Science, Service, Stewardship

2016 5-Year Review:
Summary & Evaluation of
Lower Columbia River Chinook Salmon
Columbia River Chum Salmon
Lower Columbia River Coho Salmon
Lower Columbia River Steelhead

National Marine Fisheries Service
West Coast 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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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 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 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 on June 28, 2005 (70 FR 37160), and for steelhead DPSs on January 5, 2006 (71 FR 834). On August 15, 2011, we published our status reviews and listing determinations for 11 ESUs of Pacific salmon and 6 DPSs of steelhead from the Pacific Northwest (76 FR 50448).

1.2 Methodology used to complete the review

On February 6, 2015, we announced the initiation of five year reviews for 17 ESUs of salmon and 11 DPSs of steelhead in Oregon, California, Idaho, and Washington (80 FR 6695). We requested that the public submit new information on these species that has become available since our original listing determinations or since the species' status was last updated. 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 and Southwest Centers 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 for a given ESU or DPS relative to the four salmon and steelhead population viability criteria. They also considered new information on ESU and DPS composition. At the end of this process, the science team prepared reports detailing the results of their analyses (NWFSC 2015).

To further inform the reviews, we also asked salmon management biologists from our West Coast Region familiar with hatchery programs to consider new information available since the previous listing determinations. Among other things, they considered whether any hatchery programs have ended or new hatchery programs have started, any 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. They produced a report (Jones 2015) describing their findings. Finally, we consulted salmon management biologists from the West Coast Region who are 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 the best available scientific information, including the work of the Northwest Fisheries Science Center (NWFSC 2015); the report of the regional biologists regarding hatchery programs (Jones 2015); 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 lower Columbia River salmon and steelhead; 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

80 FR 6695; February 6, 2015

1.3.2 Listing history

Beginning in 1998, NMFS began listing salmonid species in the lower Columbia River 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 **Re-classification:** Threatened

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
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 **Re-classification:** Threatened
Coho Salmon (*O. kisutch*)	Lower Columbia River Coho Salmon	**FR Notice:** 70 FR 37160 **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 **Re-classification:** Threatened

1.3.3 Associated rulemakings

The ESA requires NMFS to designate critical habitat, to the maximum extent prudent and determinable, for 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 Lower Columbia River (LCR) Chinook salmon, Columbia River (CR) chum salmon, and LCR steelhead in 2005, and we designated critical habitat for LCR coho salmon in 2016 (Table 2). 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)). In 2000, NMFS adopted 4(d) regulations for threatened salmonids that prohibit take except in specific circumstances. In 2005, we revised our 4(d) regulations for consistency between ESUs and DPSs, and, 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 Name	4(d) Protective Regulations	Critical Habitat Designations
Chinook Salmon (*O. tshawytscha*)	Lower Columbia River Chinook Salmon	**FR notice:** 65 FR 42422 **Date:** 7/10/2000 **Revised:** 6/28/2005 (70 FR 37160)	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Chum Salmon (*O. keta*)	Columbia River Chum Salmon	**FR notice:** 65 FR 42422 **Date:** 7/10/2000 **Revised:** 6/28/2005 (70 FR 37160)	**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	**FR Notice:** 81 FR 9252 **Date:** 2/24/2016
Steelhead (*O. mykiss*)	Lower Columbia River Steelhead	**FR notice:** 65 FR 42422 **Date:** 7/10/2000 **Revised:** 6/28/2005 (70 FR 37160)	**FR notice:** 70 FR 52630 **Date:** 9/2/2005

1.3.4 Review History

Table 3 lists the numerous scientific assessments of the status of lower Columbia River salmon ESUs and steelhead DPS. These assessments include status reviews conducted by our Northwest Fisheries Science Center and technical reports prepared in support of recovery planning for this species.

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

Salmonid Species	ESU Name	Document Citation
Chinook Salmon (*O. tshawytscha*)	Lower Columbia River Chinook Salmon	NWFSC 2015 Ford et al. 2011 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	NWFSC 2015 Ford et al. 2011 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	NWFSC 2015 Ford et al. 2011 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 Weitkamp et al. 1995 Johnson et al. 1991

Salmonid Species	ESU Name	Document Citation
Steelhead (*O. mykiss*)	Lower Columbia River Steelhead	NWFSC 2015 Ford et al. 2011 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. For recovery plan development, implementation, and resource allocation, we assess three criteria to determine a species' recovery priority number from 1 (high) to 12 (low): (1) magnitude of threat; (2) recovery potential; and (3) conflict with development projects or other economic activity (NMFS 2009). Table 4 lists the recovery priority numbers for the subject species, as reported in NMFS 2015a.

1.3.6 Recovery Plan or Outline

Table 4. Recovery Priority Number and Endangered Species Act Recovery Plans for the ESUs and DPS in the lower Columbia River.

Salmonid Species	ESU Name	Recovery Priority Number	Recovery Plans/Outline
Chinook Salmon (*O. tshawytscha*)	Lower Columbia River Chinook Salmon	**9**	**Title:** ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead **Available at:** http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/willamette_lowercol/lower_columbia/final_plan_documents/final_lcr_plan_june_2013_-corrected.pdf **Date:** July 12, 2013 **Type:** Final **FR Notice:** 78 FR 41911
Chum Salmon (*O. keta*)	Columbia River Chum Salmon	**9**	**Title:** ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead **Available at:** http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/willamette_lowercol/lower_columbia/final_plan_documents/final_lcr_plan_june_2013_-corrected.pdf **Date:** July 12, 2013 **Type:** Final **FR Notice:** 78 FR 41911

Salmonid Species	ESU Name	Recovery Priority Number	Recovery Plans/Outline
Coho Salmon (*O. kisutch*)	Lower Columbia River Coho Salmon	**9**	**Title:** ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead **Available at:** http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/willamette_lowercol/lower_columbia/final_plan_documents/final_lcr_plan_june_2013_-corrected.pdf **Date:** July 12, 2013 **Type:** Final **FR Notice:** 78 FR 41911
Steelhead (*O. mykiss*)	Lower Columbia River Steelhead	**9**	**Title:** ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead **Available at:** http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/willamette_lowercol/lower_columbia/final_plan_documents/final_lcr_plan_june_2013_-corrected.pdf **Date:** July 12, 2013 **Type:** Final **FR Notice:** 78 FR 41911

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2 · Review Analysis

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

2.1 Delineation of species under the Endangered Species Act

Is the species under review a vertebrate?

ESU 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 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 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 DPS policy standards?

In 1991, NMFS issued a policy on how the agency would delineate DPSs of Pacific salmon for listing consideration under the ESA (56 FR 58612). Under this policy a group of Pacific salmon populations is considered an ESU if it is substantially reproductively isolated from other con-specific populations, and it represents an important component in the evolutionary legacy of the biological species. The 1996 joint NMFS-Fish and Wildlife Service (FWS) DPS policy (61 FR 4722) affirmed that a stock (or stocks) of Pacific salmon is considered a DPS if it represents an ESU of a biological species.

2.1.1 Summary of relevant new information regarding the delineation of the lower Columbia River ESUs/DPS

ESU/DPS Composition

This section provides a summary of information presented in NWFSC 2015: Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest.

We found no new information that would justify a change in the composition of the LCR Chinook salmon ESU, the LCR coho salmon, nor the CR chum salmon (NWFSC 2015).

LCR steelhead

A review of recent DNA studies, as well as the genetic analysis conducted for NWFSC (2015), indicate that winter-run steelhead in the Clackamas River are genetically more similar to native winter-run steelhead in the upper Willamette River than to steelhead in the lower Columbia River. The new genetic information indicates that the composition of the Lower Columbia River DPS and Upper Willamette River DPS should be evaluated. In addition, a review of these DPSs' delineation would benefit from the collection of genetic data from any winter-run steelhead populations in the Willamette River below Willamette Falls that have not previously been sampled (NWFSC 2015). For example, natural spawning steelhead populations were historically present in Johnson and Mount Scott creeks (Myers et al. 2006).

Membership of Hatchery Programs

In preparing this report, our management biologists reviewed the available information regarding hatchery membership of this ESU and DPS (Jones 2015). 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.

For the ESUs and DPS in the lower Columbia River, the following programs are being recommended for addition to the respective ESUs/DPS. For CR chum salmon, the Big Creek Hatchery is recommended for addition to the ESU. For LCR Chinook salmon, Deep River Net Pens-Washougal, Klaskanine Hatchery, Bonneville Hatchery, and Cathlamet Channel Net Pens are recommended for addition to the ESU. For LCR coho salmon, Clatsop County Fisheries and Clatsop County Fisheries/Klaskanine Hatchery are both recommended for addition to the ESU.

For LCR steelhead, Upper Cowlitz Wild and Tilton River Wild are both recommended for addition to the DPS.

2.2 Recovery Criteria

The ESA requires recovery plans be developed 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 a final, approved recovery plan 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	

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	

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	X	
Columbia River Chum Salmon	X	
Lower Columbia River Coho Salmon	X	
Lower Columbia River Steelhead	X	

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

For the purposes of reproduction, salmon and steelhead typically exhibit 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.

The biological recovery criteria in the 2013 Recovery Plan (NMFS 2013a) are based on the Willamette-Lower Columbia Technical Recovery Team (WLC TRT) work that partitioned the populations of each listed salmonid species into a number of different major population groups (MPGs), or strata, and developed biological criteria and methodologies at three different levels: ESU/DPS, MPG (or stratum), and population. The following are the WLC TRT's key points in defining a viable ESU/DPS:

- Every MPG or stratum that historically existed should have a high probability of persistence.
- Within each MPG or stratum, there should be at least two populations that have at least a 95 percent probability of persisting over a 100-year time frame.
- Within each MPG or stratum, the average viability of the populations should be 2.25 or higher, using the WLC TRT's scoring system. Functionally, this is equivalent to about half of the populations in the stratum being viable; a viable population is one whose persistence probability is high or very high.
- Populations targeted for viability should include those within the ESU/DPS that historically were the most productive ("core" populations) and that best represent the historical genetic diversity of the ESU/DPS ("genetic legacy" populations). In addition, viable populations should be geographically dispersed in a way that protects against the effects of catastrophic events.
- Viable populations should meet specific criteria for abundance, productivity, spatial structure, and diversity.

There are various ways to refer to extinction risk: as viability, persistence probability, extinction risk, or—at the population level—population status. The 2013 recovery plan frequently uses the terms "persistence probability" and "population status." Only populations with a persistence probability of 95 percent or higher over a 100-year time frame are considered viable. These populations have a population status of high or very high (NMFS 2013a). The 2013 Lower Columbia River Recovery Plan also includes detailed criteria for each of the five listing factors (NMFS 2013a).

LCR Chinook Salmon

This ESU includes all naturally spawned Chinook salmon originating from the Columbia River and its tributaries downstream of a transitional point east of the Hood and White Salmon Rivers, and any such fish originating from the Willamette River and its tributaries below Willamette Falls. Not included in this DPS are: (1) spring-run Chinook salmon originating from the Clackamas River; (2) fall-run Chinook salmon originating from Upper Columbia River bright hatchery stocks, that spawn in the mainstem Columbia River below Bonneville Dam, and in other tributaries upstream from the Sandy River to the Hood and White Salmon Rivers; (3) spring-run Chinook salmon originating from the Round Butte Hatchery (Deschutes River, Oregon) and spawning in the Hood River; (4) spring-run Chinook salmon originating from the Carson National Fish Hatchery and spawning in the Wind River; and (5) naturally spawning Chinook salmon originating from the Rogue River Fall Chinook Program. This DPS does include Chinook salmon from 15 artificial propagation programs: the Big Creek Tule Chinook Program; Astoria High School Salmon-Trout Enhancement Program (STEP) Tule Chinook Program; Warrenton High School STEP Tule Chinook Program; Cowlitz Tule Chinook Program; North Fork Toutle Tule Chinook Program; Kalama Tule Chinook Program; Washougal River Tule Chinook Program; Spring Creek National Fish Hatchery (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 (Oregon Department of Fish and Wildlife (ODFW) Stock #11) (79 FR 20802; Figure 1). There are thirty-two demographically-independent populations in this ESU: 9 spring-run, 21 fall-run, and 2 late fall run. These 32 populations are organized into six MPGs: Spring-run Cascade, Spring-run Gorge, Fall-run Coastal, Fall-run Cascade, Fall-run Gorge, and Late Fall-run Cascade (NWFSC 2015).

CR Chum Salmon

This ESU includes naturally spawned chum salmon originating from the Columbia River and its tributaries in Washington and Oregon. Also, chum salmon from two artificial propagation programs: the Grays River Program and the Washougal River Hatchery/Duncan Creek Program (79 FR 20802; Figure 2). The CR chum salmon ESU consists of 17 historical populations in three MPGs: Coastal, Cascade, and Gorge. There are seven populations in the Coast MPG - Young Bay, Grays/Chinook, Big Creek, Elochoman/Skamakowa, Clatskanie, Mill/Abernathy/Germany, and Scappoose. There are eight populations in the Cascade MPG – Cowlitz-fall, Cowlitz-summer, Kalama, Lewis, Salmon Creek, Clackamas, Sandy, and Washougal, and, there are two populations – Lower Gorge and Upper Gorge – in the Gorge MPG (NMFS 2013a).

LCR Coho Salmon

This ESU includes all naturally spawned coho salmon originating from the Columbia River and its tributaries downstream from the Big White Salmon and Hood Rivers (inclusive) and any such fish originating from the Willamette River and its tributaries below Willamette Falls. Also, coho salmon from 21 artificial propagation programs: the Grays River Program; Peterson Coho Project; Big Creek Hatchery Program (ODFW) Stock #13); Astoria High School Salmon-Trout Enhancement Program (STEP) Coho Program; Warrenton High School STEP Coho Program;

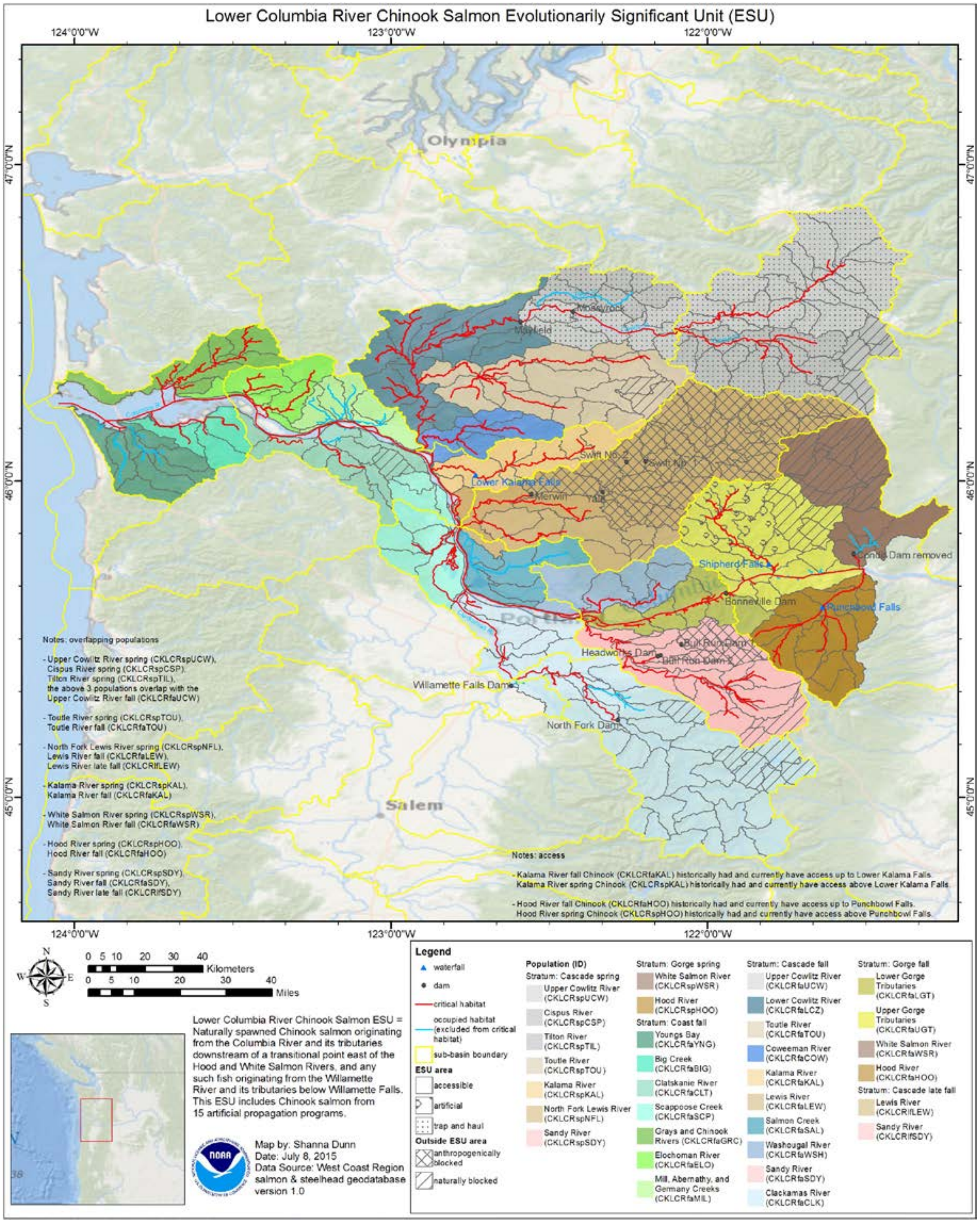

Figure 1. LCR Chinook salmon ESU population structure[1]

[1] The map above generally shows the accessible and historically accessible areas for the Lower Columbia River Chinook salmon ESU. The area displayed is consistent with the regulatory description of the composition of the Lower Columbia River 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.

