Level Criteria

Abundance & Productivity

Recommendation 1: In general, viable populations should demonstrate a combination of population growth rate, productivity, and abundance that produces an acceptable probability of population persistence. Various approaches for evaluating population productivity and abundance combinations may be acceptable, but must meet reasonable standards of statistical rigor.

Recommendation 2: A population with a non-negative growth rate and an average abundance approximately equivalent to estimated historical average abundance should be considered to be in the highest persistence category. The estimate of historical abundance should be credible, the estimate of current abundance should be averaged over several generations, and the growth rate should be estimated with an adequate level of statistical confidence. This criterion takes precedence over Recommendation 1.

Within Population Diversity

Sufficient life-history diversity must exist to sustain a population through short-term environmental perturbations and to provide for long-term evolutionary processes. The metrics

and benchmarks for evaluating the diversity of a population should be evaluated over multiple generations and should include:

- Substantial proportion of the diversity of a life-history trait(s) that existed historically.
- Gene flow and genetic diversity should be similar to historical (natural) levels and origins.
- Successful utilization of habitats throughout the range.
- Resilience and adaptation to environmental fluctuations.

Within Population Spatial Structure

The spatial structure of a population must support the population at the desired productivity, abundance, and diversity levels through short-term environmental perturbations, longer-term environmental oscillations, and natural patterns of disturbance regimes. The metrics and benchmarks for evaluating the adequacy of a population's spatial structure should specifically address:

- Quantity: Spatial structure should be large enough to support growth and abundance and diversity criteria.

- Quality: Underlying habitat spatial structure should be within specified habitat quality limits for life-history activities (spawning, rearing, migration, or a combination) taking place within the patches.

- Connectivity: Spatial structure should have permanent or appropriate seasonal connectivity to allow adequate migration between spawning, rearing, and migration patches.

- Dynamics: The spatial structure should not deteriorate in its ability to support the population. The processes creating spatial structure are dynamic, so structure will be created and destroyed, but the rate of flux should not exceed the rate of creation over time.

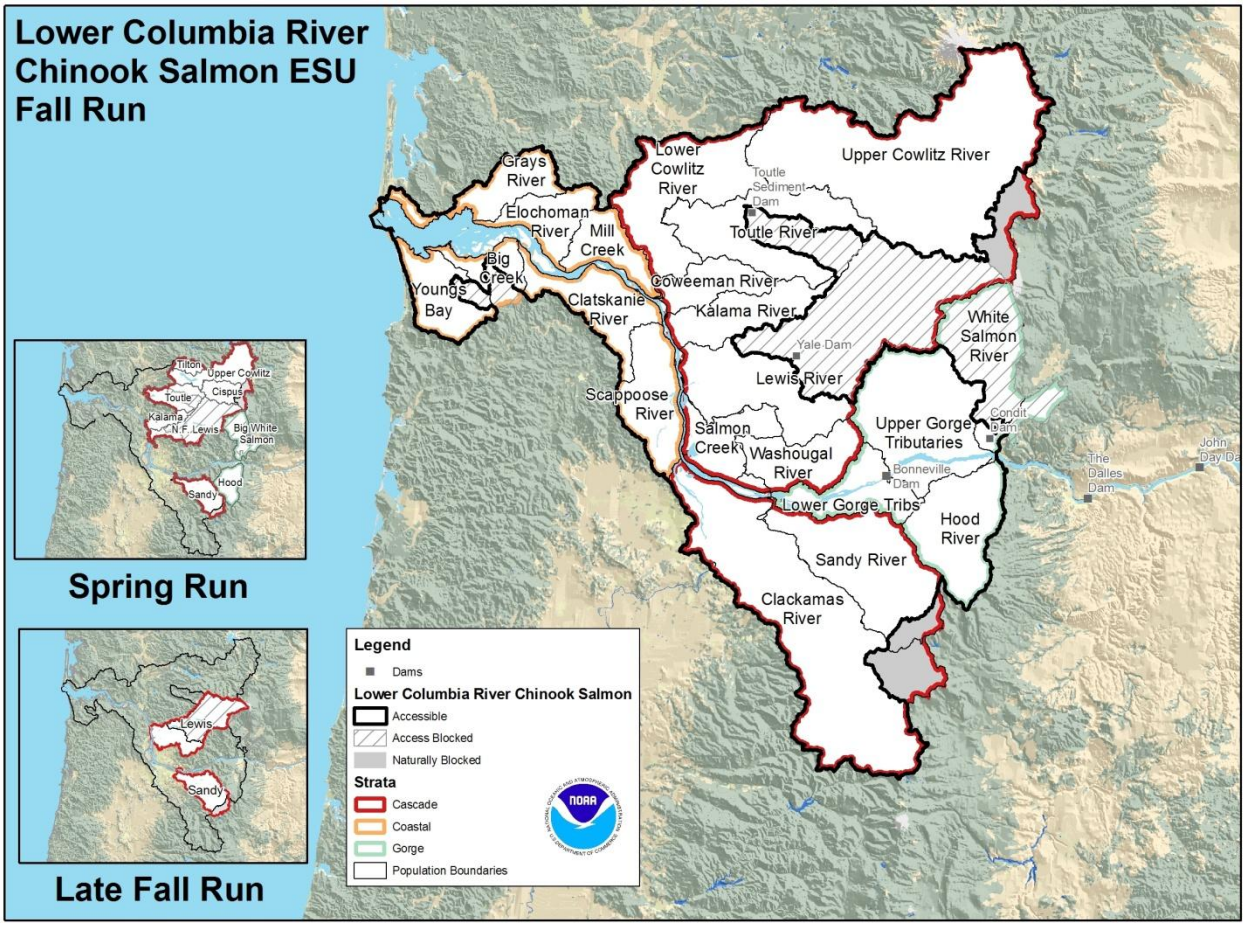
- Catastrophic Risk: The spatial structure should be geographically distributed in such a way so as to minimize the probability of a significant portion of the structure being lost because of a single catastrophic event, either anthropogenic or natural.

2.3 Updated Information and Current Species' Status

In addition to recommending recovery criteria, the WLC TRT also recommended methods for evaluating population status, or extinction risk. Their status assessment methods, like their recovery criteria, are based on evaluation of the viability parameters of abundance, productivity, spatial structure, and diversity, according to the guidelines of the VSP concept (McElhany et al. 2000). Using this method, each population's status is described as very low, low, medium, high, or very high risk of extinction based on an integrated assessment of the four VSP parameters. The WLC TRT and, more recently, local recovery planners have applied the TRT's methods. The information below is based on these analyses and is summarized from Status Review Update

for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Northwest (Ford et al. 2010).

Figure 1. Lower Columbia River Chinook Salmon population structure[2]



[2] The map above generally shows the accessible and historically accessible areas for the LCR Chinook salmon. The area displayed is consistent with the regulatory description of the boundaries of the LCR Chinook salmon found at 50 CFR17.11, 223.102, and 224.102. Actions outside the boundaries shown can affect this ESU. Therefore, these boundaries do not delimit the entire area that could warrant consideration in recovery planning or determining if an action may affect this ESU for the purposes of the ESA.

2.3.1 LCR Chinook Salmon

The LCR Chinook salmon ESU consists of 32 historical populations in six strata: Coastal fall-run, Cascade spring-run; Cascade fall-run; Cascade late fall-run; Gorge fall-run; and Gorge spring-run (Figure 1).

Abundance and Productivity

The last status review included abundance data for most LCR Chinook salmon populations up to the year 2001. For the current review, Ford et al. (2010) compiled data through 2008 or 2009 for most populations, although for the Clatskanie fall and Sandy late fall Chinook salmon populations, data were available only through 2006. Abundance of all LCR Chinook salmon populations increased during the early 2000s but has since declined back to levels close to those in 2000 for all but one population. Abundance of the Sandy spring Chinook salmon population has declined from levels in the early 2000s but remains higher than its 2000 level. In general, abundance of LCR Chinook salmon populations has not changed considerably since the previous status review (Ford et al. 2010).

Spatial Structure and Diversity

In general, the fraction of hatchery origin spawners in LCR Chinook salmon populations has not changed dramatically since the last status review (Ford et al. 2010). Assessments conducted as part of recovery planning since that status review indicate that most LCR tule fall Chinook salmon populations are at high to moderate risk for issues related to diversity and at relatively low risk for issues related to spatial structure (Ford et al. 2010). These assessments also indicate that the two LCR late fall Chinook salmon populations are at moderate to low risk for issues related to diversity and spatial structure. LCR spring Chinook salmon populations range from very high to moderate risk because of diversity, and most are at very high risk due to spatial structure concerns (Ford et al. 2010).

ESU Summary

Three evaluations of LCR Chinook salmon status, all based on WLC TRT criteria, have been conducted as part of the recovery planning process since the last status review (McElhany et al. 2007; ODFW 2010; LCFRB 2010). All three evaluations concluded that none of the ESU's six strata meet recovery criteria. Of the 32 historical populations in the ESU, 28 are considered at very high risk (and some may be extirpated or nearly so) and only two populations are considered viable.

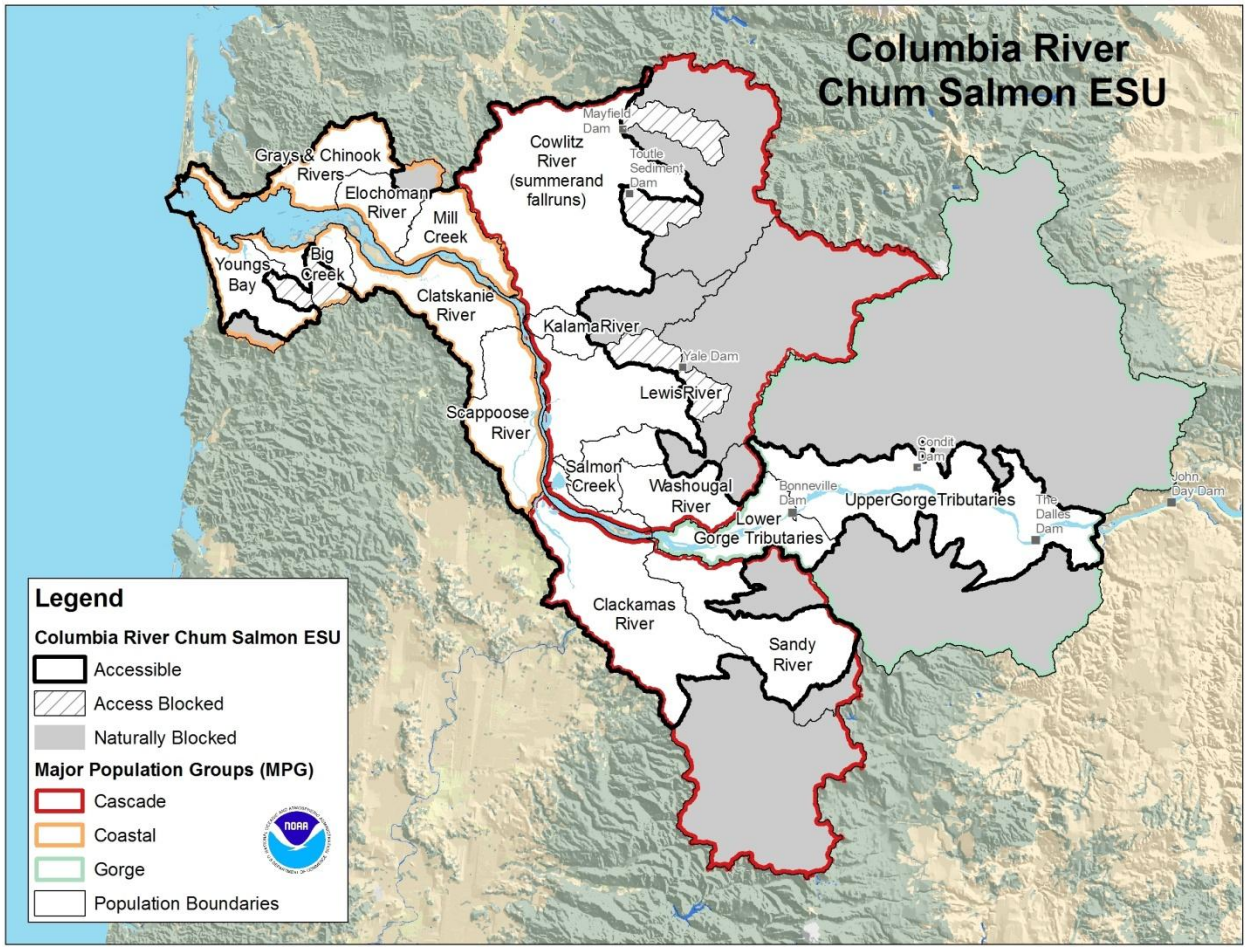
Based on the recovery plan analyses, all of the tule (fall) Chinook salmon populations are considered very high risk except one that is considered at high risk. Additional modeling conducted in association with tule harvest management suggests that three populations (the Coweeman, Lewis, and Washougal) are at a somewhat lower risk. However, even these more optimistic evaluations suggest that the remaining 18 tule (fall) Chinook salmon populations are at substantial risk because of very low natural origin spawner abundance (<100/population), high hatchery fraction, habitat degradation, and harvest impacts. The spatial structure of this component of the ESU remains relatively good.

Nearly all spring Chinook salmon populations are cut off from access to essential spawning habitat by tributary hydroelectric dams. Under Federal Energy and Regulatory Commission (FERC) relicensing settlement agreements, programs to allow access have been developed in the Cowlitz and Lewis systems. The effort in the Cowlitz is underway, but adult transport above the dams in the Lewis basin will not begin until at least 2012; thus, these programs are not yet producing self-sustaining populations. The Sandy spring Chinook salmon population, which is not affected by a tributary dam, is considered at moderate risk. All other spring Chinook salmon populations are considered at very high risk or extirpated or nearly so. The historical spring Chinook salmon population in the Hood River is extirpated, and fish are being reintroduced using an out-of-ESU hatchery stock. The historical spring Chinook salmon population in the White Salmon River is also considered extirpated; the goal is to reestablish this population after Condit Dam is removed (expected in 2012).

The two late fall Chinook salmon populations, the Lewis and the Sandy, are the only populations in this ESU considered to be at low or very low risk. Both populations have relatively few hatchery-origin spawners, and both (but especially the Lewis) have maintained high spawner abundances since the last status review.

Overall, the new information does not indicate a change in the biological risk category since the last status review. Although this ESU has made little progress toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly since the last status review.

Figure 2. Columbia River Chum Salmon population structure[3]



[3] The map above generally shows the accessible and historically accessible areas for the Columbia River chum salmon. The area displayed is consistent with the regulatory description of the boundaries of the Columbia River chum salmon found at 50 CFR17.11, 223.102, and 224.102. Actions outside the boundaries shown can affect this ESU. Therefore, these boundaries do not delimit the entire area that could warrant consideration in recovery planning or determining if an action may affect this ESU for the purposes of the ESA.

2.3.2 Columbia River Chum Salmon

The Columbia River chum salmon ESU consists of 17 historical populations in three strata: Coastal, Cascade, and Gorge (Figure 2). The Upper Gorge population includes the White Salmon subbasin (Myers et al. 2006; McElhany et al. 2003).

Abundance and Productivity

The Grays River and Lower Gorge are the only chum salmon populations with consistent natural spawning. These areas are surveyed regularly for chum salmon, and data indicate a significant increase in abundance in 2002-2004 in both the Grays River and Lower Gorge populations. Recent data indicate that abundances for both populations have returned to previous relatively low levels of perhaps a few thousand in the Grays and less than a thousand in the Lower Gorge. The presence of an unknown number of hatchery-origin spawners from a program initiated in the Grays in 1999 confounds abundance data for that population. Chum salmon are occasionally found in other Washington streams (surveyed annually since 2000) and in Oregon streams, but numbers are too sparse to convert to estimates of abundance (Ford et al. 2010). In 2010, chum salmon fry were observed outmigrating past Bonneville Dam for the first time (the progeny of adult chum migrating above Bonneville Dam to the Upper Gorge population area) (Ford et al. 2010).