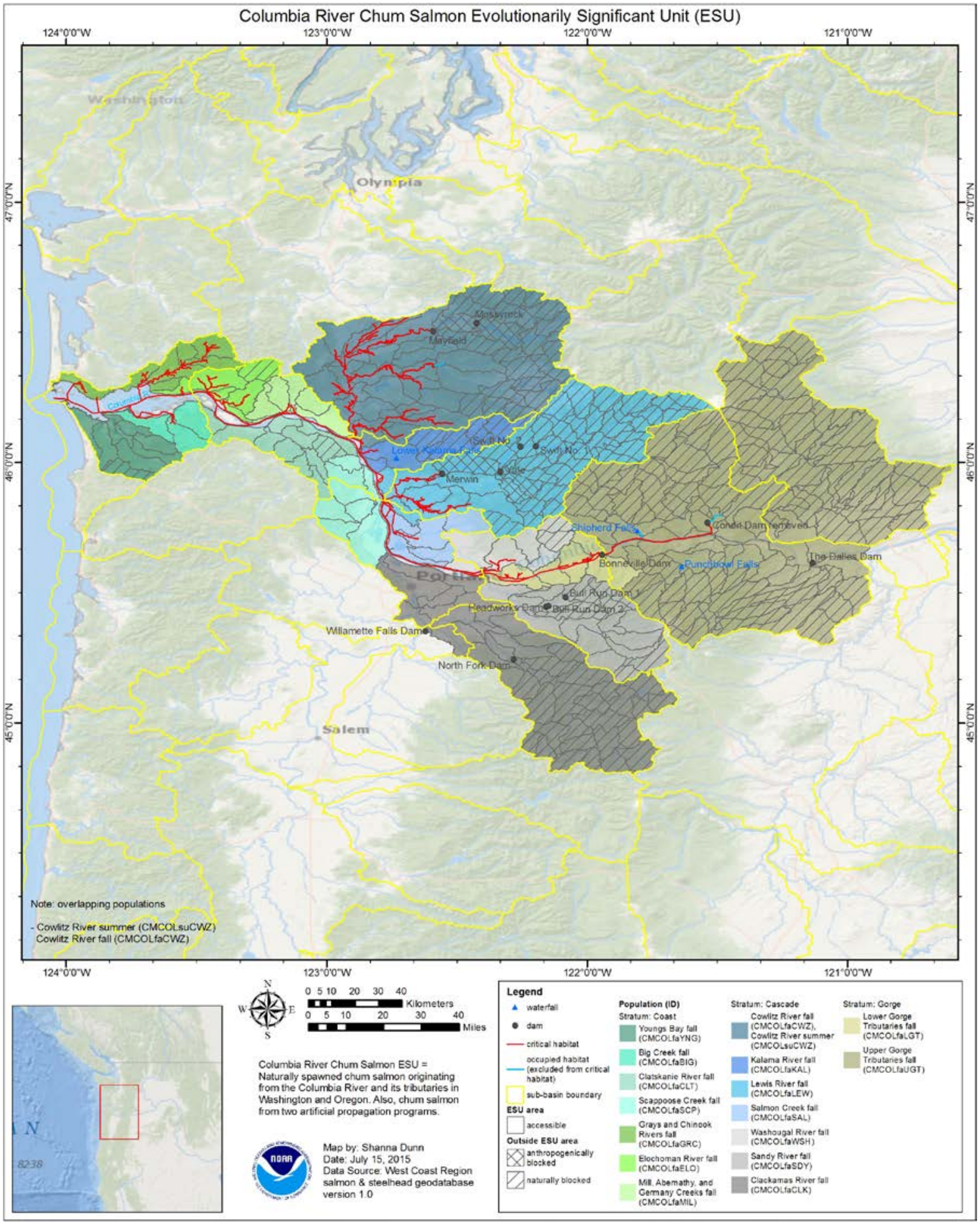

Figure 2. CR chum salmon ESU population structure[2]

[2] The map above generally shows the accessible and historically accessible areas for the Columbia River chum salmon ESU. The area displayed is consistent with the regulatory description of the composition 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.

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 Program; Kalama River Type-N Coho Program; Kalama River Type-S 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; Washougal River Type-N Coho Program; Eagle Creek National Fish Hatchery Program; Sandy Hatchery Program (ODFW Stock #11); and the Bonneville/Cascade/Oxbow Complex (ODFW Stock #14) Hatchery Program (79 FR 20802; Figure 3). Historically, the LCR coho salmon ESU consisted of a total of 24 independent populations that spawned in almost every accessible stream system in the lower Columbia River basin in three MPGs: Coast, Cascade, and Gorge. There are seven populations in the Coast MPG – Youngs Bay, Grays/Chinook, Big Creek, Elochoman/Skamokawa, Clatskanie, Mill/Abernathy/Germany, and Scappoose. There are 14 populations in the Cascade MPG – Lower Cowlitz, Upper Cowlitz, Cispus, Tilton, South Fork (SF) Toutle, North Fork (NF) Toutle, Coweeman, Kalama, NF Lewis, East Fork (EF) Lewis, Salmon Creek, Clackamas, Sandy, and Washougal, and there are three populations in the Gorge MPG – Lower Gorge, Upper Gorge/White Salmon, and Upper Gorge/Hood (NMFS 2013a).

LCR Steelhead

This DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from rivers between the Cowlitz and Wind Rivers (inclusive) and the Willamette and Hood Rivers (inclusive); excludes such fish originating from the upper Willamette River basin above Willamette Falls. This DPS does include steelhead from seven artificial propagation programs: the Cowlitz Trout Hatchery Late Winter-run Program (Lower Cowlitz); Kalama River Wild Winter-run and Summer-run Programs; Clackamas Hatchery Late Winter-run Program (ODFW Stock #122); Sandy Hatchery Late Winter-run Program (ODFW Stock #11); Hood River Winter-run Program (ODFW Stock #50); and the Lewis River Wild Late-run Winter Steelhead Program (79 FR 20802; Figure 4). Historically, the LCR steelhead DPS consisted of 23 independent populations (17 winter-run populations and six summer-run populations) broken into four MPGs: Winter-run Cascade, Summer-run Cascade, Winter-run Gorge, and Summer-run Gorge. There are 14 populations in the Winter-run Cascade MPG – Lower Cowlitz, Upper Cowlitz, Cispus, Tilton, SF Toutle, NF Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon Creek, Clackamas, Sandy, and Washougal. There are four populations the Summer-run Cascade MPG – Kalama, NF Lewis, EF Lewis, and Washougal. There are three populations – Lower Gorge, Upper Gorge, and Hood in the Winter-run Gorge MPG, and two populations – Wind and Hood in the Summer-run Gorge MPG (NMFS 2013a).

2.3 Updated Information and Current Species' Status

In addition to recommending recovery criteria, the WLC TRT also assessed the current status of each population of LCR Chinook salmon, CR chum salmon, LCR coho salmon, and LCR steelhead. Each population was rated against the biological criteria identified in previous assessments.

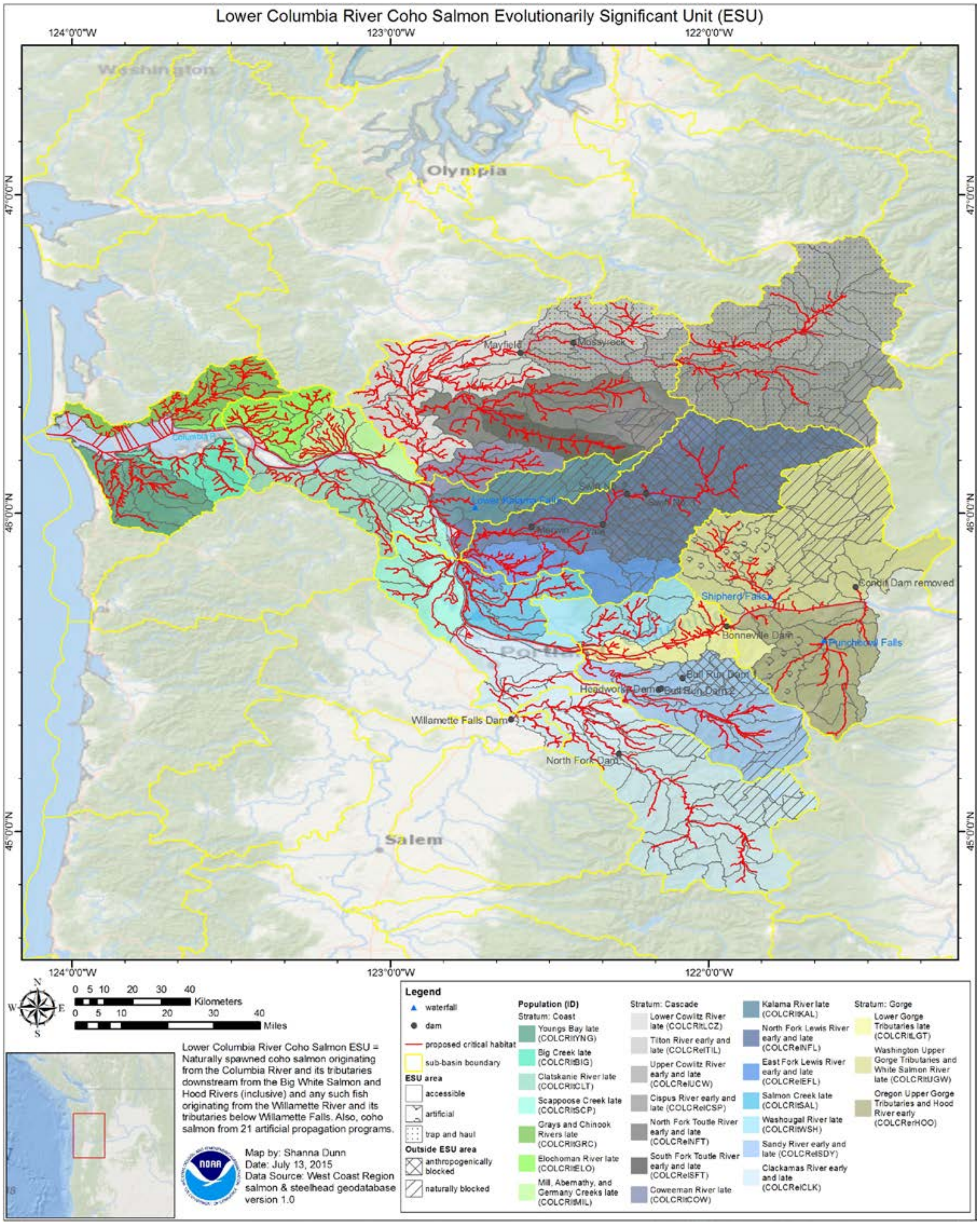

Figure 3. LCR coho salmon ESU population structure[3]

[3] The map above generally shows the accessible and historically accessible areas for the Lower Columbia River coho salmon ESU. The area displayed is consistent with the regulatory description of the composition of the Lower Columbia River 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.

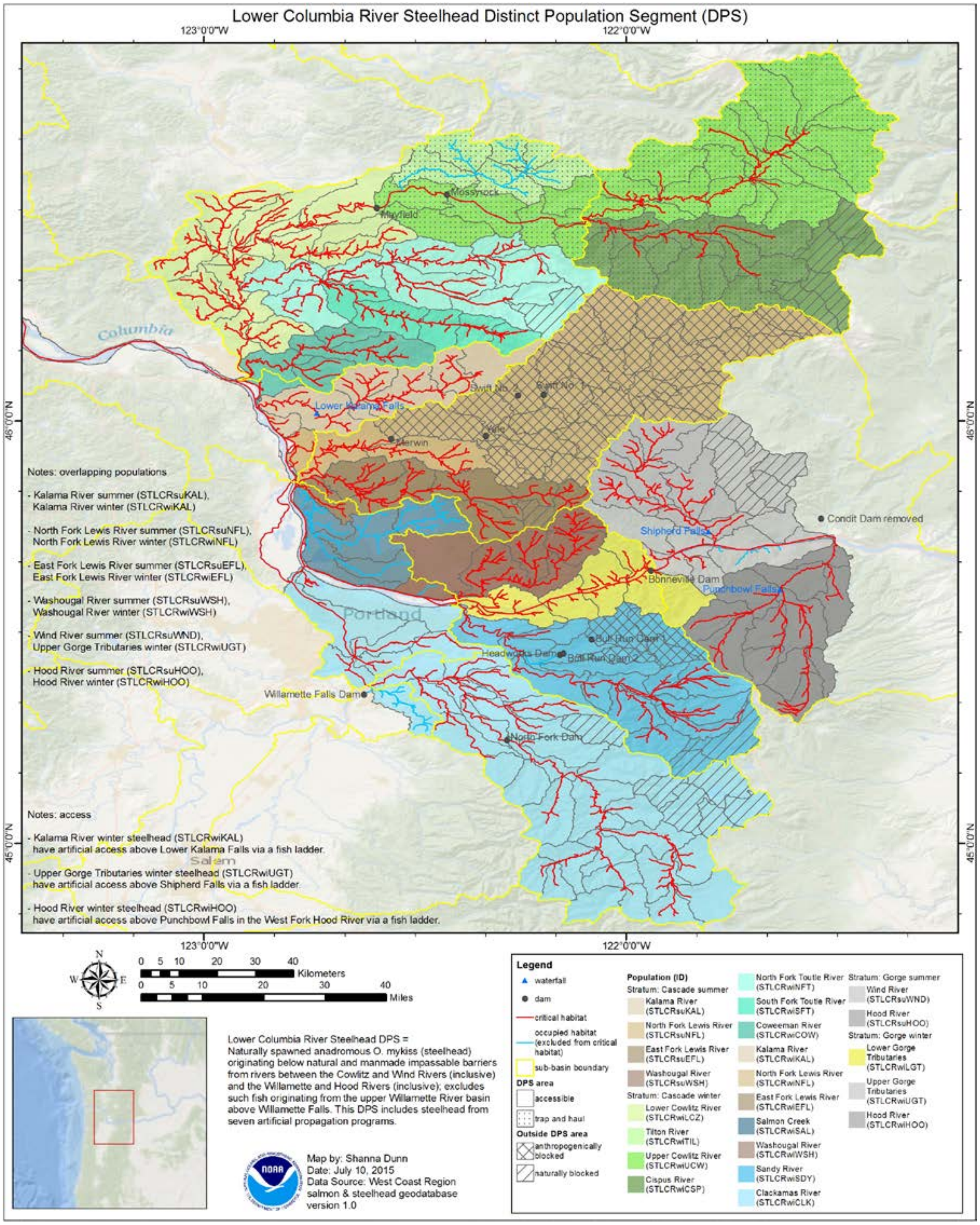

Figure 4. LCR steelhead DPS population structure[4]

[4] The map above generally shows the accessible and historically accessible areas for the Lower Columbia River steelhead DPS. The area displayed is consistent with the regulatory description of the composition of the Lower Columbia River 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.

2.3.1 Analysis of Viable Salmonid Population (VSP) Status

Information provided in this section is summarized from NWFSC 2015—Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest.

LCR Chinook Salmon

Updated Biological Risk Summary

Overall, there was little change since the last status review (Ford et al. 2011) in the biological status of Chinook salmon populations in the LCR ESU (NWFSC 2015). Increases in abundance were noted in about 70 percent of the fall-run populations and decreases in hatchery contribution were noted for several populations. Relative to baseline VSP levels identified in the Recovery Plan (NMFS 2013a) there has been an overall improvement in the status of a number of fall-run populations, although most are still far from the recovery plan goals (NWFSC 2015).

These improved fall-run VSP scores reflect both changes in biological status and improved monitoring. Spring-run Chinook populations in this ESU are generally unchanged, most of the populations are at a high or very risk due to low abundances and the high proportion of hatchery-origin fish spawning naturally. In contrast, the spring-run Chinook salmon demographically independent population (DIP) in the Sandy River has an average of over a thousand natural-origin spawners and is at moderate risk. Additionally, the removal of Marmot Dam in the Sandy River eliminated migrational delays and holding injuries that were occurring at the fish ladder. In addition, the removal of the diversion dam on the Little Sandy River restored access and flow to historical salmon habitat. Many of the spring-run populations rely upon passage programs at high head dams and downstream juvenile collection efficiencies are still too low to maintain self-sustaining natural runs. While limited numbers of naturally-produced spring-run return to the Cowlitz and Cispus rivers, no spring-run fish are transported into the Tilton River Basin and it is not clear if there are any spring-run Chinook salmon remaining in the Toutle River Basin. The removal of Condit Dam on the White Salmon River provides an opportunity for the reestablishment of a spring-run population with volitional access to historical spawning grounds (abundance estimates prior to 2012 reflected fish spawning below Condit Dam during the spring-run temporal spawning window). Spring-run Chinook salmon in the Hood River are largely of Deschutes River spring-run origin (Middle Columbia River spring-run ESU) and are not considered to benefit the status of the ESU; however, some Lower Columbia River spring-run Chinook salmon have been detected in the Hood River and their contribution (when sufficiently quantified) may need to be considered during future evaluations (NWFSC 2015).

The majority of the populations in this ESU remain at high risk, with low natural-origin abundance levels. Hatchery contribution to naturally-spawning fish remains high for a number of populations, and it is likely that many returning unmarked adults are the progeny of hatchery-origin parents, especially where large hatchery programs operate. While overall hatchery production has been reduced slightly, hatchery-produced fish still represent a majority of fish returning to the ESU. The continued release of out-of-ESU stocks: upriver bright (URB), Rogue River Select Area Bright (SAB) fall-run, Upper Willamette River spring-run, Carson Hatchery spring-run, and Deschutes River spring-run remain a concern. Relatively high harvest rates are a potential concern, especially for most spring-run and low abundance fall-run populations (NMFS 2012a). Although there have been a number of notable efforts to restore migratory access to areas upstream of dams, until efforts to improve juvenile passage systems bear fruition, it is unlikely that there will be significant improvements in the status of many spring-run populations. Alternatively, dam removals (i.e., Condit Dam, Marmot Dam, and Powerdale Dam) not only improve/provide access, but allow the restoration of hydrological processes that may improve downstream habitat conditions. Continued land development and habitat degradation in combination with the potential effects of climate change will present a continuing strong negative influence into the foreseeable future. In addition, coastal ocean conditions would suggest that recent outmigrant year classes will experience below average ocean survival with a corresponding drop in spawner abundance in the near term, depending on the duration and intensity of the existing situation (NWFSC 2015).