Spatial Structure and Diversity

Assessments conducted as part of recovery planning since the last status review indicate that spatial structure within most Washington chum salmon populations is moderate to good (Ford et al. 2010). However, methods for evaluating spatial structure of chum salmon populations may incompletely consider their microhabitat requirements, making the assessments imprecise. Assessments also show that most Washington chum salmon populations are at high risk for diversity. Diversity and spatial structure of Oregon chum salmon populations has not been assessed since the last status review. Genetic studies since the previous review also indicate that a summer-run chum salmon population existed historically in the Cowlitz River, where summer-run chum salmon are occasionally observed. These genetic analyses suggest that Cowlitz summer chum salmon should be considered a historical population in the Columbia River chum ESU. This population is a unique life history in the ESU and represents an important component of ESU diversity (Ford et al. 2010).

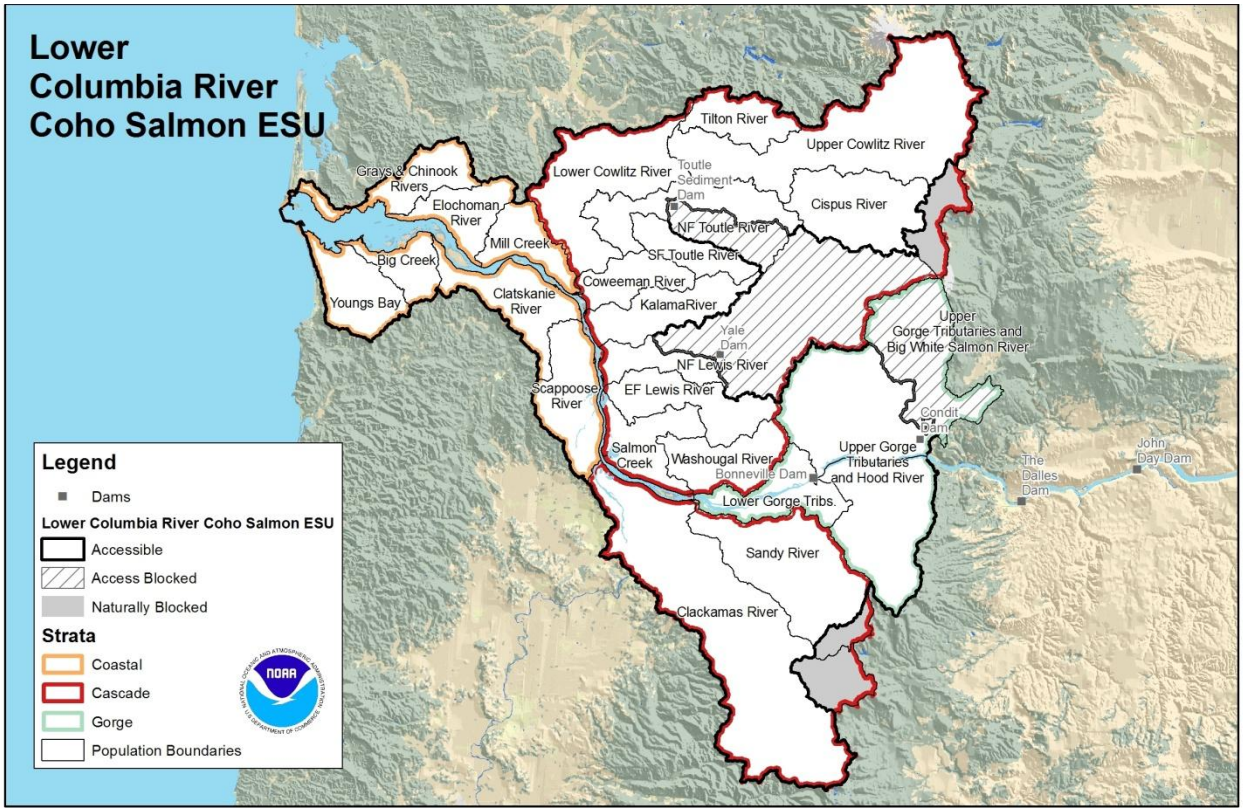
ESU Summary

None of the Columbia River chum ESU's three strata meet recovery criteria; most (15 out of 17) chum populations remain at very high risk. The Grays River and Lower Gorge populations showed sharp increases in adult abundance in 2002, but have since declined back to relatively low levels, within the range of variation observed over the last several decades. Chinook and coho salmon populations in the Lower Columbia and Willamette rivers showed similar increases in the early 2000s followed by declines to recent levels, suggesting the increase in chum salmon abundance is due to factors common to several species and may be related to ocean conditions. The Washington Department of Fish and Wildlife (WDFW) surveys the mainstem Columbia

component (under the I-205 bridge) of the Lower Gorge chum salmon population, but recent data were not available in time to analyze for this status review. We suspect these spawners follow a pattern similar to the Grays and other components of the Lower Gorge population.

Overall, the new information does not indicate a change in the biological risk category since the time of the last status review. Although this ESU has made little progress toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly.

Figure 3. Lower Columbia River Coho Salmon population structure[4]



[4] The map above generally shows the accessible and historically accessible areas for the LCR coho salmon. The area displayed is consistent with the regulatory description of the boundaries of the LCR coho salmon found at 50 CFR17.11, 223.102, and 224.102. Actions outside the boundaries shown can affect this ESU. Therefore, these boundaries do not delimit the entire area that could warrant consideration in recovery planning or determining if an action may affect this ESU for the purposes of the ESA.

2.3.3 Lower Columbia River Coho Salmon

The LCR coho salmon ESU consists of 24 historical populations in three strata: Coastal, Cascade, and Gorge (Figure 3).

Abundance and Productivity

For Oregon LCR coho salmon populations, data from 2002 through 2004 became available in 2006. These data indicate relatively low abundance of natural origin fish (averaging less than 500 spawners) for all Oregon populations except the Clackamas and Sandy. Despite low abundances, it does appear that some natural production is occurring in the Clatskanie and Scappoose populations, in addition to the Clackamas and Sandy. For the Clackamas and Sandy populations, abundance data for the years 1974 through 2008 were available for this status evaluation. Neither population shows a clear long-term trend in natural origin abundance over that entire time series, but both indicate a positive trend over the years 1995 to 2008. A negative growth rate was observed when considering the entire time series and assuming that hatchery-origin fish have the same reproductive success as natural origin fish (Ford et al. 2010).

In Washington, no coho salmon spawner data were available for the last status review, but spawner surveys have been conducted for the Mill/Germany/Abernathy population since 2005. Data for the 2006 spawning year show an estimated 3,150 spawners, with hatchery-origin fish comprising over half. This large fraction of hatchery-origin spawners in a population with no direct hatchery releases suggests that Washington populations that do have direct hatchery releases would have even higher fractions of hatchery-origin spawners and are not self-sustaining. Data on coho salmon smolt production in the Mill/Germany/Abernathy population indicate some natural production (Ford et al. 2010).

Spatial Structure and Diversity

Assessments conducted as part of recovery planning since the last status review indicate that Oregon LCR coho salmon populations are at moderate to low risk as a result of spatial structure and at high to moderate risk from issues related to diversity (Ford et al. 2010). Similar assessments for Washington LCR coho salmon populations also indicate moderate to low risk from spatial structure and, in general, high risk from issues related to diversity (Ford et al. 2010). Hatchery releases have remained relatively steady since the previous review. Overall hatchery production remains relatively high, and most populations in the ESU likely contain a substantial fraction of hatchery-origin spawners (although data are limited, particularly for Washington populations). Efforts to shift hatchery production to certain areas (e.g., Youngs Bay and Big Creek) to reduce hatchery-origin spawners in other populations (e.g., the Scappoose and Clatskanie) are relatively recent, and their success is unknown (Ford et al. 2010).