CR Chum Salmon

Updated Biological Risk Summary

The majority of the populations in this ESU are at high to very high risk, with very low abundances (NWFSC 2015). These populations are at risk of extirpation due to demographic stochasticity and Allee effects. One population, Grays River, is at low risk, with spawner abundances in the thousands and demonstrating a recent positive trend. The Washougal River and Lower Gorge populations maintain moderate numbers of spawners and appear to be relatively stable. The life history of chum salmon is such that ocean conditions have a strong influence on the survival of emigrating juveniles. The potential prospect of poor ocean conditions for the near future may put further pressure on these chum salmon populations (NWFSC 2015).

Freshwater habitat conditions may be negatively influencing spawning and early rearing success in some basins, and contributing to the overall low productivity of the ESU. Land development, especially in the low gradient reaches that chum salmon prefer, will continue to be a threat to most chum salmon populations due to projected increases in the population of the greater Vancouver-Portland area and the Lower Columbia River overall (Metro 2014). The viability of this ESU is relatively unchanged since the last review and the modest improvements in some populations do not warrant a change in risk category, especially given the uncertainty regarding climatic effects in the near future. This ESU therefore remains at moderate to high risk (NWFSC 2015).

LCR Coho Salmon

Updated Biological Risk Summary

According to the NWFSC 2015 report, the status of a number of coho salmon populations have changed since the review by McElhany et al. (2006), Ford et al. (2011), and NMFS (2013a). Changes in abundance and productivity, diversity and spatial structure were generally positive;

however, this appears to be mostly due to the improved level of monitoring (and therefore understanding of status) in Washington tributaries rather than a true change in status over time. In the absence of specific abundance and diversity data, earlier status reviews had concluded that hatchery origin fish dominated many of the coho salmon populations in the LCR ESU and that there was little natural productivity. Recent recovery efforts may have contributed to the observed natural production, but in the absence of longer term data sets it is not possible to parse out these effects. Populations with longer term data sets exhibit stable or slightly positive abundance trends. Additionally, fish passage programs are allowing for the return of relatively large numbers of naturally-produced fish to populations with previously limited numbers of spawning adults. Initiation of or improvement in the downstream juvenile facilities at Cowlitz Falls, Merwin, and North Fork Dam are likely to further improve the status of the associated upstream populations. While these and other recovery efforts have likely improved the status of a number of coho salmon DIPs, abundances are still at low levels and the majority of the DIPs remain at moderate or high risk. For the lower Columbia River region, land development and increasing human population pressures will likely continue to degrade habitat, especially in lowland areas. Although populations in this ESU have generally improved, especially in the 2013/14 and 2014/15 return years, recent poor ocean conditions suggest that population declines might occur in the upcoming return years. Regardless, this ESU is still considered to be at moderate risk (NWFSC 2015).

LCR Steelhead

Updated Biological Risk Summary

The majority of winter-run steelhead populations in this DPS continue to persist at low abundances (NWFSC 2015). Hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews. Summer-run steelhead DIPs were similarly stable, but at low abundance levels. The decline in the Wind River summer-run DIP is a source of concern, given that this population has been considered one of the healthiest of the summer-runs; however, the most recent abundance estimates suggest that the decline was a single year aberration. Passage programs in the Cowlitz and Lewis basins have the potential to provide considerable improvements in abundance and spatial structure, but have not produced self-sustaining populations to date. Recent low winter-run returns to the Upper Cowlitz River may be anomalous, related more to the development of an integrated hatchery broodstock and temporary modifications at the Cowlitz Falls Dam to benefit Chinook salmon than to a decline in viability. Efforts to provide passage above North Fork Lewis River dams offer the opportunity for substantial improvements in the winter-run steelhead population and the only opportunity to reestablish summer-run steelhead. Habitat degradation continues to be a concern for most populations. Even with modest improvements in the status of several winter-run populations, none of the populations appear to be at fully viable status, and similarly none of the MPGs meet the criteria for viability. The DPS therefore continues to be at moderate risk (NWFSC 2015).

2.3.2 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: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) 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.

Listing Factor A: Present or threatened destruction, modification or curtailment of its habitat or range

Significant habitat restoration and protection actions at the Federal, state, 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 benefit the survival and productivity of the targeted populations, we do not yet have evidence 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 should be monitored and evaluated. Generally, it takes one to five decades to demonstrate such increases in viability.

Current Status and Trends in Habitat

Below, we summarize information on the **current status and trends in habitat** conditions by ESU/DPS since our 2011 status review. We specifically address: (1) the **key emergent or ongoing habitat concerns** (threats or limiting factors) focusing on the top concerns that potentially have the biggest impact on viability; (2) **specific areas** where concerns about this ESU/DPS habitat condition remain; (3) **key protective measures and major restoration actions** leading toward achieving the recovery plan viability criteria established by the NMFS Science Centers as efforts that substantially address a key concern noted above, or that represent a noteworthy conservation strategy; (4) **key regulatory measures that are inadequate** and contributing substantially to the key concerns summarized above; and (5) **recommended future actions**, including: key near-term restoration actions that would address the key concerns summarized above; projects to address monitoring and research gaps; fixes or initiatives to address inadequate regulatory mechanisms, and highlighting priority habitat areas that should be prioritized when sequencing restoration actions.

1) Key Emergent or Ongoing Habitat Concerns

- Reduced complexity, connectivity, quantity, and quality of habitat used for spawning, rearing, foraging, and migrating continues to be a concern for all four lower Columbia River listed species. Loss of habitat from conversion to agricultural or urbanized uses continues to be a particular concern throughout the lower Columbia River region, especially the loss of habitat complexity in the lower tributary/mainstem Columbia River interface, and concomitant changes in water temperature (LCFRB 2010, ODFW 2010, NMFS 2013a).

- Toxic Contamination – All salmon and steelhead species pass through the lower Columbia River as they migrate up or down the mainstem. Toxic contamination through the production, use, and disposal of numerous chemicals from multiple sources including industrial, agricultural, medical and pharmaceutical, and common household uses that enter the Columbia River in wastewater treatment plant effluent, stormwater runoff, and nonpoint source pollution is a growing concern (Morace 2012; Nilsen and Morace 2014). Data collected by the Washington State Department of Ecology, Oregon Department of Environmental Quality and the Columbia River Contaminants and Habitat Characterization (ConHab) Project indicates contaminants are present at levels of concern (Alvarez et al. 2014; Counihan et al. 2013; Nilsen and Morace 2014; Nilsen et al. 2014a and 2014b). Most of these chemicals have been identified as needing a Total Maximum Daily Load (TMDL). Dams blocking or impeding passage for adult and juvenile fish in all four listed species (LCFRB 2010, NMFS 2013a).

2) Specific Areas of Concern

- Reduced or loss of habitat complexity, connectivity, quantity, and quality in the lower tributaries and tributary/Columbia River mainstem interface, the mainstem (especially for ocean-type Chinook salmon and chum salmon) and the estuary in Oregon and Washington. Lack of access into historically accessible floodplain habitats affects all lower Columbia River ESUs and DPS, and is particularly problematic for the full expression of juvenile coho salmon and Chinook salmon life history types (Bottom et al. 2005, NMFS 2013a).

- Toxic pollution in the estuary (NMFS 2013a).

- Dam blocking or impeding passage in the Cowlitz Basin, for Chinook salmon; the North Fork Toutle River basin, for steelhead and coho salmon; and the North Fork Lewis Basin, for steelhead (Fullerton et al. 2011; NMFS 2013a).

3) Key Protective Measures and Major Restoration Actions

Numerous habitat protection and restoration efforts have been implemented through the efforts of groups such as the Lower Columbia River Fish Recovery Board (LCFRB) in Washington, local watershed councils in Oregon, and the bi-state Lower Columbia River Estuary Partnership (LCEP). 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 continue to be implemented, and several conservation banks are in development. Specific projects and planning efforts are numerous and key habitat improvements since the previous status review are summarized below.

- Conservation Banks -- There is growing interest in the use of conservation banks and in lieu fee programs to address mitigation in the LCR Recovery Domain, and NMFS has recently prepared broad guidance for the use of these tools to address recovery needs (NMFS 2015d).

- Both Oregon and Washington have established wetland banking and in-lieu fee mitigation programs that are being investigated in the lower Columbia River recovery domain, as described in each state's weblinks.[5] We are currently working with other potential bankers to establish banks to service the lower Columbia River along the Coweeman River (WA), lower Lewis River (WA), and the mainstem lower Columbia River in both Washington and Oregon.

- Habitat Conservation Plans -- Private and state-owned forestlands in the LCR salmon and steelhead ESUs/DPS in Washington State are covered under several on-going Habitat Conservation Plans (HCPs), including the West Fork Timber (formerly Murray Pacific) HCP for forest lands in East Lewis County[6]; the Washington State Department of Natural Resources (WDNR) State Forest Trust Lands HCP[7] and the Washington State Forest Practices HCP.[8] Implementation of these plans has carried forward improvements to fish passage and road management via Road Maintenance and Abandonment Plans (RMAPs) to properly abandon or stabilize existing forest roads, and improve standards on how new roads are to be built and existing roads maintained or abandoned to ensure fish passage and minimize sediment delivery to streams and rivers. All RMAPs must be completed by 2016, and implementation of the Washington State Trust Lands HCP is on track to meet this date for state-owned forestland. Forest road improvements under the Washington State Forest Practices HCP was 70 percent complete through 2012. Small forest landowners are not required to complete RMAPs; however, they are still required to ensure roads on their forestland are not a barrier to fish passage. The Family Forest Fish Passage Program provides financial assistance to eligible small forest landowners to correct passage barriers. Through 2014, over 6,000 fish passage barriers have been corrected, opening over 4,000 miles of stream habitat. Overall, timber harvest practices that increased stream buffers, together with improved road management, have reduced the amount of sediment load to streams and rivers, and allowed better riparian conditions, all of which serve LCR salmon and steelhead.

- The Storedahl Gravel Daybreak Mine HCP continues to be implemented by the Storedahl company to address gravel mining impacts and associated restoration in the East Fork Lewis River basin where their operations are located[9], while instream flows and fish passage are

[5] http://www.oregon.gov/dsl/PERMITS/Pages/mitbank_intro.aspx
http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/pages/mitigation_banking.aspx
http://www.ecy.wa.gov/mitigation/ilf.html
http://www.ecy.wa.gov/programs/sea/wetlands/mitigation/rule/index.html

[6] This HCP now contributes to recovery in the LCR, but NOAA Fisheries Service did not issue an incidental take permit or prepare a biological opinion for this HCP because listed fish were not present in the covered area when the plan was signed. (77 FR 14062)

[7] http://www.westcoast.fisheries.noaa.gov/habitat/conservation_plans/wa_dnr_state_forest_trust_lands_west_of_the_cascades_hcp.html

[8] http://www.westcoast.fisheries.noaa.gov/habitat/conservation_plans/wa_dnr_state_forest_practices_hcp.html

[9] http://www.westcoast.fisheries.noaa.gov/habitat/conservation_plans/storedahl_gravel_daybreak_mine_expansion_hcp.html

continuing to be addressed within the Bull Run and Sandy rivers through continued implementation of the City of Portland's HCP for their municipal water supply.[10]

- Habitat restoration projects addressing limiting factors identified under locally developed components of the NMFS 2013 Lower Columbia Recovery Plan are underway. Actions to date of note include:
  - In the last five years, the LCEP and over 100 regional partners have protected or restored 1,434 acres in the lower Columbia River and estuary (LCEP 2015).
  - Between 2011-2014, (1) fish passage improvements through culverts and tidegates opened more than 18 miles of stream habitat; (2) instream habitat improvements to increase habitat complexity, enhance off-channel and side-channel habitat, and reconnect floodplains restored 147 miles of anadromous stream habitat; and, (3) approximately 9,000 acres of riparian function and condition were restored. In addition, invasive knotweed is currently being removed from throughout the Elochoman and Skamakowa watersheds through partnering with numerous landowners and the local Conservation District (Breckel 2015).
  - The Horsetail Creek Floodplain Restoration project restored 96 acres and reconnected the Columbia River to 180-acres of floodplain and off-channel habitat, which is expected to provide access and cool water refuge for rearing and out-migrating juvenile salmon and steelhead including chum, coho and Chinook salmon and steelhead from the Gorge MPGs associated with each species (LCEP 2013).
  - The Karlson Island Restoration project in eastern Cathlamet Bay restored over 320 acres of tidal marsh habitat, improving hydrology, food web connectivity, and complexity between the marsh floodplain and the Columbia River benefitting chum, coho, and Chinook salmon and steelhead in all lower Columbia River MPGs (LCREP 2013).
  - The LCFRB reports that between 2010 and 2015, 127 projects in 550 high priority tributary reaches were implemented across 13 major watersheds (Breckel 2015).
  - In 2011, the City of Portland completed a $1 billion project that reduced combined sewer overflows to the Willamette River by 94 percent. In addition, the Port of Vancouver, Washington, constructed one of the largest stormwater bio-retention facilities in the world that treats stormwater runoff from 50 acres at marine terminal number 2.[11]
  - The LCEP continues to sponsor workshops and projects and work with Congress to pass the Columbia River Basin Restoration Act to help reduce toxics (LCEP 2015).

[10] http://www.westcoast.fisheries.noaa.gov/publications/protected_species/salmon_steelhead/hcp/bull-run-ia.pdf
[11] http://www.portvanusa.com/environment/largest-stormwater-bio-retention-facility-in-world-calls-port-of-vancouver-home/

4) Key Regulatory Measures

Various federal, state, county and tribal regulatory mechanisms are in place to minimize or avoid habitat degradation caused by human use and development. Many of these mechanisms have been improved and updated in the past five years, such as the required updates of the Washington shorelines management plans. However, land use regulations which affect habitat remain a significant concern, and the implementation and effectiveness of regulatory mechanisms has not been adequately documented. See Listing Factor D: Adequacy & Inadequacy of Regulatory Mechanisms, and Protective Efforts in this document for details.

5) Recommended Future Actions

- Continue to implement and record priority habitat actions in accordance with the 2013 recovery plan using the NOAA Fisheries Recovery Action Mapping Tool: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/recovery_action_mapping_tool.html
- Systematically review and analyze the amount of habitat addressed against those high priority lower Columbia River mainstem and tributary areas identified in the NMFS 2013 Recovery Plan.
- Incorporate mechanisms to consider salmonid density dependent growth, dispersal, and survival when selecting habitat restoration actions as an approach to opening up new habitat and/or restoring degraded habitat (ISAB 2015).
- Continue to implement long-term settlement agreements at Federal Energy Regulatory Commission (FERC) licensed dams in the lower Columbia River tributaries.

Listing Factor A Conclusion

New information available since the last status review indicates there is improvement in freshwater and estuary habitat conditions because of restoration, habitat protection, and additional habitat made available by removal of Condit Dam in October 2011-2012. Improvements to fish passage and numerous tributary habitat restoration projects should result in improved survival for the lower Columbia River ESUs/DPS. However, at this time we do not have information that would reveal overall trends in habitat quality, quantity, and function. Future status assessments would benefit from a systematic review and analysis of high priority lower Columbia River mainstem and tributary areas habitat needs, identified in the NMFS 2013 Recovery Plan, and compare them to what has been accomplished.

We remain concerned about degraded habitat conditions throughout the range of the lower Columbia River ESUs and steelhead DPS, particularly with regard to tributary channel complexity, side channel and floodplain connectivity, water quality and hydrologic patterns that are legacy effects of urbanization, agriculture, timber practices, and toxic contamination from exposure to emerging and legacy chemicals. There remain numerous opportunities for habitat restoration or protection throughout the range of the lower Columbia River listed species. Additional habitat protection and restoration actions are necessary to bring these ESUs/DPS to viable status. Overall, we conclude that the risk to the species' persistence because of habitat destruction or modification has not changed since the last status review.

Listing Factor B: Overutilization for commercial, recreational, scientific, or educational purposes

Harvest

Systematic improvements in fisheries management since the last status review include:

- Use of an abundance-based harvest matrix on LCR tule fall-run Chinook salmon in 2012. The use of this matrix implements weak-stock management principles to the degree possible at this time by reducing the allowable exploitation rate to as low as 30 percent when the abundance is low, which reduces the extinction risk to all populations in the Cascade fall-run MPG by approximately 4 percent (NMFS 2012a).
- Continued implementation of the 2008 Pacific Salmon Treaty[12], which has reduced impacts to fall-run Chinook salmon in fisheries that occur north of the US/Canada border.
- Implementing an updated abundance-based harvest matrix on LCR coho salmon beginning in 2015. Implementation of the new harvest matrix includes tracking ten primary coho salmon populations in the ESU whereas the previous matrix only tracked two (NMFS 2015c).
- Implementation of the *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).
- Implementation of increased mark-selective fisheries for both coho and Chinook salmon, both recreational and commercial, which has contributed to reduced numbers of hatchery-origin spawners (WDFW 2015).

LCR Chinook Salmon

LCR Chinook salmon include three distinct life-history components: spring-run Chinook salmon, tule fall-run Chinook salmon, and late fall-run Chinook salmon (NWFSC 2015). These different components are subject to different in-river fisheries because of differences in river entry timing, but share similar ocean distributions. According to NWFSC 2015:

- Harvest of spring-run Chinook salmon dropped in the mid-1990s to around 25 to 40 percent; in recent years harvest rates have ranged from 25 to 35 percent. These rates are based on returning hatchery fish, not natural-origin fish.
- Harvest of fall-run Chinook salmon dropped to around 20 to 25 percent in the mid-1990s, increased to 50 percent in 2002, and has since decreased to 30 to 40 percent.

[12] http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/salmon_steelhead/pacific_salmon_treaty_fact_sheet_022315.pdf

- Harvest of late fall-run Chinook salmon also dropped to 20 to 25 percent in the mid-1990s, but has been increasing since. In the period from 2010 to 2014, harvest rates of late fall-run Chinook salmon ranged from 40 to 65 percent; equivalent to the harvest rates of the early 1980s. These rates for late fall-run Chinook salmon (North Fork Lewis and Sandy populations) are now based on the escapement of natural-origin fish, ensuring that there are sufficient numbers of adults on the spawning grounds.