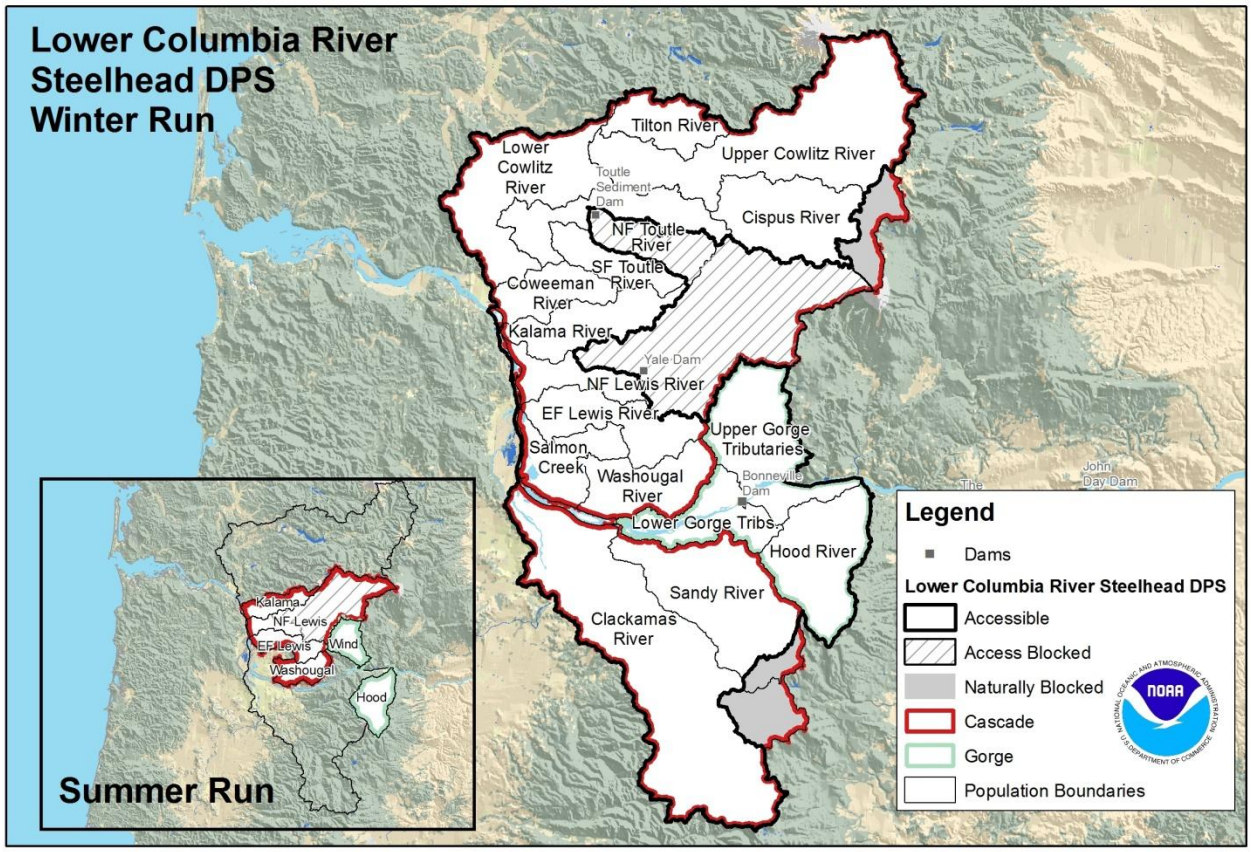
ESU Summary

Three evaluations of LCR coho salmon status, all based on WLC TRT criteria, have been conducted since the last status review, as part of the recovery planning process (McElhany et al. 2007; ODFW 2010; LCFRB 2010). All three evaluations concluded that none of the ESU's three strata meet recovery criteria. Of the 24 historical populations in the ESU, 21 are considered at

very high risk. The remaining three (Sandy, Clackamas, and Scappoose) are considered at high to moderate risk. All of the Washington populations are considered at very high risk because the limited studies available suggest most of the populations have returns that are greater than 90 percent hatchery fish. However, uncertainty about population status is high because of a lack of regular, comprehensive adult spawner surveys. As was noted in the last status review, smolt traps indicate some natural production in Washington populations, though given the high fraction of hatchery origin spawners suspected to occur in these populations, it is not clear that any are self-sustaining.

Overall, the new information considered does not indicate a change in the biological risk category since the time of the last status review. Although this ESU has made little progress toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly.

Figure 4. Lower Columbia River Steelhead population structure[5]



[5] The map above generally shows the accessible and historically accessible areas for the LCR steelhead. The area displayed is consistent with the regulatory description of the boundaries of the LCR steelhead found at 50 CFR17.11, 223.102, and 224.102. Actions outside the boundaries shown can affect this DPS. Therefore, these boundaries do not delimit the entire area that could warrant consideration in recovery planning or determining if an action may affect this DPS for the purposes of the ESA.

2.3.4 Lower Columbia River Steelhead

The Lower Columbia River steelhead DPS consists of 23 historical populations in four strata: Cascade winter-run, Cascade summer-run, Gorge winter-run, and Gorge summer-run (Figure 4).

Abundance and Productivity

The previous status review included abundance data for most LCR steelhead populations up to the year 2001. For this status evaluation, data through 2008 were available for most populations. Since the last status evaluation, all populations increased in abundance during the early 2000s, generally peaking in 2004. Abundance of most populations has since declined back to levels close to the long-term mean. Exceptions are the Washougal summer and North Fork Toutle winter populations, for which abundance is higher than the long-term average, and the Sandy, for which abundance is below the long-term average. The North Fork Toutle winter steelhead population appears to be experiencing an increasing trend dating back to 1990, which is likely partially the result of recovery of habitat since the eruption of Mt. St. Helens in 1980. In general, the LCR steelhead populations do not show any sustained, dramatic changes in abundance since the previous status review (Ford et al. 2010).

Spatial Structure and Diversity

Total releases of hatchery steelhead in the LCR steelhead DPS have increased since the last status review, from about 2 million to around 3 million fish per year. Some populations (e.g., the Hood River and the Kalama) have relatively high fractions of hatchery-origin spawners, whereas others (e.g., the Wind) have relatively few hatchery-origin spawners (Ford et al. 2010). Assessments since the last status review indicate that Oregon LCR steelhead populations are generally at moderate risk because of diversity issues and low risk because of spatial structure (Ford et al. 2010). Similar assessments for Washington LCR steelhead populations also indicate moderate risk because of diversity issues, in general, and moderate to low risk because of spatial structure (Ford et al. 2010).

DPS Summary

Three evaluations of LCR steelhead status, all based on WLC TRT criteria, have been conducted as part of recovery planning since the last status review (McElhany et al. 2007; ODFW 2010; LCFRB 2010). All three evaluations concluded that none of the DPS's four strata meet recovery criteria. Of the 23 historical populations in the DPS, 16 are considered at high or very high risk. Populations in the upper Lewis, Cowlitz, and White Salmon watersheds are cut off from access to essential spawning habitat by tributary hydroelectric dams. As part of FERC relicensing settlement agreements, programs to allow access have been initiated in the Cowlitz and Lewis systems. The effort in the Cowlitz is underway, but adult transport above the dams in the Lewis basin will not begin until at least 2012; thus, these programs have not yet produced self-sustaining populations. The populations generally remain at relatively low abundance with relatively low productivity.

Overall, the new information considered does not indicate a change in the biological risk category since the time of the last status review. Although this DPS has made little progress

toward meeting its recovery criteria, there is no new information to indicate that its extinction risk has increased significantly.

2.3.5 Five-Factor Analysis

Section 4(a)(1)(b) of the ESA directs us to determine whether any species is threatened or endangered because of any of the following factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence. Section 4(b)(1)(A) requires us to make listing determinations after conducting a review of the status of the species and taking into account efforts to protect such species. Below we discuss new information relating to each of the five factors as well as efforts being made to protect the species.

Present or threatened destruction, modification or curtailment of its habitat or range

Significant habitat restoration and protection actions at the Federal, state, tribal, and local levels have been implemented to improve degraded habitat conditions and restore fish passage. While these efforts have been substantial and are expected to improve survival and productivity of the targeted populations, we do not yet have information demonstrating that improvements in habitat conditions have led to improvements in population viability. The effectiveness of habitat restoration actions and progress toward meeting the viability criteria will be monitored and evaluated with the aid of new reporting techniques. Generally, it takes one to five decades to demonstrate such increases in viability. Below, we summarize several noteworthy restoration and protection actions implemented since the last review. We also note areas where concerns remain about the LCR salmon ESU's and steelhead DPS' habitat condition.

The implementation of the Federal Columbia River Power System (FCRPS) Biological Opinion (Opinion) (NMFS 2008a; NMFS 2010) has provided a number of actions that will result in survival improvements, reduced duration of outmigration to the estuary, improvements in juvenile survival and condition, and increased access to habitats. Some of the major milestones include installation of corner collectors at Bonneville Dam in 2004 to improve collection and passage efficiency for juveniles and a Memorandum of Agreement signed between the Bonneville Power Administration and the State of Washington that will lead to implementing habitat improvement projects in the lower Columbia River.

Improvements in operations and fish passage at Non-Federal hydropower facilities and dams

Federal Energy Regulatory Commission relicensing settlement agreements are being implemented in a number of Lower Columbia River tributaries: Cowlitz River (for Tacoma Power's Cowlitz River Project), Lewis River (for PacifiCorp's Lewis River Hydroelectric Project), Clackamas River (for Portland General Electric's Clackamas River Hydroelectric Project), Hood River (for PacifiCorp's Powerdale Hydroelectric Project), and the Sandy River (for Portland General Electric's Marmot Dam). Improvements achieved to date as part of long-term (35 to 50 year) passage and habitat improvement programs under these agreements include:

- Increased juvenile survival at Mayfield Dam (on the Cowlitz River) for Tilton Chinook salmon, coho salmon, and winter steelhead as a result of passage system improvements.

- Improved adult survival at River Mill Dam (on the Clackamas River) as a result of a new fish ladder.

- Increased habitat access and improved survival for Sandy River spring-, fall-, and late-fall Chinook salmon, Sandy River coho salmon, and Sandy River winter-run steelhead as a result of the removal of Marmot Dam (Portland General Electric's Bull Run Hydroelectric Project).

- Increased habitat access and survival for Hood River spring and fall Chinook salmon, Hood River winter and summer steelhead, and Hood River coho salmon as a result of the removal of Powerdale Dam.

Management of Tributary Habitat

Numerous habitat protection and restoration efforts have been implemented through the efforts of groups such as the Lower Columbia River Fish Recovery Board in Washington, local watershed councils in Oregon, and the bi-state Lower Columbia River Estuary Partnership. Federal and state agencies, tribal governments, local governments, soil and water conservation districts, conservation organizations, and private landowners have also sponsored and participated in habitat protection and restoration projects. Funding mechanisms have included the Washington Salmon Recovery Funding Board, Oregon Watershed Enhancement Board, the Pacific Coastal Salmon Recovery Fund, and other Federal state, local, and tribal programs. A number of habitat conservation plans have also been approved or continue to be implemented. Specific projects and planning efforts are numerous and key habitat improvements since the previous status review include:

- The Washington Forest Practices Habitat Conservation Plan, completed in December 2005, which will protect and improve aquatic and riparian habitat on non-Federal and non-tribal forestland in Washington while allowing forest management activities to occur.

- The Bull Run Water Supply Habitat Conservation Plan, completed in September 2008, which will protect and improve aquatic habitat while allowing the city of Portland to continue to manage the Bull Run River Watershed in the Sandy River Basin as a water supply for the City of Portland.

- The removal of Hemlock Dam in August 2009 from U.S. Forest Service land in the Wind River Basin of Washington will improve habitat access water quality for the Wind River summer steelhead population.

- Habitat restoration projects in the Lower Columbia River, including the Julia Butler Hansen National Wildlife Refuge and Fort Columbia Tidal Reconnection projects, both of which will restore off-channel habitat function and provide access for rearing and out-migrating juvenile salmon and steelhead. Another project, the South Clatsop Slough restoration project, restored access to 48 acres of intertidal salt marsh habitat.

Locally developed recovery plans are complete for the Oregon and Washington portions of the Lower Columbia. The Oregon Fish and Wildlife Commission adopted the Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead in August 2010, and the Lower Columbia Fish Recovery Board adopted the Washington Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan in June 2010 (LCFRB 2010). NMFS has also drafted a plan for the White Salmon subbasin (which was excluded from the LCFRB planning area); and in January 2011, NMFS adopted the Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead. These plans, which will form the basis of the NMFS ESA recovery plan for the Lower Columbia, identify habitat degradation as a limiting factor for almost all Lower Columbia River populations of salmon and steelhead. They also identify the impacts of tributary and/or mainstem hydropower (including effects of mainstem hydropower on the Columbia River estuary) as limiting factors for most populations. Although many habitat restoration projects have been implemented in the Lower Columbia River and its tributaries, the scale of habitat recovery actions identified in these plans is much greater than the scale of habitat actions implemented to date.

Most land in the Lower Columbia River area is in private ownership, making successful efforts to protect and restore habitat on private lands key to recovery in the Lower Columbia. Accomplishing protection and restoration of these private lands will be especially challenging in the face of continued urbanization, development, and resource extraction.

Substantial opportunities to protect functioning habitat, provide access to historically occupied habitat, and restore degraded habitat continue to exist. Progress in recovery planning has helped to identify priority actions and projects, although continuing work is needed to better define these priorities and to develop projects at the scale and scope that will be most meaningful. Improvements in monitoring and reporting of habitat restoration actions and their effects on habitat function and population parameters are also needed to document population response to changing habitat conditions.

Federal Land Management

A substantial portion of land in the Lower Columbia River region is in Federal ownership, so the protection and restoration of salmon and steelhead habitat on Federal lands is also crucial to

recovery. Federal land managers have taken a number of measures to protect and restore habitat throughout the range of the LCR salmon ESUs and steelhead DPS. In response to NMFS' request for information that has become available since the last status evaluations, Federal land managers commented that habitat improvements have occurred on Federal lands because of implementation of the Northwest Forest Plan, restoration activities carried out under the Aquatic Habitat Restoration Activities Biological Opinion (ARBO), and other management efforts, including the Forest Service's Legacy Road Restoration Program.

However, there is uncertainty over the future conservation of LCR salmon and steelhead on Federal lands. The level of protection afforded to the LCR ESUs and DPS and their habitat will be determined on Federal lands by land management plans currently under development by the Forest Service and Bureau of Land Management (BLM). The content of these management plans and the manner in which they are implemented and integrated with the recovery plan will help determine the extent to which Federal land management will contribute to recovery.

Significant opportunities exist for recovery and/or conservation actions on Federal lands because of the responsibilities of the land management agencies under ESA section 7(a)(1). NMFS will continue to work with the Forest Service and BLM to identify opportunities for restoration actions on Federal lands. We will also work with these agencies, to the degree possible, to provide technical assistance for projects that benefit LCR salmon and steelhead species. Initiation and completion of consultation by Forest Service and BLM on all actions where consultation is required is also a conservation priority.

New information available since the last status review indicates that many restoration and protection actions have been implemented in freshwater and estuary habitat but does not reveal overall trends in habitat quality, quantity, and function. In addition, we remain concerned with threats to habitat throughout the range of LCR salmon and steelhead, particularly with regard to activities that affect the quality and accessibility of habitats, and habitat-forming processes, on private lands and considering the likelihood of continuing land use and development. We therefore conclude that the risk to the species' persistence because of habitat destruction or modification has not changed since the last status review.

Overutilization for commercial, recreational, scientific, or educational purposes

Research and Monitoring

The absolute quantity of take authorized for scientific research and monitoring is relatively low but has increased over the past five years as a result of increased monitoring to improve assessment of population status and trends, inform evaluation of restoration action effectiveness, and enhance monitoring of overall progress toward recovery. NMFS anticipates additional increases with implementation of the FCRPS Biological Opinion and Hatchery and Genetics Management Plans. If take associated with research and monitoring activities continues to increase, the potential impacts to the viability of the affected ESUs/DPS will need to be evaluated.

Harvest

In general, harvest rates on LCR steelhead and Columbia River chum salmon have remained stable since the last status review, while harvest rates on LCR Chinook salmon and coho salmon have decreased. Analyses conducted as part of the recovery planning process have not identified overutilization from harvest as a limiting factor for Columbia River chum salmon since harvest impacts on chum salmon have been limited for decades to incidental take in lower river mainstem fisheries. Harvest impacts on LCR steelhead have also been relatively low for some time, although recovery plan analyses have identified harvest as a secondary limiting factor for the DPS.