CR Chum Salmon

CR chum salmon were historically abundant and subject to substantial harvest until the 1950s (Johnson et al. 1997). In recent years, there has been no directed harvest of CR chum salmon (NWFSC 2015). Commercial harvest has been less than 100 fish per year since 1993, and all recreational fisheries have been closed since 1995. The incidental harvest rate on CR chum salmon was 1.9 percent in 2013 (ODFW and WDFW 2015) and 0.8 percent in 2014 (TAC 2015). Overall, the exploitation rate has been below one percent for the last five years (NWFSC 2015).

LCR Coho Salmon

LCR coho salmon are part of the Oregon Production Index and are harvested in ocean fisheries primarily off the coasts of Oregon and Washington, with some harvest that historically occurred off of the West Coast Vancouver Island (NWFSC 2015). Canadian coho salmon fisheries were severely restricted in the 1990s to protect upper Fraser River coho salmon, and have remained so ever since. Ocean fisheries off California were closed to coho salmon retention in 1993 and have remained closed ever since. Ocean fisheries for coho salmon off of Oregon and Washington were dramatically reduced in 1993 in response depressed status of Oregon Coast natural coho salmon and subsequent listing, and moved to mark-selective fishing beginning in 1999. LCR coho salmon benefitted from the more restrictive management of ocean fisheries. Overall exploitation rates regularly exceeded 80 percent in the 1980s, but have remained below 30 percent since 1993. In addition, freshwater fisheries impacts on naturally-produced coho salmon have been markedly reduced through the implementation of selective fisheries. The most recent impact rate for LCR coho salmon was 17.1 percent in 2014 (TAC 2015; NWFSC 2015).

LCR Steelhead

There is no direct harvest of naturally-produced steelhead in the LCR DPS, other than a catch and release fishery in the Wind River (NWFSC 2015). Steelhead are intercepted in mainstem fisheries targeting non-listed hatchery and naturally-produced Chinook salmon, and non-listed steelhead. Mark-selective net fisheries in the mainstem Columbia River can result in post-release mortality rates of 10 to over 30 percent, although there is considerable disagreement on the overall rate. During the 2014 season, an estimated 350 unmarked winter-run steelhead were encountered with a 20 percent mortality rate (ODFW and WDFW 2015). Recreational fisheries targeting marked hatchery-origin steelhead encounter natural-origin fish at a relatively high rate, but hooking mortalities are generally lower than those in the net fisheries. Estimated mortality for naturally produced winter-run steelhead has averaged 2.2 percent (2009-2013) for non-tribal commercial and recreational fisheries (ODFW and WDFW 2015). The current *U.S. v. Oregon* Management Agreement (2008-2017) has, on average, maintained reduced harvest impacts for

LCR steelhead fisheries (TAC 2011-14) with 2014 harvest rates for winter-run steelhead in mainstem fisheries at 0.6 percent (TAC 2015), and with harvest rates for summer-run steelhead below 15 percent for those above Bonneville Dam (NWFSC 2015).

Research and Monitoring

Much of the scientific research and monitoring being conducted for listed lower Columbia River salmonid species is intended to fulfill managers' obligations under the ESA to ascertain the status of the species. In 2014, researchers were approved to take up to 2,241,989 naturally produced juvenile listed salmonids with a 1.18 percent mortality rate. The majority of the requested nonlethal take of juvenile salmonids has been and is expected to continue to be captured with screw traps, beach seines, and backpack electrofishing units (NMFS APPS database; https://apps.nmfs.noaa.gov/). Our records from the past nine years indicate that mortality rates for screw traps are typically less than 1 percent and backpack electrofishing typically less than 3 percent. Researchers deploy screw traps from late winter through early summer to capture juvenile salmon during their annual outmigration. Managers use the data collected from screw traps to derive estimates of outmigration abundance. Backpack electrofishing is used to capture juvenile fish for abundance estimates, tagging and marking, and tissue samples. However, a small number of the naturally produced adult fish may die as an unintended result of the research.

Because the majority of fish that researchers capture and release recover shortly after handling with no long-term ill effects, the effect of the action we consider here is the potential mortality. When compared to the abundance of these listed lower Columbia River salmonid species, the potential mortality levels are typically low. These effects would be spread out over various channels and tributaries of the lower Columbia River region. Thus, no population is likely to experience a disproportionate amount of these losses. Therefore, the research would likely have only a very small impact on abundance, a similarly small impact on productivity, and no measureable effect on spatial structure or diversity.

The quantity of permits issued over the past five has trended slightly down over the past five years; however, the overall effect on listed populations has not changed substantially. Therefore, we conclude that the risk to the species' persistence because of utilization related to scientific studies remains essentially unchanged since the last status review.

Listing Factor B Conclusion

New information available since the last status review indicates that overall, improved ocean fisheries management and implementation of selective freshwater fisheries continue to reduce harvest impacts on most of the listed lower Columbia River salmon and steelhead, with the exception of the bright fall-run component of the LCR Chinook salmon ESU where harvest rates are up to 40 to 65 percent in recent years, equivalent to the harvest rates of the early 1980s, and, the LCR coho salmon ESU where harvest rates are up to 30 percent (NWFSC 2015). Research impacts have increased slightly (NMFS APPS database; https://apps.nmfs.noaa.gov/). We, therefore, conclude that although there has been systematic improvements in fisheries management since the last status review, there remain concerns about both bright fall-run LCR Chinook salmon and LCR coho salmon harvest rate trends and the risk to the species' persistence because of overutilization since the last 2011 status review remains about the same.

Listing Factor C: Disease or Predation

Predation

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). Although actions to reduce avian predation in the Columbia River Basin have been ongoing with implementation of the Federal Columbia River Power System (FCRPS) Biological Opinion (Opinion), high levels of avian predation by Caspian terns and double-crested cormorants continue to affect lower Columbia River listed salmonid ESUs and DPS. Further, predation remains a concern due to a general increase in pinniped populations along the West Coast. Non-indigenous fish affect salmon and their ecosystems through many mechanisms.

Caspian Terns

The NMFS' 2008 FCRPS Opinion recommended that the Action Agencies implement the Caspian Tern Management Plan [Reasonable and Prudent Alternative (RPA) Action 45] to substantially reduce this species' nesting habitat and salmonid predation rates in the Columbia River estuary by 2018. The plan calls for reductions in nesting habitat for Caspian terns at East Sand Island in the lower estuary, concurrent with the development of alternative nesting habitat elsewhere in the interior Northwest and along California coast (i.e., outside the Columbia River basin) (NMFS 2014a). To date, nine alternative nesting habitat islands totaling 8.3 acres have been constructed at interior locations, but no coastal sites have been developed. Tern nesting habitat on East Sand Island has been reduced from 6 acres down to a current 1.58 acres, which has reduced the colony from a pre-management level of about 9,000 pairs to 6,000 to 6,500 pairs. However, this is short of the reduction to 3,500 to 4,000 pairs that was anticipated by the management plan and assessed in the 2008 Opinion's analysis (NMFS 2014a).

Double-crested Cormorants

The number of double-crested cormorants nesting in the Columbia River estuary has increased from about 150 pairs in the early 1980s to 11,000 to 13,500 pairs, with most of the increase occurring over the past 10 years (Appendix E in NMFS 2014a). Consumption rates of juvenile salmon and steelhead also increased during this period; in 2006, double-crested cormorants probably consumed more than 4 percent of the juvenile yearling Chinook salmon and about 13 percent of the juvenile steelhead in the lower Columbia River. In the 2014 FCRPS Supplemental Opinion, NMFS therefore recommended that the Action Agencies develop a cormorant management plan and implement actions to reduce cormorant numbers to no more than 5,380 to 5,939 nesting pairs on East Sand Island (RPA Action 46). The Corps completed a Cormorant Management Environmental Impact Statement and Management Plan in early 2015 and began implementation on East Sand Island in late May by culling adults and oiling eggs.

Pinnipeds

Status of Pinnipeds Populations in Oregon and Washington

Pinniped predation continues to remain a concern for listed species in Oregon and Washington due to a general increase in pinniped populations along the West Coast. For example, California sea lions have increased at a rate of 5.4 percent per year between 1975 and 2011 (NMFS 2015b), Steller sea lions have increased at a rate of 4.18 percent per year between 1979 and 2010 (Allen and Angliss 2014), and harbor seals likely remain at or near carrying capacity in Washington and Oregon (Jefferies et al. 2003, Brown et al. 2005, respectively, as cited in NMFS 2014b).[13]

Columbia River Basin

In the Columbia River Basin, there has been a steady influx of pinnipeds (Figure 5), especially California sea lions, over the past 5 years with sharp increases in California sea lion presence in 2013 of 750 animals, 1,420 animals in 2014,[14] and 2,340 animals in 2015.[14]

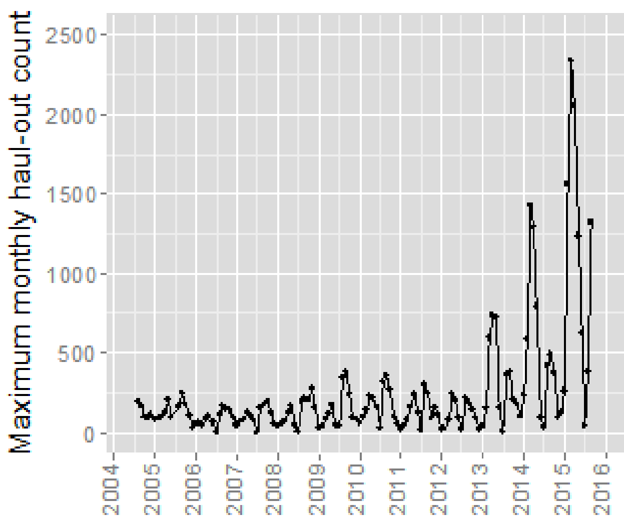

Figure 5. Estimated peak counts (spring and fall) of California sea lions in the East Mooring Basin in Astoria, Oregon, 2004 through 2015.[14]

As pinniped numbers have increased in the Columbia River Basin over the past 13 years (2002 through 2014), more than 40,000 fish from listed and non-listed salmon and steelhead stocks (listed stocks: Upper Columbia River spring-run Chinook salmon, Snake River spring/summer-run Chinook salmon, Upper Columbia River steelhead, Snake River Basin steelhead, Middle Columbia River steelhead; non-listed stocks: Middle Columbia River spring-run Chinook salmon, Upper Columbia River summer-run Chinook salmon, Deschutes River summer-run Chinook salmon) have been consumed by California sea lions in the vicinity of Bonneville Dam (Stansell et al. 2014). Most, but not all, California sea lions leave Bonneville Dam by the end of

[13] The last population estimates of harbor seals in Washington (coastal population) and Oregon was in 2003 and 2005 (Jefferies et al. 2003, Brown et al. 2005, respectively, as cited in NMFS 2014b), when the population growth rate was estimated at 7 percent (NMFS 2014b).

[14] E-mail to Robert Anderson, NMFS, from Bryan Wright, ODFW, October 28, 2015.

May, and there have been a handful that have taken residence in the area between Bonneville Dam forebay and the Dalles Dam. All up-river stocks are subject to pinniped predation in the vicinity of Bonneville Dam, although it is the spring-run stocks that are at greatest risk because of 'run' timing.

The states of Oregon, Washington and Idaho are operating under a Marine Mammal Protection Act Section 120 authorization, that allows for the lethal removal of California sea lions that are individually identifiable and observed to be having a significant negative impact on ESA-listed salmonids at Bonneville Dam, to address the threat of predation by California sea lions in the vicinity of Bonneville Dam. Between 2008 and 2014 this program has prevented the loss of between 7,000 and 24,000 salmonids at Bonneville Dam (Wright et al. 2015).

Ongoing research in the Columbia River (Wargo Rub 2014)[15] suggests that 10 to 45 percent of the returning adult salmon are unaccounted for during the 146 mile migration between the Columbia River estuary and the Bonneville Dam, at the time when the California sea lions are present in the Columbia River in large numbers. If California sea lions are in fact responsible for a substantial fraction of this estimated loss, then this additional source of pinniped predation (in addition to documented predation at Bonneville Dam) may represent a significant shift in the severity of pinniped predation to the recovery of listed Columbia River Basin salmon and steelhead stocks, in addition to anthropogenic threats (e.g., impacts from habitat loss, dams, etc.).

Additionally, California sea lions numbers over the past five years at Willamette Falls, 28 miles south of the confluence of the Willamette and Columbia Rivers at Portland, Oregon, have been steadily increasing and their predation on listed salmonid stocks has reached significant levels (Brown et al. 2015). In the late winter and spring months of 2014 and 2015, some 25-50 California sea lions consumed between 8-14 percent of the listed spring-run Chinook salmon and winter-run steelhead, respectively, attempting to pass the falls to upriver spawning areas (Wright et al. 2015).

The effect of marine mammal predation on the productivity and abundance of Columbia River Basin salmon and steelhead stocks has not been quantitatively assessed at this time. The absolute number of animals preying upon salmon and steelhead throughout the lower Columbia River and Willamette River is not known. In addition to pinniped predation on salmonids, this steady influx of pinnipeds into the Columbia River may also represent a threat to other species, such as eulachon. For example, in 2015 Washington Department of Fish and Wildlife (WDFW)[16] estimated, based on biomass reconstruction for eulachon consumption, that harbor seals were consuming an estimated 2,700,000 eulachon per day in the Columbia River estuary.

[15] Wargo Rub, A.M. 2014. Preliminary report on survival and run timing of adult spring/summer Chinook salmon through the lower Columbia River to Bonneville Dam. PowerPoint presentation to Northwest Power and Conservation Council (October 27, 2014).

[16] E-mail (forwarded) to Robert Anderson, NMFS, from Brent Norberg, NMFS, on February 19, 2015, from Steven Jefferies, WDFW, regarding sea lion counts in Astoria, Oregon.

The information available since the last status review clearly indicates that predation by pinnipeds on listed stocks of Columbia River Basin salmon and steelhead, as well as eulachon, has increased at an unprecedented rate. So while there are management efforts to reduce pinniped predation in the vicinity of Bonneville Dam, this management effort is insufficient to reduce the severity of the threat, especially pinniped predation in the Columbia River estuary (river miles 1 to 145) and at Willamette Falls.

Recommendations

- Expand monitoring efforts in the Columbia River and Willamette River to assess predator-prey interactions between pinnipeds and listed species.
- Maintain predatory pinniped management actions at Bonneville Dam to reduce the loss of up-river listed salmon and steelhead stocks.
- Complete life-cycle/extinction risk modeling to quantify predation rates by predatory pinnipeds on listed salmon and steelhead stocks in the Columbia River and Willamette River.
- Expand research efforts in the Columbia River estuary on survival and run timing for adult salmonids migrating through the lower Columbia River to Bonneville Dam.

Fish Predation

A variety of non-indigenous fishes to the Lower Columbia River recovery domain affect salmon and their ecosystems. A number of studies have concluded that many established non-indigenous species (e.g., 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).

Some indigenous fish species are also recognized as significant predators of ESA-listed salmonids in the lower Columbia River basin, such as the northern pikeminnow. The construction of dams and dredging of waterways in the Columbia River basin has created reservoirs and islands from dredged spoils that have facilitated population explosions of the native Northern pikeminnow (Waples et al. 2008). In 1990, a sport fishing reward program was implemented to reduce the numbers of northern pikeminnow in the Columbia River basin to reduce predation upon juvenile salmon and steelhead (NMFS 2010). Further, NMFS' 2008 FCRPS Opinion recommended the Northern Pikeminnow Management Program (RPA Action 43) to continue the sport-reward fishery while evaluating its effectiveness (NMFS 2008a) which was further expanded in the 2014 FCRPS Supplemental Opinion (NMFS 2014a).

Disease

Disease rates over the past five years are believed to be consistent with the previous review period. A strain of infectious haematopoietic necrosis virus (IHNV) was detected on along the Pacific Coast that originated in the Columbia River was reported in the last status review but has not be detected on the Pacific Coast since 2011 (Kurath 2012). There was concern that this strain of IHNV would be more virulent and increase the spread of the infection but these concerns have not been borne out as IHNV reports in the basin have declined in the past few years. These fluctuations in the disease rates are considered normal but current high water temperatures and low water flows, associated with climate change effects, could exacerbate conditions that can lead to increase disease rates.

Listing Factor C Conclusion

New information available since the last status review indicates there is an increase in the level of avian and pinniped predation on Lower Columbia River listed salmonids. 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. The disease rates have continued to fluctuate within the range observed in past review periods and are not expected to affect the extinction risk of the lower Columbia River ESUs/DPS.

Listing Factor D: Adequacy & Inadequacy of Regulatory Mechanisms and Protective Efforts

Various Federal, state, county and tribal regulatory mechanisms are in place to reduce habitat loss and degradation caused by human use and development and harvest impacts. New information available since the last status review indicates that the adequacy of a number of regulatory mechanisms has improved slightly. Examples of regulatory mechanisms for **Habitat** and for **Harvest** are listed below followed by our conclusion and bulleted summary of concerns regarding the current adequacy of existing regulatory mechanisms.

Habitat

Mainstem Hydrosystem Improvements

The implementation of the RPAs in the 2008 FCRPS Opinion (NMFS 2008a), as amended in 2010 (NMFS 2010) and supplemented in 2014 (NMFS 2014a), has provided a number of actions that are improving the survival and condition of salmon and steelhead migrants through the mainstem Columbia River, including the reach that passes through the Columbia River Gorge and the estuary:

- Flow management from storage reservoirs
- Operations and maintenance activities to maintain biological performance
- Piscivorous fish, avian, and pinniped predation control measures

Changes in the life-cycle productivity of lower Columbia River salmonids, as updated in this status review, were affected by alterations to the FCRPS since about 2005. Juvenile and adult passage facilities at all of the mainstem FCRPS dams, including Bonneville, are the subject of ongoing testing for passage survival and behavioral responses with the results informing further changes to facility design and project operations under the principle of adaptive management.