Improvements in fisheries management since the last status review include:

- Significant reduction in harvest impacts on LCR tule fall Chinook salmon, from 49 percent in 2005 to 38 percent in 2010.
- Negotiation and implementation of the 2008 Pacific Salmon Treaty, which has reduced impacts to fall Chinook salmon of fisheries that occur north of the US/Canada border.
- Use of an abundance-based harvest matrix and continued low harvest rates on Lower Columbia River coho. Harvest rates on LCR coho salmon were reduced in the mid 1990s from levels exceeding 50 percent to recent rates of 8 to 20 percent through implementation of the harvest matrix.
- Implementation of mark-selective fisheries for LCR coho salmon, which has contributed to reduced numbers of hatchery-origin spawners.
- Completion of the 2008 U.S. v. Oregon Management Agreement (in effect through 2017), which will maintain harvest impacts reductions secured in previous agreements on the ESUs/DPS (NMFS 2008b).

New information available since the last ESA status review indicates harvest impacts have remained stable or decreased somewhat, but research impacts have increased. We conclude that the absolute degree of change in either direction from these factors has not changed substantially since the last status review.

Disease or predation

Although actions to reduce avian predation in the Columbia basin have been ongoing through implementation of the FCRPS Biological Opinion, high levels of avian predation continue to significantly affect the Lower Columbia River ESUs/DPS. A Columbia basin-wide assessment of avian predation on juvenile salmonids indicates that the most significant impacts to smolt survival occur in the Columbia River estuary (Collis et al. 2009). The combined consumption of juvenile salmonids by Caspian terns and double-crested cormorants nesting on East Sand Island

was estimated to be between 7 and 16 million smolts annually. This represents approximately 10 percent of all the salmonid smolts that survive to the estuary in an average year.

Predation also remains a concern due to a general increase in pinniped populations along the West Coast. California sea lion populations are growing rapidly, and there is potential that these predators could substantially reduce the abundance of several salmon and steelhead ESUs/DPSs. The available information clearly indicates that adult salmon contribute substantially to the diets of pinnipeds in the lower Columbia River and estuary, especially in the spring, late-summer, and fall seasons when Chinook salmon are most abundant (Scordino 2010). The effect of marine mammals on the productivity and abundance of Columbia River basin ESA-listed salmon and steelhead populations has not been quantitatively assessed. The absolute number of animals preying upon salmon and steelhead throughout the lower Columbia River and estuary is not known, the duration of time that they are present is uncertain, and the portion of their diet that is made up of listed species is unknown. We do have information to indicate that Steller sea lion abundance is increasing in the lower Columbia River and that predation by California sea lions at Bonneville Dam continues to increase (NMFS 2011).

A sport fishing reward program was implemented in 1990 to reduce the numbers of Northern pike minnow in the Columbia basin (NMFS 2010). The program continues to meet expected targets, which may reduce predation on smolts in the mainstem Columbia River.

Non-indigenous fishes affect salmon and their ecosystems through many mechanisms. A number of studies have concluded that many established non-indigenous species (in addition to smallmouth bass, channel catfish, and American shad) pose a threat to the recovery of ESA-listed Pacific salmon. Threats are not restricted to direct predation; non-indigenous species compete directly and indirectly for resources, significantly altering food webs and trophic structure, and potentially altering evolutionary trajectories (Sanderson et al. 2009; NMFS 2010).

Disease rates over the past five years are believed to be consistent with the previous review period. Climate change impacts such as increasing temperature may increase susceptibility to diseases. Recent reports indicate the spread of a new strain of infectious haematopoietic necrosis virus along the Pacific coast may increase disease related concerns for Lower Columbia River ESUs/DPS in the future.

New information available since the last status review indicates there is an increase in the level of avian and pinniped predation on LCR salmon and steelhead. At this time we do not have information available that would allow us to quantify the change in extinction risk due to predation. We therefore conclude that the risk to the species' persistence because of predation has increased by an unquantified amount since the last status review.

Inadequacy of existing regulatory mechanisms

New information available since the last status review indicates that the adequacy of some regulatory mechanisms has improved. For example:

- The Bull Run Water Supply Habitat Conservation Plan, completed in September 2008, will protect and improve aquatic habitat while allowing the city of Portland to continue to manage the Bull Run River Watershed in the Sandy River Basin as a water supply for the City of Portland.
- The Washington Forest Practices Habitat Conservation Plan, completed in December 2005, will protect and improve aquatic and riparian habitat on non-Federal and non-tribal forestland in Washington while allowing forest management activities to occur.
- The City of Portland's stormwater program, including the Green Streets Program and Gray-to-Green Initiative.
- Road maintenance programs approved under the NMFS 4(d) rule for the Oregon Department of Transportation (renewed in 2010), Clackamas County (2009), and Marion County (renewed in 2009).

These and other regulatory mechanisms are promising developments and could yield enhanced protections for ESA-listed salmonids in the Lower Columbia River. At this time, however, we lack adequate documentation of enforcement, compliance, and effectiveness to evaluate whether these programs, and regulatory programs in general, are having the desired beneficial impacts on habitat conditions and salmonid population viability for the ESUs/DPS under review.

We conclude that the risk to the species' persistence because of the adequacy of existing regulatory mechanisms has decreased slightly, based on the improvements noted above. However, many ongoing threats to LCR salmon and steelhead habitat could be ameliorated by strengthening existing regulatory mechanisms.

Other natural or manmade factors affecting its continued existence

Climate Change

Current research by Mote and Salathé (2010), and other members of the University of Washington Climate Impacts Group, is providing insights to potential future climate change impacts for the Pacific Northwest region. Although the values or severity of these changes may be uncertain, and their biological impacts on salmonids have yet to be demonstrated, there is general scientific agreement regarding the impacts already evident in the last 40 years of climatological data and expected trends.

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

- Increased water temperatures.
- Decreases in snow pack causing a shift of peak flows from summer to spring, and a decrease in summer flows. Shifts in the timing of peak flows will likely result in changes in outmigration timing, changes in survival, changes in distribution, and changes in the availability of spawning and rearing habitats.
- Peak flows will be flashier, likely resulting in channel scouring and increased risk of sedimentation.
- Likely increase in winter flooding events.
- Under future climate scenarios, higher elevation areas will likely continue to provide habitat conditions within the biological tolerances of salmonids. However, lower and transitional areas will experience increasing temperatures, reducing the available spawning and rearing habitats, altering distribution, and diminishing survival.

Expected climate change impacts to ocean conditions include:

- Increasing ocean acidification (although there is uncertainty about the downstream effects on marine food webs and salmonid survival in the ocean).
- Ocean temperatures will increase resulting in changes in the distribution and abundance of warm- and cold-water species. There is uncertainty about the effects on marine food webs and ocean survival of salmonids.
- Likely changes to a variety of processes such as the pattern and cycle of the Pacific Decadal Oscillation and the intensity and patterns of upwelling.

Over the past 40 years climate change has degraded environmental conditions for Pacific Northwest salmon and steelhead. The certainty in modeled climate change impacts has increased as has our understanding of likely impacts of these changes on salmonid populations. While climate change impacts remain a recovery concern over the long term, it is unknown whether climate change impacts have changed in the few years since the last review.

Hatchery Effects

Hatchery programs can provide short-term demographic benefits, such as increases in abundance during periods of low natural abundance. They also can help preserve genetic resources until limiting factors can be addressed. However, the long-term use of artificial propagation may pose

risks to natural productivity and diversity. The magnitude and type of the risk depends on the status of affected populations and on specific practices in the hatchery program.

Implementation of reforms and changes in hatchery management has occurred since the last status review, although the benefits have not yet been fully realized and documented. Improvements include:

- Marking of all hatchery-produced Lower Columbia River coho salmon, Chinook salmon, and steelhead. Marking allows identification of hatchery-origin fish and facilitates broodstock collection (i.e., managers can readily select natural-origin fish for broodstock), control of numbers of hatchery-origin fish spawning naturally, monitoring and evaluation of hatchery program and natural population performance, and targeting of harvest on hatchery-origin adults. Fish are marked by clipping the adipose fin, except for fish produced for conservation purposes; these fish are internally marked or given an external marking other than the adipose fin clip.

- Hatchery reforms and program closures, which have contributed to modest reductions in total hatchery production of coho and fall Chinook salmon and to reduced impacts of hatchery fish on specific natural populations (see below for specifics).

- Changes in release locations of fish from some fall Chinook and coho salmon programs in an effort to reduce straying into specific populations and to meet other management goals (see below for specifics).

- Installation of weirs in the Grays and North Fork Toutle rivers to allow removal of hatchery-origin fish so they do not spawn naturally.