The 2008 FCRPS Opinion also set up an offsite mitigation program that includes habitat restoration below Bonneville Dam. These projects are designed to reconnect portions of the historical floodplain that have been isolated behind dikes and levees for many years. Lower Columbia and upper Willamette River salmonids are expected to benefit from increased flux of insect prey from the river margins to the mainstem migration corridor (Diefenderfer et al. 2013).

Improvements in Operations and Fish Passage at FERC-licensed Hydropower Facilities and Dams

Federal Energy Regulatory Commission relicensing settlement agreements implemented in Lower Columbia River tributaries since the 2011 status review include:

<u>Cowlitz River (for Tacoma Power's Cowlitz River Hydroelectric Project)</u>

Starting in 2014, Tacoma Power began building a new downstream collector for juvenile migrants at Cowlitz Falls Dam. Construction completion is targeted for the end of 2016.

<u>Lewis River (for PacifiCorp's Lewis River Hydroelectric Project)</u>

Fish were reintroduced above the upper dam (Swift #1) beginning with adult transport in 2012 and juvenile downstream collection began in 2013. For this to happen, a Swift Reservoir Floating Surface Collector was built, and a Merwin upstream adult passage system was constructed.

<u>Clackamas River (for Portland General Electric's Clackamas River Hydroelectric Project)</u>

Many Juvenile transport and sorting facilities have been improved with the extension of the migrant pipeline and Timber Park migrant facility. These modifications have reduced travel times from over 2 weeks to 2 hours. In addition, these actions have decreased predation vulnerability in the North Fork Ladder and new facilities have decreased handling during enumeration.

The North Fork adult sorting facility has decreased/removed handling of all species for hatchery fish removal. This facility also decreased water temperatures ~1.0° C during the maximum summer temperatures in the North Fork Ladder.

Improvements to downstream passage have been made at River Mill Dam and North Fork Dam through the addition of a 500 and 1,000 cubic feet per second (cfs) surface collectors. Initial evaluations have determined these to be about 97 percent (Ackerman and Pyper 2015) and 90 percent (Ackerman 2016) effective (including reservoir guidance) for guiding fish respectively. The additional corner collector at North Fork reservoir is collecting an additional percentage of downstream migrants, making this project outstanding for collection of fish.

New instream minimum flow requirements in the Oak Grove Fork and Faraday Diversion reach have also improved production capacity, spawning distribution and migration conditions.

Sandy River Delta Dam Removal -- US Army Corps of Engineers

The removal of the 750-foot-long Sandy River Delta Dam is helping restore hydrological complexity and backwater habitats. This effort is also reducing water temperatures in the East Channel and decreases the potential for juvenile stranding. The U.S. Army Corps of Engineers and its partners, the Bonneville Power Administration, U.S. Forest Service (USFS), and Portland Water Bureau completed this action on November 30, 2013. Removing the dam and reconnecting the East Channel benefits juvenile salmonids spawned in the Sandy River system and fish migrating down the Columbia River by providing year-long access to the East Channel during a variety of flow conditions (http://www.nwp.usace.army.mil/Missions/Current/SandyRiverDelta.aspx).

Condit Dam Removal (PacifiCorp)

Condit Dam, a 125-foot high concrete gravity structure, was completed in 1913 on the White Salmon River (river mile 3.3) near White Salmon, Washington. The dam was initially built to supply power to the Crown Willamette Paper Company in Camas, Washington and could generate up to about 14 megawatts of electricity. The original construction included a wooden fish ladder that was damaged by floods in 1914 and again in 1918. The ladder was not restored after the 1918 event. An experimental fish elevator was constructed in 1925 but it failed and that effort was abandoned. Thus, fish had not passed the project since 1918 and nearly 33 miles of historic steelhead habitat was cut off (PacifiCorp 2011).

In 1999, PacifiCorp, Federal and state agencies, Tribes, and non-governmental organizations reached an agreement to remove the dam and appurtenant facilities. Beginning in September 2011, PacifiCorp excavated a large tunnel through the base of the dam. On October 26, 2011, PacifiCorp breached the last 10 feet of concrete at the upstream end of the tunnel with explosives and drained the reservoir. The original cofferdam used during construction was left on the riverbed and subsequently encased in reservoir sediments. Even though fish could migrate through the new tunnel in the dam, the cofferdam prevented migration beyond the project site. PacifiCorp removed the cofferdam on April 24, 2012, restoring full passage to historic habitat on the mainstem White Salmon River (PacifiCorp 2012a and b). In mid-July 2012, Yakama Nation staff observed adult steelhead jumping at Husum Falls and BZ Falls well upstream of Condit Dam (pers. comm., Jeanette Burkhardt, Biologist, Yakama Nation, July 18, 2012).

As Condit Dam and associated facilities were being razed, PacifiCorp and its contractors restored much of the new bank line in the old reservoir reach to its original contours and conducted extensive planting with native grasses, shrubs and trees. Engineered log jams were installed at various locations to reduce erosion. Demolition of the dam continued until September 14, 2012, when all in-water work was completed and the dam was fully removed (PacifiCorp 2012a and b).

Estuary Habitat Research, Monitoring and Evaluation

The FCRPS Action Agencies are also implementing a Research, Monitoring, and Evaluation (RME) program in the estuary (the Columbia River below Bonneville Dam) under the 2008 FCRPS Opinion and its 2010 and 2014 supplements (NMFS 2008a; NMFS 2010; NMFS 2014a).

This includes two primary components: action effectiveness monitoring and critical uncertainties research.

The habitat restoration project sponsors have been implementing the Action Agencies' Action Effectiveness Monitoring and Research (AEMR) plan (Johnson et al. 2013) in an effort to document the ecological success of their efforts. The AEMR monitoring program addresses the following types of questions:

- Are habitat restoration projects in the lower Columbia River estuary improving:
    - Juvenile salmon access into and from the site?
    - Juvenile salmon performance (body condition? growth? life history diversity?)
    - Prey production?
    - Flux of prey, macro-detritus from restoring areas to the main stem?
- Are listed Chinook and sockeye salmon and steelhead from the interior Columbia River basin using the site?
- Have hydrological processes been improved (e.g., tidal influence and flood regime) and are they self-maintaining?
- Has connectivity with the mainstem Columbia River been improved and is it self-maintaining?
- Is the rate of sediment accretion at the site at an expected level post-restoration and is the restored land elevation likely to be able to maintain itself over time?
- Is the channel cross-sectional area at the restored site likely to maintain itself over time?
- Is the percent cover of native (versus non-native, invasive) plant species increasing?
- Are water temperatures appropriate for shallow water rearing habitats of juvenile salmon (i.e., relative to surrounding riverine/estuarine areas and/or reference sites)?

The AEMR plan includes three levels of sampling:

- Level 1—intensive monitoring of both habitat and fish indicators. Level 1 is performed at a subset of the habitat restoration sites at the following intervals after construction: 1-3, 5, and 10 years. Indicators include juvenile salmon density, condition, growth, genetic stock, diet, residence time, prey production, and macrodetritus export.
- Level 2—extensive monitoring of a set of core habitat metrics at a larger number of the sites at 1, 3, and 5 years after construction. Core habitat metrics include vegetation percent cover, plant biomass, dissolved oxygen, water velocity, and channel cross-sections.

- Level 3—monitoring of key (controlling) habitat factors at all of the restoration sites at intervals of 1 and 5 years after construction. These include standard photo points, water surface elevation (a predictor of juvenile salmonid access from and materials flux to the mainstem), water temperature, and sediment accretion.

During 2014, ten sites received level 3 and five sites received level 2 monitoring. Three sites were chosen for the most intensive, level 1 monitoring in 2016. Results to date are preliminary, but generally show positive effects from restoration actions. This program will continue at least through 2018, the end of the term of the 2008 FCRPS Opinion.

The second type of RME in the estuary, critical uncertainties research, focuses on information requested by the Expert Regional Technical Group (ERTG), a group of scientists that evaluates the benefits of proposed estuary habitat improvement actions. Questions posed by the ERTG that are under investigation include:

- What is the ecological role of large, woody debris (LWD) in tidal marshes, river floodplains, and floodplain lakes and ponds?
- What is the ecological role and impact of pilings (treated wood structures used to slow the river along its banks) on salmon? Do they need to be removed?
- Do constructed or created habitats provide similar benefits to juvenile salmon as analogous natural habitats in the Columbia River estuary?
- How do juvenile salmon use floodplain lakes and ponds?
- Do juvenile fish penetrate into and shelter within the emergent wetlands, upland meadows, shrub vegetation, and forests that fringe the lower Columbia River estuary?
- Does the spatial organization of restoration projects have non-linear (e.g., cumulative) effects on salmon use, survival, production, and life history diversity?
- How do hatchery-produced stocks affect the benefit of estuary restoration projects to natural stocks?

One recent project (Roegner et al. 2015) investigated the contribution of floodplain habitats to the recovery of Columbia River basin Chinook salmon. By characterizing the genetic stocks using shallow water habitats in eight reaches below Bonneville Dam, the project is assisting strategic planning for the restoration of habitats used by lower and upper Columbia River basin populations.

Federal Land Management

According to NMFS Geographic Information System (GIS) database, roughly 39 percent of land in the Lower Columbia River region is in Federal ownership. 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. Since the last status review, habitat improvements and restoration activities continue to occur on Federal lands through implementation of the Northwest Forest Plan (NWFP), and under the Aquatic Habitat Restoration Activities Biological Opinion (ARBO) (NMFS 2013b) and other management efforts. Preliminary results of monitoring Federal lands at the NWFP-scale indicate improving trends in aquatic macroinvertebrates and water temperatures (Miller et al. 2014). Upslope and riparian conditions show areas with positive trends due to maturing vegetation and road decommissioning, and areas with negative trends due to large fires. For the first time in 30 years, in 2012, the USFS updated its planning regulations governing development and implementation of land management plans under the National Forest System (77 FR 21162). However, uncertainty remains over the future conservation of lower Columbia River salmon and steelhead on Federal lands. The level of protection afforded to the lower Columbia River ESUs and DPS and their habitat will be determined on Federal lands by land management plans currently under development by the USFS and the U.S. Bureau of Land Management (BLM).

Clean Water Act

The Federal Clean Water Act addresses the development and implementation of water quality standards, the development of Total Maximum Daily Loads (TMDLs)[17], filling of wetlands, point source permitting, the regulation of stormwater, and other provisions related to protection of U.S. waters. The Clean Water Act is administered in the States of Oregon and Washington with oversight by the U. S. Environmental Protection Agency (EPA). State water quality standards are set to protect beneficial uses, which include several categories of salmonid use.

Each state has a water quality certification program under which it reviews projects that will discharge dredged or fill materials into waters of the U.S. and issues certifications that the proposed action meets State water quality standards and other aquatic protection regulations, if appropriate. Each state also issues National Pollution Discharge Elimination System (NPDES) permits for discharges from industrial point sources, waste-water treatment plants, construction sites, and municipal stormwater conveyances to allow for the discharge of constituents into the lower Columbia River, with established parameters for the allowance of mixing zones if the discharged constituent(s) do(es) not meet existing water quality standards at the 'end of the pipe.' TMDLs are prepared to develop actions to reduce concentrations of specific contaminants or natural constituents recognized within a waterbody[18] that fail to meet water quality standards in repeated testing. These constituents may be pesticides such as dieldrin which is regulated under the Federal Insecticide, Fungicide and Rodenticide Act, industrial chemicals such as polychlorinated biphenyls (PCBs) regulated under the Toxic Substances Control Act[19], or physical measures of water such as temperature for which numeric water quality standards have been developed. TMDLs have been developed for only dioxin and total dissolved gas in the

[17] A TMDL is a pollution budget and includes a calculation of the maximum amount of a pollutant that can occur in a waterbody and allocates the necessary reductions to one or more pollutant sources. A TMDL serves as a planning tool and potential starting point for restoration or protection activities with the ultimate goal of attaining or maintaining water quality standards.
[18] Under section 303(d) of the Clean Water Act, states, territories and authorized tribes (included in the term State here) are required to submit lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet water quality standards. A TMDL is only issued if a contaminant is on the 303(d) list for the specific water body.
[19] The Toxic Substances Control Act (TSCA) of 1976 provides EPA with authority to require reporting, record-keeping and testing requirements, and restrictions relating to chemical substances and/or mixtures. Certain substances are generally excluded from TSCA, including, among others, food, drugs, cosmetics and pesticides.

lower Columbia River, but there are numerous toxicants that have yet to be addressed in a TMDL. The need for TMDLs to address these issues has been identified and TMDLs will eventually be developed.

All of the species pass through the mainstem Columbia River as they migrate up or down the river. Toxic contamination through the production, use, and disposal of numerous chemicals from multiple sources including industrial, agricultural, medical and pharmaceutical, and common household uses that enter the Columbia River in wastewater treatment plant effluent, stormwater runoff, and nonpoint source pollution is a growing concern (Morace 2012; Nilsen and Morace 2014). Data collected by the Washington State Department of Ecology (WDOE), Oregon Department of Environmental Quality (DEQ), and the Columbia River Contaminants and Habitat Characterization Project (ConHab) indicates contaminants are present at levels of concern (Alvarez et al. 2014; Counihan et al. 2013; Nilsen and Morace 2014; Nilsen et al. 2014a and 2014b). Most of these chemicals have been identified as needing a TMDL. TMDLs are either underway or planned in the future.

- DEQ submitted Oregon's 2010 Integrated Report and 303(d) list to EPA in May 2011. The Integrated Report was approved by EPA and finalized in December, 2012 (http://www.deq.state.or.us/wq/assessment/assessment.htm).
- Washington State Use-based (e.g., aquatic life use) Surface Water Quality Standards, Washington Administrative Code (WAC) 173-201A. The EPA approved the Washington State's updated Water Quality Assessment 305(b) report and 303(d) list in 2012 (http://www.ecy.wa.gov/programs/Wq/303d/index.html).

Non-Federal Tributary Land Management

Oregon's 2010 Integrated Report and 303(d) list

In May 2011, Oregon's Department of Environmental Quality (DEQ) submitted an Integrated Report that met the requirements of the federal Clean Water Act for Sections 305(b) and 303(d) to the U.S. Environmental Protection Agency (EPA). The Integrated Report was approved and finalized in December 2012 (http://www.deq.state.or.us/wq/assessment/assessment.htm).

Washington State Use-based (e.g., aquatic life use) Surface Water Quality Standards, Washington Administrative Code (WAC) 173-201A

The 2003 standards were amended in 2006 to provide additional spawning and incubation temperature criteria of salmon, trout, and char. The standards include an Anti-degradation Policy, which was approved by the EPA in May 2007. The EPA approved the Washington State's 2008 Water Quality Assessment 305(b) report and 303(d) list in January 2009. The EPA approved Washington State's 2010 updated Water Quality Assessment 305(b) report and 303(d) list in 2012 (http://www.ecy.wa.gov/programs/Wq/303d/index.html).

Washington Shoreline Management Act (SMA), Ch. 90.58 RCW

In 1971, the Washington State Legislature passed the Washington Shoreline Management Act (SMA), adopted by public referendum in 1972. The purpose of the Act is to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines by requiring every county and many cities to develop a Shoreline Master Plan (SMP) to govern development in shoreline areas, including all wetlands, river deltas, and riparian areas associated with rivers, streams and lakes. The Washington State Department of Ecology promulgated more protective shoreline requirements in 2003. All counties in Washington State, and the cities within those counties, are subject to these requirements and are updating their shoreline master programs pursuant to the update schedule specified in RCW 90.58.080.

The intent of the 1971 Washington Shoreline Management Act is to accommodate uses that require a shoreline location in a manner that maintains the public's right to access and use and protects shoreline environmental resources in order to avoid piecemeal and uncoordinated shoreline development. Under the Act, cities and counties with shorelines of the state must prepare and adopt a SMP that is essentially a shoreline-specific comprehensive plan, zoning ordinance, and development permit system. The State approves the SMP and the local government implements it. As of July 2015, 130 SMPs have been completed statewide. Within the lower Columbia River Domain, seven SMP updates were completed since 2010, 15 are underway, and one has yet to be started. However, as of 2015, budget cuts permanently eliminated staff to provide technical assistance to local government planning and grant funding to complete SMPs. Without alternative funding sources, completion of the remaining 16 SMPs in the Domain are unlikely to be completed soon, if at all.

Washington Growth Management Act (GMA), Revised Code of Washington Ch. 36.70A and Critical Areas Ordinance (CAO)

As with the SMA, GMA also has an update process for city and county critical areas ordinances. Most critical areas ordinances were originally adopted following GMA's enactment in 1990/1991. The CAO are typically amended more often than shoreline master programs. Required updates continue to be implemented as required by the ordinance.

Hydraulic Code Rules, Washington Administrative Code (WAC) 220-660

The WDFW protects fish life by using its authority to provide approvals for construction or other work that might affect the flow or bed of waters of the state. The 1994 rules for this authority were amended in 2014 to substantially improve fish protection. The amended rules incorporate new science in the design and construction standards for hydraulic projects such as stream bank protection, culverts and bridges, shoreline armoring, docks and other overwater structures. These standards include using the least impacting technically feasible alternative for bank protection and shoreline armoring, designing water crossings to avoid measurably impacting expected channel functions and processes, and designing and locating overwater structures to protect fish habitats of special concerns. These habitats include spawning, feeding and rearing (refugia) areas and migration corridors.

In 2013, WDFW began monitoring new and replacement culverts on fish-bearing streams in western Washington and new and replacement marine shoreline armoring in Puget Sound. This monitoring is resulting in on-going changes to the rules, policies and procedures to improve both implementation of the current hydraulic code rules and the effectiveness of those rules to protect fish habitats.

Fish Passage Barrier Removal Board (Revised Code of Washington (RCW) 77.95.160)
In 2015, the Washington state legislature created the Fish Passage Barrier Removal Board to establish a new statewide strategy for fish barrier removal and administering grant funding available for that purpose. The legislation established several key objectives for the new strategy including:

- Coordination with all relevant state agencies and local governments to maximize state investments in removing fish barriers.
- Realizing economies of scale by bundling projects whenever possible.
- Streamlining the permitting process whenever possible without compromising public safety and accountability.

Chaired by WDFW, the board includes representatives of the Washington State Department of Transportation, WDNR, Tribes, city and county governments, and the Governor's Salmon Recovery Office. In developing the statewide strategy, the board has been working closely with salmon recovery organizations to approve statewide guidelines. Highlights of the Boards work include:

- Approving two project pathways:
    - Watershed Pathway - Remove multiple barriers within a stream system.
    - Coordinated Project Pathway - Remove additional barriers upstream or downstream of a planned and funded project.
- Approving the initial focus areas for Watershed Pathway.
- Analyzing barriers submitted for Coordinated Project Pathway.

Oregon's Integrated Water Resource Strategy
In August 2012, Oregon's Water Resources Department initiated a new statewide program further restore and protect streamflow throughout the state (OWRD 2012).

Washington and Oregon Forest Practices Regulations (OAR 629 and Title 222 WAC)
The effectiveness of the Oregon and Washington State forest practices regulations is regularly assessed by WDNR and the Oregon Department of Forestry.

Oregon's Statewide Planning Guidelines
Since 1973, Oregon has maintained a strong statewide program for land use planning, managed and implemented by the Department of Land Conservation and Development. The foundation of that program is a set of 19 Statewide Planning Goals addressing land use and related topics, such as citizen involvement, housing, and natural resources. Most of the goals are accompanied by

guidelines, which are suggestions about how a goal may be applied. Oregon´s statewide goals are achieved through local comprehensive planning. State law requires each city and county to adopt a comprehensive plan and the zoning and land-division ordinances needed to put the plan into effect. The local comprehensive plans must be consistent with the Statewide Planning Goals. Plans are reviewed for such consistency by the state´s Land Conservation and Development Commission (LCDC). When LCDC officially approves a local government´s plan, the plan is said to be acknowledged. It then becomes the controlling document for land use in the area covered by that plan. Oregon´s planning laws apply not only to local governments but also to special districts and state agencies. The laws strongly emphasize coordination -- keeping plans and programs consistent with each other, with the goals, and with acknowledged local plans.

Oregon's Aquatic Invasive Species Prevention Program

Since 2011, Oregon has implemented HB 2220 that created an Aquatic Invasive Species (AIS) Prevention Program and established a new user fee to boaters; "Aquatic Invasive Species Prevention Permit". The AIS Prevention Program is co-managed by the ODFW and Oregon State Marine Board (OSMB).

Harvest

Pacific Fisheries Management Council Harvest Management

Salmon fisheries in the exclusive economic zone (three to 200 miles offshore) of Washington, Oregon, and California have been managed under salmon Fishery Management Plans (FMPs) of the Pacific Fishery Management Council (PFMC) since 1977. While all species of salmon fall under the jurisdiction of the current plan (PFMC 2014), the FMP currently contains fishery management objectives only for Chinook salmon, coho salmon, pink salmon (odd-numbered years only), and any salmon species listed under the ESA measurably impacted by PFMC fisheries. The PFMC does have an FMP for steelhead. Incidental catches of steelhead in harvests targeting other species are inconsequential (low hundreds of fish each year) to very rare (PFMC 2014). In the event this situation should change, management objectives for steelhead could be developed and incorporated by plan amendment.

The constraints on take of ESA-listed species evaluated under incidental take statements and reasonable, prudent alternatives are collectively referred to as consultation standards. These constraints take a variety of forms including FMP conservation objectives, limits on the time and area during which fisheries may be open, ceilings on fishery impact rates, and reductions from base period impact rates. NMFS may periodically revise consultation standards and annually issues a guidance letter reflecting the most current information (e.g., Stelle 2015). Even though the current FMP does not manage for steelhead because they are so rarely caught in ocean fisheries and retention of steelhead in non-treaty fisheries is currently prohibited, based on currently available information, NMFS has concluded that ocean fishery management actions beyond those already in place that seek to shape fisheries to minimize impacts to steelhead are not necessary (Stelle 2015).

Columbia River Harvest Management: *U.S. v. Oregon*

Harvest impacts on LCR salmon and steelhead in mainstem Columbia River fisheries in mainstem commercial, mainstem recreational, and mainstem treaty fisheries continue to be managed under the 2008-2017 *U.S. v. Oregon* Management Agreement (NMFS 2008b). The parties to the agreement are the United States, the states of Oregon, Washington, and Idaho, and four Columbia River Treaty Tribes: Warm Springs, Yakama, Nez Perce, and Umatilla. The agreement sets harvest rate limits on fisheries impacting lower Columbia River salmonids and these harvest limits continue to be annually managed by the fisheries co-managers (TAC 2011-14). Treaty tribes, states, and federal fisheries managers have begun discussions on the development of a new *U.S. v. Oregon* Management Agreement to replace the current agreement prior to 2019.

Listing Factor D Conclusion

Based on the improvements noted above, we conclude that the risk to the species' persistence because of the adequacy of existing regulatory mechanisms has decreased slightly. Despite this improvement, there remain concerns regarding existing regulatory mechanisms, including:

- Lack of documentation or analysis of the effectiveness of existing land-use regulatory mechanisms, land-use management plans, and fisheries harvest management regulations.

- NMFS notes that certain Federal, state, and local land and water use decisions continue to occur without the benefit of ESA review. State and local decisions have no Federal nexus to trigger the ESA Section 7 consultation requirement, and thus certain permitting actions allow direct and indirect species take and/or adverse habitat effects.

- With regard to Federal actions, there continues to be confusion among some entities as to the relationship between ESA mandates, federal preemption, and the primacy of regulatory obligations, that impairs the consultation process or even prevents consultation from occurring. An example of this is found in the intertwined roles of U.S. Army Corps of Engineers who consults on Federal Navigation Channel dredging and deepening to accommodate larger vessels (NMFS 2012b; NMFS 2012c; NMFS 2015c); but these consultations do not include a related consultation by the U.S. Coast Guard who have authority to regulate the large vessel traffic that the deepening intends to accommodate in the Columbia River. Thus, ship wake fish stranding (Pearson and Skalski 2011), a phenomenon that increases with vessel size and vessel speeds, continues to be a significant regulatory concern in the lower Columbia River that needs to be addressed.

Listing Factor E: Other natural or manmade factors affecting its continued existence

Climate Change (NWFSC 2015)

The Intergovernmental Panel on Climate Change (IPCC) and U.S. Global Change Research Program recently published updated assessments of anthropogenic influence on climate, as well as projections of climate change over the next century (IPCC 2013; Melillo et al. 2014). Reports from both groups document ever increasing evidence that recent warming bears the signature of rising concentrations of greenhouse gas emissions. There is moderate certainty that the 30-year average temperature in the Northern Hemisphere is now higher than it has been over the past 1,400 years. In addition, there is high certainty that ocean acidity has increased with a drop in pH of 0.1 (NWFSC 2015).

Projected Climate Change

Trends in warming and ocean acidification are highly likely to continue during the next century (IPCC 2013). In winter across the west, the highest elevations (e.g. in the Rocky Mountains) will shift from consistent longer (>5 months) snow-dominated winters to a shorter period (3-4 months) of reliable snowfall (Klos et al. 2014); lower, more coastal or more southerly watersheds will shift from consistent snowfall over winter to alternating periods of snow and rain ("transitional"); lower elevations or warmer watersheds will lose snowfall completely, and rain-dominated watersheds will experience more intense precipitation events and possible shifts in the timing of the most intense rainfall (e.g., Salathe et al. 2014). Warmer summer air temperatures will increase both evaporation and direct radiative heating. When combined with reduced winter water storage, warmer summer air temperatures will lead to lower minimum flows in many watersheds. Higher summer air temperatures will depress minimum flows and raise maximum stream temperatures even if annual precipitation levels do not change (e.g., Sawaske and Freyberg 2014) (NWFSC 2015).

Higher sea surface temperatures and increased ocean acidity are predicted for marine environments in general (IPCC 2013). However, regional marine impacts will vary, especially in relation to productivity. The California Current is strongly influenced by seasonal upwelling of cool, deep, water that is high in nutrients and low in dissolved oxygen and pH. An analysis of 21 global climate models found that most predicted a slight decrease in upwelling in the California Current, although there is a latitudinal cline in the strength of this effect, with less impact toward the north (Rykaczewski et al. 2015; NWFSC 2015).

Impacts on Salmon

Studies examining the effects of long term climate change to salmon populations have identified a number of common mechanisms by which climate variation is likely to influence salmon sustainability. These include direct effects of temperature such as mortality from heat stress, changes in growth and development rates, and disease resistance. Changes in the flow regime (especially flooding and low flow events) also affect survival and behavior. Expected behavioral responses include shifts in seasonal timing of important life history events, such as the adult migration, spawn timing, fry emergence timing, and the juvenile migration (NWFSC 2015).

Climate impacts in one life stage generally affect body size or timing in the next life stage and can be negative across multiple life stages (Healey 2011; Wade et al. 2013; Wainwright and Weitkamp 2013). Changes in winter precipitation will likely affect incubation and/or rearing stages of most populations. Changes in the intensity of cool season precipitation could influence migration cues for fall and spring adult migrants, such as coho salmon and steelhead. Egg survival rates may suffer from more intense flooding that scours or buries redds. Changes in hydrological regime, such as a shift from mostly snow to more rain, could drive changes in life history, potentially threatening diversity within an ESU (Beechie et al. 2006). Changes in summer temperature and flow will affect both juvenile and adult stages in some populations, especially those with yearling life histories and summer migration patterns (Quinn 2005; Crozier and Zabel 2006; Crozier et al. 2010). Adults that migrate or hold during peak summer temperatures can experience very high mortality in unusually warm years. For example, in 2015 only 4 percent of adult Redfish Lake sockeye survived the migration from Bonneville to Lower Granite Dam after confronting temperatures over 22°C in the lower Columbia River. Marine migration patterns could also be affected by climate induced contraction of thermally suitable habitat. Abdul-Aziz et al. (2011) modeled changes in summer thermal ranges in the open ocean for Pacific salmon under multiple IPCC warming scenarios. For chum salmon, pink salmon, coho salmon, sockeye salmon, and steelhead, they predicted contractions in suitable marine habitat of 30-50 percent by the 2080s, with an even larger contraction (86-88 percent) for Chinook salmon under the medium and high emissions scenarios (A1B and A2) (NWFSC 2015).

Terrestrial and Ocean Conditions and Marine Survival (NWFSC 2015)

Environmental conditions in both fresh and marine waters inhabited by Pacific Northwest salmon are influenced, in large part, by two ocean-basin scale drivers, the Pacific Decadal Oscillation (PDO) (Mantua et al. 1997) and the El Niño-Southern Oscillation (ENSO). Starting in late 2013, however, abnormally warm conditions in the Central NE Pacific Ocean known as the “warm blob” (Bond et al. 2015) has also had a strong influence on both terrestrial and marine habitats (NWFSC 2015).

The Warm Blob

Marine waters in the North Pacific Ocean have been warmer than average since late fall 2013, when the “warm blob” first developed in the central Gulf of Alaska (Bond et al. 2015). The warm blob was caused by lower than normal heat loss from the ocean to the atmosphere and of relatively weak mixing of the upper ocean, due to unusually high and persistent sea level pressure. Temperature anomalies of the near-surface (upper ~100 m) waters exceeded 3°C in January 2014, or 4 standard deviations (Freeland and Whitney 2014). These anomalies were the greatest observed in this region and season since at least the 1980s and possibly as early as 1900 (Bond et al. 2015; NWFSC 2015).

Pacific Decadal Oscillation

The PDO describes the most prominent mode of variability in the North Pacific sea surface temperature (SST) field (Mantua et al. 1997). Positive PDO values are characterized by warm SSTs along the West Coast of North America and cold SSTs in the central North Pacific and are associated with warm and dry Pacific Northwest (PNW) winters (especially for the Interior Columbia River Basin) and low snowpack. Negative PDO value have the opposite pattern (cold along the coast and warm in the central North Pacific) and are associated with cold wet winters throughout the PNW (high snowpack) (Mantua et al. 1997). Because the PDO is a measure of SSTs and the eastern North Pacific Ocean has been extremely warm, it has been positive since January 2014 (NWFSC 2015).

El Niño-Southern Oscillation

El Niño-Southern Oscillation (ENSO) is a tropical phenomenon that influences climate patterns around the globe. Much like the PDO, the warm phase (El Niño) is characterized by warm SSTs along the West Coast of North America, while negative values (La Niña) produce cold SSTs along the coast. Like the PDO, ENSO also influences terrestrial environments, and PNW winter snowpack is low during warm El Niño events and high during cool La Niña years. The latest ENSO forecasts point to a strong to very strong El Niño persisting into spring 2016, with some models predicting that this event will be comparable to the exceptional 1997/98 event (NWFSC 2015).

Freshwater environments

Sea surface temperatures across the Northeast Pacific Ocean are anomalously warm which has contributed to above average terrestrial temperatures in the PNW (Bond et al. 2015). Mean air temperatures for Washington, Oregon, and Idaho were the warmest on record for the 24-month period ending in August 2015 (from a 120-year record starting in 1895). In contrast, precipitation in the PNW was slightly above average during 2014. Since January 2015, however, precipitation has been below average and the 8-month period from January to August was the 11th driest on record. The exceptionally warm air during the winter of 2014/2015 and below average precipitation from January-April resulted in anomalously low snow pack conditions in the Olympic and Cascade Mountains, with most areas having less than 25 percent of average snow pack in April 2015 (compared to the 1981-2010 record). The combined effects of low flows and high air temperatures resulted in higher than normal stream temperatures and reports of fish kills of salmon and sturgeon in the Willamette and mainstem Columbia Rivers in late June and July 2015 (NWFSC 2015).

Marine survival

Ocean conditions important for PNW salmon became unusually warm early in 2014, and are currently at or near record warm temperatures for much of the northeast Pacific Ocean. There is an abundance of evidence highlighting impacts on coastal marine ecosystems, including sea bird die offs, range shifts for subtropical fish and plankton, etc. Juvenile salmon entering the coastal ocean in 2015 may have experienced especially poor ocean conditions. The expected impacts of the 2015/16 El Niño include intense winter downwelling, increased northward moving currents, increased upper ocean stratification, and overall reduced productivity. These conditions will likely prime the PNW's coastal ocean for very poor productivity in spring 2016. Combining the expected El Niño effects over the next 6 to 8 months with existing warm ocean conditions will likely lead to poor or perhaps very poor early marine survival for PNW salmon going to sea in spring 2016 (NWFSC 2015).

Pacific salmon are a cold water species: they flourish in cold streams and cold and productive marine ecosystems, such as those present in the early 2010s, resulting in record returns for many ESUs. The exceptionally warm marine waters in 2014 and 2015 (and associated warm-water food webs) and warm stream temperatures observed during 2015 were unfavorable for high marine or freshwater survival. West Coast salmon entering the ocean in 2016 will likely encounter subtropical foodwebs that do not promote high survival. The full impact of these unusual environmental conditions will not be known until adults return beginning this fall and continuing for the next few years (NWFSC 2015).

Hatchery Effects

LCR Chinook Salmon

A recent review by the Hatchery Scientific Review Group (HSRG) (HSRG 2009) identified 19 hatchery programs, many long-standing, with some hatcheries having been in operation for over 100 years. On average fall-run Chinook salmon programs have released 50 million fish annually, with spring-run and URB programs releasing a total of 15 million fish annually. As a result of this high level of hatchery production and low levels of natural production, many of the populations contain over 50 percent hatchery fish among their naturally spawning assemblages (NWFSC 2015).

In addition, the release of a number of out-of-ESU stocks continues to be a concern (Willamette River and Interior Columbia River stocks of spring-run Chinook salmon programs and the URB and SAB programs). Annual production out-of-ESU stocks has been approximately 12.5 million fish (2008-2014). URB releases were transitioned from Bonneville Hatchery to the Little White Salmon NFH beginning in 2010 in order reduce interactions with native tule fall-run Chinook salmon spawning below Bonneville Dam. A study by Smith and Engle (Smith and Engle 2011) found that 4.3 to 15.0 percent of juveniles in the (Big) White Salmon River were LCR fall-run x URB hybrids, yet no returning hybrid adults were detected. This would suggest that the risks of long-term genetic introgression may be low, but that the short term effect on productivity may be significant (NWFSC 2015).

Furthermore, the HSRG (2009) identified the use of out-of-basin stocks in Select Area Fishery Evaluation (SAFE) areas as a concern, especially in light of the high level of straying onto nearby spawning grounds. Approximately 750,000 out-of-ESU Rogue River Bright (RRB) fall-run Chinook salmon are currently being released into Youngs Bay, creating a potential for interaction with natural-origin fall-run juveniles and adults. In the past, naturally produced juvenile Rogue River Chinook salmon and RRB x LCR fall-run Chinook salmon juvenile hybrids have been detected in nearby tributaries on the Washington State side of the Lower Columbia River (Marshall 1997). Naturalized and hatchery-origin Rogue River Bright (aka SAB) fall-run Chinook salmon have also been recovered during spawning surveys in the Grays River (Rawding et al. 2014). Releases of out-of-ESU Upper Willamette River spring-run Chinook salmon into Oregon tributaries near the mouth of the Columbia River may not pose a long-term genetic risk, due to the absence of spring-run spawning habitat; but may pose a risk to natural-origin juveniles due to competition and predation. The continued large scale release of both native and non-native Chinook salmon hatchery stocks into the Youngs Bay and Big Creek DIPs will likely constrain the recovery of these populations, which are currently identified as only “secondary populations” in the recovery plan (NWFSC 2015).

CR Chum Salmon

There are currently four hatchery programs in the Lower Columbia River releasing juvenile chum salmon: Grays River Hatchery, Big Creek Hatchery, Lewis River Hatchery, and Washougal Hatchery. The total annual production from these hatcheries has not exceeded 500,000 fish, with the majority being released as unmarked fish during their first spring. Releases of Grays River fish into Big Creek are scheduled to be phased out as production of the Big Creek Hatchery stock is expanded (Homel 2014). Unmarked fish are allowed to spawn naturally above the Big Creek weir, and excess hatchery fish are released into nearby basins to help reestablish naturally-spawning populations. All of the hatchery programs in this ESU use integrated stocks developed to supplement natural production. Other populations in this ESU persist at very low abundances and the genetic diversity available would be very low (NWFSC 2015).