Below we describe some of these improvements in more detail, in addition to describing new hatchery programs and program closures (Jones et al. 2011).

Lower Columbia River Chinook Salmon

Overall hatchery production of LCR fall Chinook salmon has gone down slightly since the last status review. Several actions have been completed that are likely to reduce hatchery strays in specific populations (e.g., shifts in production and new weirs on the Grays and North Fork Toutle rivers), although data to confirm this are not yet available.

One program, the Elochoman Hatchery Fall Chinook Salmon Program, was terminated due to facility and funding constraints and to reduce impacts on the Elochoman River tule fall Chinook salmon population.

Spring Chinook salmon hatchery production in the LCR Chinook salmon ESU has increased, primarily in the Lewis River basin in preparation for reintroducing spring Chinook salmon above

the dams on the North Fork Lewis River. There are no late-fall Chinook hatchery programs in the LCR Chinook ESU.

Columbia River Chum Salmon

Hatchery programs in the Columbia River chum ESU are being used for reintroduction programs. The three hatchery programs identified in the last status review continue operating, with variable release numbers depending on return year and funding levels. Because these three programs are for recovery purposes only, fish produced in these programs are being internally marked. In the fall of 2010 a new program was initiated at Big Creek Hatchery in Oregon to develop a program that will be used to reintroduce chum salmon into LCR tributaries in Oregon. This program will use broodstock collected in the Grays River, Washington, with the goal of developing a localized broodstock from future returns to Big Creek Hatchery (Jones et al. 2011). The goal of all these programs is to reduce extinction risk of the ESU.

Lower Columbia River Coho Salmon

Overall hatchery production of LCR coho salmon has gone down slightly since the last status review. Several actions have been completed that are likely to reduce hatchery strays in specific populations (e.g., a new weir on the North Fork Toutle river), although data to confirm this are not yet available. Several programs have been terminated. The Elochoman Hatchery closed in 2008, eliminating the Elochoman Hatchery Type-S and Type-N Coho Salmon programs. These programs were terminated due to facility and funding constraints and to reduce impacts on the Elochoman River coho salmon population.

The Cowlitz Type-N coho salmon program has begun to integrate natural-origin coho salmon into its broodstock. These natural-origin coho salmon are the progeny of Cowlitz Hatchery Type-N coho salmon and naturally produced coho salmon spawning in newly accessible habitat in the upper Cowlitz River basin (Jones et al. 2011).

Lower Columbia River Steelhead

Total steelhead releases have increased since the previous status review (Ford et al. 2010). Some hatchery programs considered part of the DPS have been terminated. Releases of Cowlitz Hatchery late-run winter steelhead into the Upper Cowlitz and Cispus rivers were terminated, with the last returns expected in 2012. This program was eliminated as part of a test to determine the productivity of natural-origin steelhead in newly accessible habitat above Cowlitz Falls Dam. The release of Cowlitz Hatchery late-run winter steelhead into the Tilton River, with last returns expected in 2009, was also terminated for a similar evaluation. Releases from one other program considered part of the DPS, the Hood River Summer Steelhead program, ended in 2009 with the last returns expected in 2011. This program was ended due to the removal of Powerdale Dam (which eliminated the ability to collect broodstock and manage adult returns) (Jones et al. 2011).

Summary

New information available since the last status review indicates that although hatcheries have mitigated the immediate extinction risk of listed salmon and steelhead species in the Lower Columbia River, the long-term role of hatcheries in the conservation of these ESUs/DPS remains uncertain

Efforts being made to Protect the Species

When considering whether to list a species as threatened or endangered, section 4(b)(1)(A) of the ESA requires that NMFS take into account any efforts being made to protect that species. Throughout the range of salmon ESUs and steelhead DPSs, there are numerous Federal, state, tribal and local programs that protect anadromous fish and their habitat. The proposed listing determinations for West Coast salmon and steelhead (69 FR 33102) reviewed these programs in detail.

In the final listing determinations for salmon (70 FR 37160) and steelhead (71 FR 834), we noted that while many of the ongoing protective efforts are likely to promote the conservation of listed salmonids, most efforts are relatively recent, have yet to demonstrate their effectiveness, and for the most part do not address conservation needs at scales sufficient to conserve entire ESUs or DPSs. Therefore, we concluded that existing protective efforts did not preclude listing several ESUs of salmon and several DPSs of steelhead.

In our above five-factor analysis, we note the many habitat, hydropower, hatchery, and harvest improvements that occurred in the past five years. We currently are working with our Federal, state, and tribal co-managers to develop monitoring programs, databases, and analytical tools to assist us in tracking, monitoring, and assessing the effectiveness of these improvements.

2.4 Synthesis

The ESA defines an endangered species as one that is in danger of extinction throughout all or a significant portion of its range, and a threatened species as one that is likely to become an endangered species in the foreseeable future throughout all or a significant portion of its range. Under ESA section 4(c)(2), we must review the listing classification of all listed species at least once every five years. While conducting these reviews, we apply the provisions of ESA section 4(a)(1) and NMFS' implementing regulations at 50 CFR part 424.

To determine if a reclassification is warranted, we review the status of the species and evaluate the five factors identified in ESA section 4(a)(1): (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; and (5) other natural or man-made factors affecting a species' continued existence. We then make a determination based solely on the best available scientific and commercial information, taking into account efforts by states and foreign governments to protect the species.

The updated status reviews completed by our Northwest Fisheries Science Center indicate that the LCR ESUs and DPS are not currently meeting their recovery criteria. While in each ESU or DPS, a number of populations have high or medium persistence probability, none of the strata in any of the ESUs or DPS are currently considered viable. Multiple populations in each stratum of each ESU or DPS will need improved viability ratings in order to meet the recovery criteria. While little improvement in ESU or DPS viability has been observed over the last five years, there is also no new information to indicate that the extinction risk has increased. The Science Center concluded, after reviewing the available new information, that the biological risk categories for the LCR Chinook salmon and coho ESUs, the Columbia River chum ESU, and the LCR steelhead DPS have not changed since the last status review.

Our analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the persistence of the LCR Chinook salmon, coho, and steelhead and Columbia River chum has not changed significantly since our final 2005 ESU and 2006 DPS listing determinations. Improvements have been made in operations and fish passage at tributary dams and at the FCRPS dams, and numerous habitat restoration projects have been completed in many Lower Columbia River tributaries. We expect that these actions eventually will provide benefit to all the LCR ESUs and the LCR steelhead DPS. Most land in the Lower Columbia River is in private ownership, making successful efforts to protect and restore habitat on private lands key to recovery in the Lower Columbia, particularly in the face of continuing development. There are also substantial portions of Federal land in the Lower Columbia, so the protection and restoration of salmon and steelhead habitat on Federal lands is also crucial to recovery.

Harvest rates on Lower Columbia River steelhead and Columbia River chum salmon have remained stable and relatively low since the last status review, while harvest rates on Lower Columbia River Chinook salmon and coho salmon have decreased. Research impacts on all

species are relatively low but have increased since the last status review. In addition, avian and pinniped predation on Lower Columbia River salmon and steelhead has increased, although we are unable to quantify the resulting change in extinction risk. The impacts that hatcheries and climate change pose to long-term recovery also remain a concern.

After considering the biological viability of the Lower Columbia River coho and Chinook salmon ESUs, the Columbia River chum salmon ESU, and the Lower Columbia River steelhead DPS and the current status of the ESA section 4(a)(1) factors, we conclude that the status of the Lower Columbia River ESUs and DPS has not changed significantly since the last status review. However, the implementation of sound recovery actions in each "H"—hydropower, habitat, hatcheries, and harvest—is underway and must continue to achieve recovery. In addition, the biological benefits of some actions, habitat restoration and protection efforts, in particular, have yet to be fully expressed and will likely take another five to 20 years to result in measurable improvements to population viability. By continuing to implement actions that address the factors limiting population viability and monitoring the effects of the actions over time, we will ensure that recovery efforts meet the biological needs of each population and, in turn, contribute to the recovery of the Lower Columbia River ESUs and DPS. Once complete, the Lower Columbia River Salmon and Steelhead Recovery Plan will be the primary guide for identifying future actions to target and address limiting factors and threats for the Lower Columbia River ESUs and DPS. Over the next five years, it is crucial to continue to implement recovery actions and monitor our progress.