LCR Coho Salmon

Hatchery releases have remained relatively steady at 10–17 million since the 2005 BRT report (NWFSC 2015). The HSRG (2009) reported that overall hatchery production remains relatively high (15.7 million coho salmon released in tributary programs and 2.1 million released in SAFE areas). Most of the populations in the ESU contain a substantial number of hatchery-origin spawners. Recent efforts to shift production into localized areas (e.g., Youngs Bay and Big Creek) in order to reduce the influence of hatchery fish in other nearby populations (e.g., Scappoose and Clatskanie) are considered as in transition at this time. Reductions were also noted in the number of hatchery-origin juvenile coho salmon released into the Sandy River. Mass marking of hatchery-released fish, in conjunction with expanded coho salmon spawning surveys, has provided more accurate estimates of hatchery straying (NWFSC 2015).

Integrated hatchery programs were developed in a number of basins to limit the loss of genetic diversity. The integrated program in the Cowlitz River was recently initiated using predominantly natural-origin broodstock. An integrated program for Type N coho salmon has been ongoing in the Lewis River for over a decade. Still, the majority of hatchery production is from segregated programs and few populations met the HSRG (2009) criteria for primary or contributing populations (NWFSC 2015).

The HSRG (2009) recommended a number of infrastructure changes to hatcheries to improve the homing and collection of returning hatchery fish. Overall, the HSRG (2009) report concludes that changes in hatchery programs alone are unlikely to result in populations achieving their recovery goals without additional changes in harvest (more selective fisheries to remove hatchery-origin fish) and improvements in habitat (NWFSC 2015).

LCR steelhead

Total steelhead hatchery releases in the Lower Columbia River steelhead DPS have decreased since the last status review, declining from a total (summer- and winter-run) release of approximately 3.5 million to 3 million from 2008 to 2014 (NWFSC 2015). Some populations continue to have relatively high fractions of hatchery-origin spawners, whereas others (e.g., Wind River) have relatively few hatchery-origin spawners. One of the major changes in hatchery operations was the elimination of the out-of-DPS steelhead broodstock programs in the Cowlitz River Basin. The early winter-run Chambers Creek program was replaced by an integrated late winter-run steelhead program, and Skamania summer-run releases were terminated in the NF Toutle River. Out of DPS releases of Skamania summer-run and Chambers Creek early winter-run steelhead have also been terminated in the EF Lewis River. Integrated broodstocks have been developed for a number of populations (NF Lewis River and Sandy River); however, out of DPS stocks continue to be released, primarily early winter-run Puget Sound steelhead and summer-run Skamania steelhead into a number of basins, including the Kalama River, Lewis River, Salmon Creek, and Clackamas River. Where hatcheries maintain multiple stocks of steelhead there continues to be some risk of hybridization between different run times or native and out-of-DPS stocks (NWFSC 2015).

Where adults are handled in upstream passage programs (e.g., Clackamas River, Cowlitz River, Kalama River, and Lewis River) hatchery-origin fish are often removed from the river or recycled for additional harvest opportunities (NWFSC 2015).

Listing Factor E Conclusion

Climate Change

Trends in warming and ocean acidification are highly likely to continue during the next century (IPCC 2013). Analysis of ESU specific vulnerabilities to climate change by life stage will be available in the near future, upon completion of the *West Coast Salmon Climate Vulnerability Assessment*. In summary, both freshwater and marine productivity tend to be lower in warmer years for most populations considered in this status review. These trends suggest that many populations might decline as mean temperature rises. However, the historically high abundance of many southern populations is reason for optimism and warrants considerable effort to restore the natural climate resilience of these species (NWFSC 2015).

Terrestrial and Ocean Conditions and Marine Survival

It is clear that current anomalously warm marine and freshwater conditions have been and will continue to be unfavorable for Pacific Northwest salmon. How extreme the effects will be is difficult to predict, although decreased salmon productivity and abundance observed during prior warm periods provide a useful guide. How long the current conditions will last is also unknown, but NOAA’s coupled forecast system model (CFS version 2) suggests that the warm conditions associated with the strengthening El Niño will persist at least through spring 2016. The model currently predicts temperature anomalies during the March-April-May 2016 period will exceed 2°C at the equator and 0.5-2°C in the NE Pacific. Unfortunately, longer forecasts are not available (NWFSC 2015).

On a positive note, after previous strong El Niño events (e.g., 1982/83 and 1997/98), there was a rapid transition from warm to cold conditions along the West Coast, which resulted in greatly improved marine survival for Pacific salmon for several years following the El Niño. Whether a similar rapid transition to cold conditions will occur with this El Niño is not known or presently forecast, but is within the realm of possibility (NWFSC 2015).

Pacific salmon are a cold water species: they flourish in cold streams and cold and productive marine ecosystems, such as those present in the early 2010s, resulting in record returns for many ESUs. The exceptionally warm marine waters in 2014 and 2015 (and associated warm-water food webs) and warm stream temperatures observed during 2015 were unfavorable for high marine or freshwater survival. West Coast salmon entering the ocean in 2016 will likely encounter subtropical foodwebs that do not promote high survival. The full impact of these unusual environmental conditions will not be known until adults return beginning this fall and continuing for the next few years (NWFSC 2015).

Hatchery Effects

For the LCR Chinook salmon ESU, the majority of the populations in this ESU remain at high risk, with low natural-origin abundance levels (NWFSC 2015). Hatchery contribution to naturally-spawning fish remains high for a number of populations, and it is likely that many returning unmarked adults are the progeny of hatchery-origin parents, especially where large hatchery programs operate. While overall hatchery production has been reduced slightly, hatchery-produced fish still represent a majority of fish returning to the ESU. The continued release of out-of-ESU stocks: URB, Rogue River (SAB) fall-run, Upper Willamette River spring-run, Carson Hatchery spring-run, and Deschutes River spring-run remain a concern (NWFSC 2015).

For the CR chum salmon ESU, all of the hatchery programs in this ESU use integrated stocks developed to supplement natural production (NWFSC 2015). Other populations in this ESU persist at very low abundances and the genetic diversity available would be very low (NWFSC 2015).

For the LCR coho salmon ESU, hatchery releases have remained relatively steady at 10–17 million since the 2005 BRT report (NWFSC 2015). For most populations the proportion of hatchery origin fish naturally spawning exceeds criteria set for primary and contributing populations (NWFSC 2015).

For the LCR steelhead DPS, hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews (NWFSC 2015). Some populations continue to have relatively high fractions of hatchery-origin spawners, whereas others (e.g., Wind River) have relatively few hatchery-origin spawners. One of the major changes in hatchery operations was the elimination of the out-of-DPS steelhead broodstock programs in the Cowlitz River Basin (NWFSC 2015). At the present time, hatchery-related threats have not yet been ameliorated sufficiently to meet threat reduction targets.

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.

For the LCR Chinook salmon ESU, only two of 32 populations (Lewis River late fall-run and Sandy River late fall-run) could be considered viable or nearly so; with a few exceptions the remainder of the populations fall far short of their recovery goals in abundance (NWFSC 2015). Increases in abundance were noted in about 70 percent of the fall-run populations and decreases in hatchery contribution were noted for several populations. Spring-run populations are generally unchanged; most of the populations are at a high or very risk due to low abundances and the high proportion of hatchery-origin fish spawning naturally. The majority of the populations in this ESU remain at high risk, with low natural-origin abundance levels. Hatchery contribution to naturally-spawning fish remains high for a number of populations, and it is likely that many returning unmarked adults are the progeny of hatchery-origin parents, especially where large hatchery programs operate. While overall hatchery production has been reduced slightly, hatchery-produced fish still represent a majority of fish returning to the ESU (NWFSC 2015).

For the CR chum salmon ESU, the majority of the populations in this ESU are at high to very high risk, with very low abundances (NWFSC 2015). These populations are at risk of extirpation due to demographic stochasticity and Allee effects. Freshwater habitat conditions may be negatively influencing spawning and early rearing success in some basins, and contributing to the overall low productivity of the ESU. Land development, especially in the low gradient reaches that chum salmon prefer, will continue to be a threat to most chum salmon populations due to projected increases in the population of the greater Vancouver-Portland area and the lower Columbia River overall (Metro 2014). This ESU therefore remains at moderate to high risk (NWFSC 2015).

For the LCR coho salmon ESU, changes in abundance and productivity, diversity and spatial structure were generally positive; however, this appears to be mostly due to the improved level of monitoring (and therefore understanding of status) in Washington tributaries rather than a true change in status over time (NWFSC 2015). In the absence of specific abundance and diversity data, earlier status reviews had concluded that hatchery origin fish dominated many of the coho salmon populations in the ESU and that there was little natural productivity. Populations with longer term data sets exhibit stable or slightly positive abundance trends. Although populations in this ESU have generally improved, especially in the 2013/14 and 2014/15 return years, recent poor ocean conditions suggest that population declines might occur in the upcoming return years. Regardless, this ESU is still considered to be at moderate risk (NWFSC 2015).

For the LCR steelhead DPS, the majority of winter-run steelhead DIPs in this DPS continue to persist at low abundances (NWFSC 2015). Hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews. Summer-run steelhead DIPs were similarly stable, but at low abundance levels. Even with modest improvements in the status of several winter-run DIPs, none of the populations appear to be at fully viable status, and similarly none of the MPGs meet the criteria for viability. The DPS therefore continues to be at moderate risk (NWFSC 2015).

Our analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the LCR salmon ESUs and steelhead DPS persistence has not changed significantly since our final listing determination in 2006 and the last 5-year status review in 2011. However, the implementation of sound management actions in each H—habitat, hydropower, hatcheries, and harvest—is essential to the recovery of the listed lower Columbia River salmonids and must continue. The biological benefits of habitat restoration and protection efforts, in particular habitat restoration, have yet to be fully expressed and will likely take another five to 20 years before we would expect to see measurable improvements to population viability. We need to continue to implement actions that address the factors limiting population survival and monitor the effects of the action over time such that restoration efforts meet the biological needs of each species and, in turn, contribute to the recovery of these ESUs and DPS. The ESA Recovery Plan for Lower Columbia River Coho

Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead (NMFS 2013a) is the primary guide for identifying future actions to target and address limiting factors and threats for these listed species. Over the next five years, it will be important continue to implement these actions and monitor our progress.

2.4.1 ESU/DPS Delineation and Hatchery Membership

The Northwest Fisheries Science Center's review found that no new information has become available that would potentially justify a change in boundaries for the LCR Chinook salmon, CR chum salmon, and LCR coho salmon ESUs. For the LCR steelhead DPS, new genetic information indicates that the composition of the Lower Columbia River DPS and Upper Willamette River DPS should be evaluated (NWFSC 2015). A review of these DPSs' delineation would benefit from the collection of genetic data from any winter-run steelhead populations in the Willamette River below Willamette Falls that have not previously been sampled.

The West Coast Regional Office's review of new information to inform the ESU/DPS membership status of various hatchery programs (Jones 2015) and made the following recommendations:

- For the LCR Chinook salmon ESU, Deep River Net Pens-Washougal, Klaskanine Hatchery, Bonneville Hatchery, and Cathlamet Channel Net Pens were recommended for ESU inclusion.
- For the CR chum salmon ESU, the Big Creek Hatchery was recommended for ESU inclusion.
- For the LCR coho salmon ESU, Clatsop County Fisheries and Clatsop County Fisheries/Klaskanine Hatchery were recommended for ESU inclusion.
- For the LCR steelhead DPS, Upper Cowlitz Wild and Tilton River Wild were both recommended for DPS inclusion.

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 for the LCR Chinook salmon ESU, the CR chum salmon ESU, the LCR coho salmon ESU, and the LCR steelhead DPS since the time of their last status review (NWFSC 2015).
- Our analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the persistence of the LCR Chinook salmon ESU, the CR chum salmon ESU, the LCR coho salmon ESU, and the LCR steelhead DPS has not changed significantly since our listing determination in 2006. The overall level of concern remains the same (NWFSC 2015).

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3 · Results

3.1 Classification

Listing status:

Based on the information identified above, we determine that no reclassifications for any of the four species are appropriate. Therefore:

- The Lower Columbia River Chinook Salmon should remain listed as threatened.
- The Columbia River Chum Salmon should remain listed as threatened.
- The Lower Columbia River Coho Salmon should remain listed as threatened.
- The Lower Columbia River Steelhead should remain listed as threatened.

ESU/DPS delineation:

LCR steelhead

A review of recent DNA studies, as well as the genetic analysis conducted for NWFSC (2015), indicate that winter-run steelhead in the Clackamas River are genetically more similar to native winter-run steelhead in the Upper Willamette River than to steelhead in the lower Columbia River. The new genetic information indicates that the composition of the Lower Columbia River DPS and Upper Willamette River DPS should be evaluated. In addition, a review of the boundary would benefit from the collection of genetic data from any winter-run steelhead populations in the Willamette River below Willamette Falls that have not previously been sampled (NWFSC 2015). For example, natural spawning steelhead populations were historically present in Johnson and Mount Scott creeks (Myers et al. 2006).

LCR Chinook, CR Chum, and LCR Coho Salmon

There is no new information since the last status review that would justify a change in composition of the LCR Chinook, the CR chum, or the LCR coho salmon ESUs (NWFSC 2015).

Hatchery membership:

For the ESUs and DPS in the lower Columbia River, the following programs were recommended for ESU/DPS inclusion since the last review (Jones 2015). For CR chum salmon, the Big Creek Hatchery was recommended for ESU inclusion. For LCR Chinook salmon, Deep River Net Pens-Washougal, Klaskanine Hatchery, Bonneville Hatchery, and Cathlamet Channel Net Pens were recommended for ESU inclusion. For LCR coho salmon, Clatsop County Fisheries and Clatsop County Fisheries/Klaskanine Hatchery were both recommended for ESU inclusion. For LCR steelhead, Upper Cowlitz Wild and Tilton River Wild were both recommended for DPS inclusion.

3.2 New Recovery Priority Number

Since the previous five year review, NMFS updated the recovery priority numbers to nine for each of the ESUs and DPS in the lower Columbia River (NMFS 2015a) as listed in Table 4 of this document.

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4 · Recommendations for Future Actions

In our review of the listing factors we identified several actions critical to improving the status of the four LCR species. The most important actions to be taken over the next five years include implementation of the high priority strategies and actions identified in the 2013 LCR Recovery Plan, the 2008 Biological Opinion on the U.S. vs Oregon (in-river harvest) Management Agreement, the 2008 FCRPS Opinion (i.e., RME measures described as the RPAs to operation of the hydrosystem alone; NMFS 2008) and in the 2010 and 2014 Supplemental FCRPS Opinions NMFS 2010, 2014), and the completion of ESA consultations on the hatchery programs affecting the LCR steelhead DPS and salmon ESUs. We are currently in the process of identifying actions that address the factors contributing to the existing high risk rating for each population, since such actions have the greatest potential to improve VSP parameters for the species.

While we recognize and will continue to support recovery actions that improve the status of contributing and sustaining salmonid populations of the Lower Columbia, we will continue to emphasize efforts that benefit primary populations in need of the greatest acceleration in viability to support delisting of their respective ESUs/DPSs. These efforts will be directed according to recovery criteria, the best available scientific information concerning ESU/DPS status, the role of the populations in meeting ESU/DPS recovery goals and MPG viability, the limiting factors and threats recognized at the population level, and the likelihood of action effectiveness to guide our recommendations for future actions. NMFS will continue to coordinate with the Federal, state, tribal, and local implementing entities during this prioritization process to ensure that risk factors and actions identified in the recovery plan, and the actions identified in the Harvest Biological Opinion, the FCRPS Opinion, and the ESA consultations on hatchery programs are addressed. Specifically, we recommend:

- Continuing to implement and record priority habitat actions in accordance with the NMFS 2013 recovery plan (NMFS 2013a) using the NOAA Fisheries Recovery Action Mapping Tool.[20]
- Systematically reviewing and analyzing the amount of habitat protected/restored against those high priority lower Columbia River mainstem and tributary areas identified in the NMFS 2013 Recovery Plan (NMFS 2013a).
- Analyzing and documenting the effectiveness of existing land-use regulatory mechanisms, land-use management plans, and fisheries harvest management regulations.
- Incorporating mechanisms of salmonid density dependent growth, dispersal, and survival when selecting habitat restoration actions as an approach to opening up new habitat and/or restoring degraded habitat (ISAB 2015).

[20] http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/recovery_action_mapping_tool.html

- Continuing to implement long-term settlement agreements at FERC licensed dams in the lower Columbia River tributaries.
- Continuing monitoring efforts and reducing predation risk in the lower Columbia River between pinnipeds, birds, and fish predators and ESA-listed species.
- Continuing research efforts in the Columbia River estuary on survival and run timing for adult salmonid migration.
- Reevaluating the allowable harvest rates for LCR Chinook salmon and LCR coho salmon.
- Completing ESA section 7 consultations on hatchery and harvest biological opinions and hatchery genetic management plans.
- Expanding reintroduction efforts to include programs for CR chum salmon.
- Continuing to analyze the impact of hatchery-produced salmon upon natural-origin lower Columbia River salmon and steelhead.

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5 · References

5.1 Federal Register Notices

June 15, 1990 (55 FR 24296). Notice: Endangered and Threatened Species; Listing and Recovery Priority Guidelines.

November 20, 1991 (56 FR 58612). Notice of Policy: Policy on Applying the Definition of Species Under the Endangered Species Act to Pacific Salmon.

February 7, 1996 (61 FR 4722). Notice of Policy: Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act.

March 19, 1998 (63 FR 13347). Final Rule: Endangered and Threatened Species: Threatened Status for Two ESUs of Steelhead in Washington, Oregon, and California.

March 24, 1999 (64 FR 14308). Final Rule: Endangered and Threatened Species; Threatened Status for Three Chinook Salmon Evolutionarily Significant Units (ESUs) in Washington and Oregon, and Endangered Status for One Chinook Salmon ESU in Washington.

March 25, 1999 (64 FR 14508). Final Rule: Endangered and Threatened Species: Threatened Status for Two ESUs of Chum Salmon in Washington and Oregon.