2.4.1 ESU/DPS Delineation and Hatchery Membership

- Recent genetic analyses are inconclusive regarding the transitional boundary between the Lower Columbia River and Middle Columbia River steelhead DPSs and Chinook ESUs (Ford et al. 2010). No new substantive information was available concerning the ESU boundaries for Columbia River chum salmon and Lower Columbia River coho salmon.

- The NMFS Northwest Regional Office's review of new information informed our understanding of the ESU/DPS membership status for various hatchery programs (Jones et al. 2011). Overall, many hatchery programs that are part of the listed ESUs/DPS are trending toward divergence from the ESU/DPS. These programs will be reevaluated in the future to determine if they should remain part of the ESUs/DPS. Specific changes since the NMFS 2005 status evaluation include:

Lower Columbia River Chinook Salmon ESU

The Elochoman Fall Chinook Salmon Hatchery Program has been eliminated and four new fall Chinook salmon programs have been initiated. The new programs—Deep River Net-Pen Fall Chinook Salmon, Klaskanine Hatchery Fall Chinook Salmon, Bonneville Hatchery Tule Fall Chinook Salmon, and Little White Salmon National Fish Hatchery Tule Fall Chinook Salmon—are actually changes in release locations of fish produced at, and previously released from, existing programs that are part of the ESU. The new programs warrant consideration for inclusion in the ESU.

Columbia River Chum Salmon ESU

The Big Creek chum salmon hatchery program was initiated in the fall of 2010 and will be evaluated as part of NMFS' next 5-year status review to determine ESU membership.

Lower Columbia River Coho Salmon ESU

The Elochoman Type-S and Type-N coho salmon hatchery programs have been eliminated. The Washougal River Type-N Coho Program should have been included as part of the ESU in the 2005 listing determination but was inadvertently omitted from the regulatory text defining this ESU.

Lower Columbia River Steelhead DPS

The Hood River Summer Steelhead Hatchery Program and the Cowlitz Hatchery Upper Cowlitz, Cispus, and Tilton steelhead hatchery programs have been eliminated. One new steelhead program has been initiated: the Lewis River Late-Run Winter Steelhead program, which began in 2009, and uses steelhead that are genetically representative of the North Fork Lewis River natural-origin winter steelhead population for broodstock and is representative of the DPS. This program warrants consideration for inclusion in the DPS.

2.4.2 ESU/DPS Viability and Statutory Listing Factors

- The Northwest Fisheries Science Center's review of updated information does not indicate a change in the biological risk category since the time of the last status review for the Lower Columbia River salmon ESUs and the steelhead DPS (Ford et al. 2010).

- Our analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the LCR salmon ESUs' persistence has not changed significantly since our final listing determination in 2005. Similarly, neither has the collective risk of the five listing factors to the LCR steelhead's persistence changed significantly since our final listing determination in 2006.

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3 · Results

3.1 Classification

Listing status:

Based on the information identified above, we determine that no reclassification for any of the four species is appropriate, and therefore:

- The LCR Chinook salmon ESU should remain listed as threatened.
- The Columbia River chum salmon ESU should remain listed as threatened.
- The LCR coho salmon ESU should remain listed as threatened.
- The LCR steelhead DPS should remain listed as threatened.

ESU/DPS delineation:

Available genetic and biogeographic information clearly shows that the Klickitat Basin falls in a transition zone between the Interior Columbia and Coastal/Lower Columbia River Eco-regions. Given the lack definitive information to support adjusting the boundary between the Lower Columbia and Middle Columbia River ESUs and DPS, we conclude that the existing boundaries for the Lower Columbia River steelhead DPS, the Lower Columbia River Chinook salmon ESU, and the Lower Columbia River coho salmon ESU should be maintained.

Hatchery membership:

Terminated programs to be removed from the ESU/DPS:

- The Elochoman River Tule Chinook Salmon Hatchery Program has been eliminated and should be removed from the Lower Columbia River Chinook ESU.
- The Elochoman Type-S and Type-N Coho Salmon Hatchery Programs have been eliminated and should be removed from the Lower Columbia River coho ESU.
- The Hood River Summer Steelhead Hatchery Program (ODFW stock #50) and the Cowlitz Hatchery Upper Cowlitz, Cispus, and Tilton steelhead hatchery programs have been terminated and should be removed from the Lower Columbia River steelhead DPS.

New programs or omissions that should be considered for inclusion in the ESU or DPS:

- The Lewis River Late-Run Winter Steelhead Program, which began in 2009 and uses steelhead genetically representative of the North Fork Lewis River natural-origin winter steelhead population for broodstock, should be considered for inclusion in the Lower Columbia River steelhead DPS.
- The four new fall Chinook salmon programs initiated since the previous status review include Deep River Net-Pen Fall Chinook, Klaskanine Hatchery Fall Chinook, Bonneville Hatchery Tule

Fall Chinook, and Little White Salmon National Fish Hatchery Tule Fall Chinook. These four Chinook salmon programs are changes in release locations for fish produced at, and previously released from, existing hatchery programs that are part of the ESU. Based on similarity to the natural populations, these four programs should be considered for inclusion in the LCR Chinook salmon ESU.

- The Washougal River Type-N Coho Program should have been included as part of the ESU in the 2005 listing determination but was inadvertently omitted from the regulatory text defining the LCR coho salmon ESU.

Programs to be reevaluated for inclusion in the ESUs/DPS:

- The new Big Creek chum hatchery program should be evaluated as part of the next status review to determine ESU membership.
- Many hatchery programs that are part of the listed ESUs/DPS are trending toward divergence from the listed ESUs/DPS and should be reevaluated in the future to determine if they should remain part of the ESUs/DPS.

3.2 New Recovery Priority Number

There are no changes in the recovery priority numbers listed in Table 4 for the Lower Columbia River ESUs/DPS.

4 · Recommendations for Future Actions

In our review of the listing factors, we identified several actions critical to improving the status of the Lower Columbia River salmon ESUs and steelhead DPS. The most important actions to be carried out over the next 5 years include implementation of the locally developed recovery plans for the Oregon and Washington portions of the ESUs/DPS (LCFRB 2010; ODFW 2010); completion and implementation of the NMFS Lower Columbia River recovery plan (which will be based on the local plans); implementation of Federal Energy and Regulatory Commission Settlement Agreements in the Cowlitz, Lewis, White Salmon, Hood, Clackamas, and Sandy river basins; implementation of the 2008 Harvest Biological Opinion and the 2010 FCRPS Biological Opinion; and completion of ESA consultations on hatchery programs in the Lower Columbia River.

The following recovery actions are particularly important:

- aggressive efforts to prioritize and implement habitat protection and restoration actions;
- actions to decrease the adverse effects of hatchery fish on priority populations;
- efforts to address tributary hydropower impacts, and;
- efforts to continue to address harvest impacts for Lower Columbia River Chinook salmon.

NMFS will work with local recovery planning partners to prioritize and direct actions and to ensure that risk factors and actions identified in recovery plans and relevant biological opinions are addressed. Recovery plan implementation must include efforts to improve coordination and cooperation among implementing partners; to identify clear near-term priorities for recovery actions; and to conduct research, monitoring, and evaluation to address critical uncertainties and improve population status and trend information.

There is also a need for quantitative analysis of net habitat loss and restoration/protective efforts and for developing a methodology for evaluating the effectiveness of regulatory mechanisms relative to VSP criteria. If take associated with research and monitoring continues to increase, the potential impacts to the viability of the affected ESUs/DPS will need to be evaluated.

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National Marine Fisheries Service
5-Year Review

Lower Columbia River Chinook Salmon
Columbia River Chum Salmon
Lower Columbia River Coho Salmon
Lower Columbia River Steelhead

Conclusion:

Based on the information identified above, we conclude:

- The Lower Columbia River Chinook salmon ESU should remain listed as threatened.
- The Columbia River Chum salmon ESU should remain listed as threatened.
- The Lower Columbia River Coho salmon ESU should remain listed as threatened.
- The Lower Columbia River Steelhead DPS should remain listed as threatened.

REGIONAL OFFICE APPROVAL

Northwest Regional Administrator, NOAA Fisheries

Approve: William Stelle Date: *July 26, 2011*