July 10, 2000 (65 FR 42422). Final Rule: Endangered and Threatened Species; Final Rule Governing Take of 14 Threatened Salmon and Steelhead Evolutionarily Significant Units (ESUs).

June 14, 2004 (69 FR 33102). Final Rule: Endangered and Threatened Species: Proposed Listing Determinations for 27 ESUs of West Coast Salmonids.

June 28, 2005 (70 FR 37160). Final Rule: Endangered and Threatened Species: Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs.

June 28, 2005 (70 FR 37204). Final Policy: Policy on the Consideration of Hatchery-Origin Fish in Endangered Species Act Listing Determinations for Pacific Salmon and Steelhead.

September 2, 2005 (70 FR 52630). Final Rule: Endangered and Threatened Species; Designation of Critical Habitat for 12 Evolutionarily Significant Units of West Coast Salmon and Steelhead in Washington, Oregon, and Idaho.

January 5, 2006 (71 FR 834). Final Rule: Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead.

August 15, 2011 (76 FR 50448). Notice of availability of 5-year reviews: Endangered and Threatened Species; 5-Year Reviews for 17 Evolutionarily Significant Units and Distinct Population Segments of Pacific Salmon and Steelhead.

April 9, 2012 (77 FR 21162). Final Rule and Record of Decision: National Forest System Land Management Planning.

March 8, 2012 (77 FR 14062). Proposed Rule: Endangered and Threatened Wildlife and Plants; Revised Critical Habitat for the Northern Spotted Owl

July 12, 2013 (78 FR 41911). Notice of availability: Endangered and Threatened Species; Recovery Plans.

April 14, 2014 (79 FR 20802). Final Rule: Endangered and Threatened Wildlife; Final Rule To Revise the Code of Federal Regulations for Species Under the Jurisdiction of the National Marine Fisheries Service

February 6, 2015 (80 FR 6695). Notice of Initiation of 5-year Reviews: Endangered and Threatened Species; Initiation of 5-Year Reviews for 32 Listed Species of Pacific Salmon and Steelhead, Puget Sound Rockfishes, and Eulachon.

February 24, 2016 (81 FR 9252). Final Rule: Endangered and Threatened Species; Designation of Critical Habitat for Lower Columbia River Coho Salmon and Puget Sound Steelhead.

5.2 Literature Cited

Abdul-Aziz, O.I., N.J. Mantua, and K.W. Myer. 2011. Potential climate change impacts on thermal habitats of Pacific salmon (*Oncorhynchus spp.*) in the North Pacific Ocean and adjacent seas. Canadian Journal of Fisheries and Aquatic Sciences. 68:1660-1680.

Ackerman, N.K. and B. Pyper. 2015. Evaluation of juvenile salmonid passage through the River Mill Hydroelectric Development. 2014 Progress Report. Clackamas River Project (FERC 2195). Prepared by Portland General Electric Company and Fish Metrics, Inc.

Ackerman, N.K. 2016. Pilot Evaluation Guidance Efficiency at North Fork Dam after Installation of the Floating Surface Collector. Prepared by Portland General Electric Company, February 18, 2016.

Allen, B. M. and R. P. Angliss. 2014. Steller Sea Lion Eastern U.S. Stock Assessment. NOAA-TM-AFSC-301.

Alvarez, D.A., S. Perkins, E. Nilsen, and J. Morace. 2014. Spatial and temporal trends in occurrence of emerging and legacy contaminants in the Lower Columbia River 2008–2010. Science of the Total Environment. 484:322-330.

Beechie, T., E. Buhle, M. Ruckelshaus, A. Fullerton, and L. Holsinger. 2006. Hydrologic regime and the conservation of salmon life history diversity. Biological Conservation. 130:560-572.

Bond, N.A., M.F. Cronin, H. Freeland, and N. Mantua. 2015. Causes and impacts of the 2014 warm anomaly in the NE Pacific. Geophysical Research Letters. 42:3414-3420.

Bottom, D.L., C.A. Simenstad, J. Burke, A.M. Baptista, D.A. Jay, K.K. Jones, E. Casillas, and M.H. Schiewe. 2005. Salmon at River's End: The Role of the Estuary in Decline and Recovery of Columbia River Salmon. U.S. Dept. Commerce, NOAA Technical Memorandum NMFS-NWFSC-68. 246 p.

Breckel, J. 2015. Personal communication by Jeff Breckel, Executive Director, Lower Columbia Fish Recovery Board. Email dated May 7, 2015 to Scott Rumsey, Portland Branch Chief, Protected Resources Division, National Marine Fisheries Service and Jeff Fisher, Washington Coast/Lower Columbia River Branch Chief, Oregon/Washington Coastal Area Office, National Marine Fisheries Service.

Brown, R.F., B.E. Wright, S.D. Riemer, and J. Laake. 2005. Trends in abundance and current status of harbor seals in Oregon: 1977-2003. Mar. Mammal Sci. 21(4):657-670.

Brown, S.J., B. Delong, and D. Hatch. 2015. Briefing on the current status of marine mammal populations in the lower Columbia and Willamette Rivers. PowerPoint Presentation to Northwest Power and Conservation Council (January 6, 2015).

Collis, K., D.D. Roby, D.E. Lyons, Y. Suzuki, J.Y. Adkins, L. Reinalda, N. Hostetter, L. Adrean, M. Bockes, P. Loschl, D. Battaglia, T. Marcella, B. Cramer, A. Evans, M. Hawbecker, M. Carper, J. Sheggeby, and S. Sebring. 2009. Research, Monitoring, and Evaluation of Avian Predation on Salmonid Smolts in the Lower and Mid-Columbia River. 2008 Final Season Summary. Prepared for the Bonneville Power Administration and the U.S. Army Corps of Engineers, Portland District, Portland, Oregon.

Counihan, T., I. Waite, E. Nilsen, J. Hardiman, E. Elias, and G. Gelfenbaum. 2013. Using sediment transport models to inform an assessment of sediment contaminant concentrations in reaches of the Columbia River Estuary. Science of the Total Environment. 484:331-343.

Crozier, L.G. and R.W. Zabel. 2006. Climate impacts at multiple scales: evidence for differential population responses in juvenile Chinook salmon. Journal of Animal Ecology. 75:1100-1109.

Crozier, L., R.W. Zabel, S. Achord, and E.E. Hockersmith. 2010. Interacting effects of density and temperature on body size in multiple populations of Chinook salmon. Journal of Animal Ecology. 79:342-349.

Diefenderfer, H. L., G. E. Johnson, R. M. Thom, A. B. Borde, C. M. Woodley, L. A. Weitkamp, K. E. Buenau, and R. K. Kropp. 2013. An evidence-based evaluation of the cumulative effects of tidal freshwater and estuarine ecosystem restoration on Endangered juvenile salmon in the Columbia River. PNNL-23037. Final report prepared by Pacific Northwest National Laboratory and Northwest Fisheries Science Center for the U.S. Army Corps of Engineers Portland District, Portland, Oregon. December 1, 2013.

Ford, M.J. (Ed.), T. Cooney, P. McElhany, N. Sands, L. Weitkamp, J. Hard, M. McClure, R. Kope, J. Myers, A. Albaugh, K. Barnas, D. Teel, P. Moran, and J. Cowen. 2011. Status Review Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Pacific Northwest. U.S. Department of Commerce. NOAA Technical Memorandum NMFS-NWFSC-113. November 2011.

Freeland, H. and F. Whitney. 2014. Unusual warming in the Gulf of Alaska. PICES press. 22:51-52.

Fullerton, A.H., S.T. Lindley, G.R. Pess, B.E. Feist, E.A. Steel, and P. McElhany. 2011. Human Influence on the Spatial Structure of Threatened Pacific Salmon Metapopulations. Conservation Biology. 25:932–944.

Good, T.P., R.S. Waples, and P. Adams (Editors). 2005. Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-66, 598 p.

Healey, M. 2011. The cumulative impacts of climate change on Fraser River sockeye salmon (*Oncorhynchus nerka*) and implications for management. Canadian Journal of Fisheries and Aquatic Sciences. 68:718-737.

Homel, K. 2014. Chum Salmon reintroduction plan. Draft. Oregon Department of Fish and Wildlife, Clackamas, OR. 200 p.

HSRG (Hatchery Scientific Review Group). 2009. Columbia River Hatchery Reform System-Wide Report. February 2009. 272 p.

IPCC (Intergovernmental Panel on Climate Change). 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. Available from: http://www.climatechange2013.org/ Cambridge, United Kingdom and New York, NY, USA.

ISAB (Independent Scientific Advisory Board for the Northwest Power and Conservation Council). 2015. Density Dependence and its Implications for Fish Management and Restoration Programs in the Columbia River Basin. ISAB 2015-1. February 2015. Portland, Oregon.

Jefferies, S., H. Huber, J. Calambokidis, and J. Laake. 2003. Trends and status of harbor seals in Washington State: 1978-1999. Journal of Wildlife Management. 67:207-218.

Johnson, O. W., T. A. Flagg, D. J. Maynard, G. B. Milner, and F. W. Waknitz. 1991. Status review for lower Columbia River coho salmon. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-F/NWC-202.

Johnson, O. W., W. S. Grant, R. G. Kope, K. G. Neely, F. W. Waknitz, and R. S. Waples. 1997. Status review of chum salmon from Washington, Idaho, Oregon, and California. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-32.

Johnson, G., C. Corbett, J. Doumbia, M. Schwartz, R. Scranton, and C. Studebaker. 2013. A programmatic plan for restoration action effectiveness monitoring and research in the lower Columbia River and estuary. Final draft. Prepared by the Pacific Northwest National Lab for the Bonneville Power Administration, Portland, Oregon. 43 p.

Jones, R. 2015. 2015 5-Year Review – Updated Evaluation of West Coast Hatchery Programs in 28 Listed Salmon Evolutionarily Significant Units and Steelhead Distinct Population Segments for listing under the Endangered Species Act. Memorandum to Chris Yates.

Klos P.Z., T.E. Link, and T.J. Abatzoglou. 2014. Extent of the rain-snow transition zone in the western U.S. under historic and projected climate. Geophysical Research Letters. 41:4560-4568.

Kurath, G. 2012. An online database for IHN virus in Pacific Salmonid fish—MEAP-IHNV: U.S. Geological Survey Fact Sheet 2012–3027, 4 p.

LCFRB (Lower Columbia Fish Recovery Board). 2004. Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan. Lower Columbia Fish Recovery Board, Olympia, WA.

LCFRB (Lower Columbia Fish Recovery Board). 2010. Washington Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan. Lower Columbia Fish Recovery Board, Olympia, WA.

LCREP (Lower Columbia River Estuary Partnership). 2013. Habitat Restoration Project Application - Karlson Island Restoration Project. 14 p. Available at: http://www.estuarypartnership.org/sites/default/files/resource_files/Karlson%20Island%20-%20Estuary%20Partnership%20Project%20Application%20Form.pdf

LCEP (Lower Columbia Estuary Partnership). 2013. Horsetail Creek Floodplain Restoration Project. Available at: http://www.estuarypartnership.org/our-work/habitat-restoration/horsetail-creek-floodplain-restoration-project

LCEP (Lower Columbia Estuary Partnership). 2015. 2015 State of the Estuary. Available at: http://www.estuarypartnership.org/sites/default/files/LCEP%20State%20of%20the%20Estuary%202015%20Final%20Small.pdf

Maher, M., M.B. Sheer, E.A. Steel, and P. McElhany. 2005. Atlas of Salmon and Steelhead Habitat in the Oregon Lower Columbia and Willamette Basins. Report for the Willamette-Lower Columbia Technical Recovery Team. Produced by the NOAA Northwest Fisheries Science Center. 203 p.

Mantua, N.J., S.R. Hare, Y. Zhang, J.M. Wallace, and R.C. Francis. 1997. A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society. 78:1069-1079.

Marshall, A.R. 1997. Report on the genetic analysis of Abernathy Creek juvenile Chinook. Investigation of natural production by Rogue River stock hatchery-origin Chinook. Department of Fish and Wildlife. Fish Management Program. 13 p.

McElhany, P., M. Ruckleshaus, M.J. Ford, T. Wainwright, and E. Bjorkstedt. 2000. Viable Salmon Populations and the Recovery of Evolutionarily Significant Units. U. S. Department of Commerce, National Marine Fisheries Service, Northwest Fisheries Science Center, NOAA Technical Memorandum NMFS-NWFSC-42. 156 p. http://www.nwfsc.noaa.gov/publications/techmemos/tm42/tm42.pdf

McElhany, P., C. Busack, M. Chilcote, S. Kolmes, B. McIntosh, J. Myers, D. Rawding, A. Steel, C. Steward, D. Ward, T. Whitesel, and C. Willis. 2006. Revised viability criteria for salmon and steelhead in the Willamette and Lower Columbia Basins. Review draft. April 1, 2006. Available at http://www.nwfsc.noaa.gov/trt/wlc_docs/Revised_WLC_Viability_Criteria_Draft_Apr_2006.pdf.

McElhany, P., M. Chilcote, J. Myers, and R. Beamesderfer. 2007. Viability Status of Oregon Salmon and Steelhead Populations in the Willamette and Lower Columbia Basins. Report Prepared for Oregon Department of Fish and Wildlife and National Marine Fisheries Service.

Melillo, J.M., T.C Richmond, and G.W. Yohe. 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program.

Metro. 2014. 2014 Urban Growth Report. Investing in our communities 2015-2035. Metro. 30 p.

Miller, S.A., S.N. Gordon, P. Eldred, R.M. Beloin, S. Wilcox, M. Raggon, H. Anderson, and A. Muldoon. 2014. Northwest Forest Plan–the first 20 years (1994-2013): watershed condition status and trend. Gen. Tech. Rep. PNW-GTR-XXX. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Xxx p.

Morace, J.L. 2012. Reconnaissance of contaminants in selected wastewater-treatment-plant effluent and stormwater runoff entering the Columbia River, Columbia River Basin, Washington and Oregon, 2008–10: U.S. Geological Survey Scientific Investigations Report 2012–5068, 68 p.

Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel, D.M. Van Doornik and M.T. Maher. 2006. Historical Population Structure of Pacific Salmonids in the Willamette River and Lower Columbia River Basins. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-73. 311 p.

Nilsen, E. and J. Morace. 2014. Foodweb transfer, sediment transport, and biological impacts of emerging and legacy organic contaminants in the lower Columbia River, Oregon and Washington, USA: USGS Contaminants and Habitat (ConHab) Project. Science of the Total Environment. 484:319-321.

Nilsen. E., E.T. Furlong, and R. Rosenbauer. 2014a. Reconnaissance of Pharmaceuticals and the wastewater indicators in streambed sediments of the lower Columbia River basin, Oregon and Washington. Journal of the American Water Resources Association. 50(2):291-301.

Nilsen, E., S. Zaugg, D. Alvarez, J. Morace, I. Waite, T. Counihan, J. Hardiman, L. Torres, R. Patiño, M. Mesa, and R. Grove. 2014b. Contaminants of legacy and emerging concern in largescale suckers (*Catostomus macrocheilus*) and the foodweb in the lower Columbia River, Oregon and Washington, USA. Science of the Total Environment. 484:344-352.

NMFS (National Marine Fisheries Service). 1996a. Status Review of West Coast Steelhead from Washington, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC- 27, August 1996.

NMFS (National Marine Fisheries Service). 1996b. Conclusions Regarding the Updated Status of West Coast Coho Salmon. December 20, 1996, NMFS-NWFSC Status Review Update Memo.

NMFS (National Marine Fisheries Service). 1997a. Scientific Disagreements Regarding Steelhead Status under the ESA. July 18, 1997, NMFS-NWFSC Status Review Update Memo.

NMFS (National Marine Fisheries Service). 1997b. Update for Deferred and Candidate ESUs of West Coast Steelhead. December 18, 1997, NMFS-NWFSC Status Review Update Memo.

NMFS (National Marine Fisheries Service). 1997c. Status Review of Chum Salmon from Washington, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-32, December 1997.

NMFS (National Marine Fisheries Service). 1998a. Update for Deferred ESUs of West Coast Steelhead, Hatchery Populations. January 13, 1998, NMFS-NWFSC/SWFSC Status Review Update Memo.

NMFS (National Marine Fisheries Service). 1998b. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-35, February 1998.

NMFS (National Marine Fisheries Service). 1998c. Conclusions Regarding the Updated Status of Puget Sound, Lower Columbia River, Upper Willamette River, and Upper Columbia River Spring-run ESUs of West Coast Chinook Salmon. December 23, 1998, NMFS-NWFSC Status Review Update Memo.

NMFS (National Marine Fisheries Service). 1999a. Conclusions Regarding the Updates Status of the Columbia River Chum Salmon ESU and Hood Canal Summer-run Chum Salmon ESU. February 12, 1999, NMFS-NWFSC Status Review Update Memo.

NMFS (National Marine Fisheries Service). 1999b. Evaluations of the Status of Chinook and Chum Salmon and Steelhead Hatchery Populations for ESUs Identified in Final Listing Determinations. March 4, 1999, NMFS-NWFSC Status Review Update Memo.

NMFS (National Marine Fisheries Service). 2005. Draft Interim Regional Recovery Plan for Portions of Three Evolutionarily Significant Units (ESUs) of Salmon and Steelhead—Columbia River Chinook (*Onchorhynchus tshawytscha*), Columbia River Chum (*Onchorhynchus keta*), and Lower Columbia River Steelhead (*Onchorhynchus mykiss*)—within the Washington Lower Columbia Management Unit. National Oceanic and Atmospheric Administration's National Marine Fisheries Service Supplement to the Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan. Prepared by National Marine Fisheries Service Northwest Region. April 15, 2005.

NMFS (National Marine Fisheries Service). 2008a. Endangered Species Act - Section 7 Consultation Biological Opinion. Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin, and ESA Section 10(a)(I)(A) Permit for Juvenile Fish Transportation Program. NMFS, Portland, Oregon.

NMFS (National Marine Fisheries Service). 2008b. Biological Opinion: Impacts of *U.S. v Oregon* Fisheries in the Columbia River in Years 2008-2017 on ESA Listed Species and Magnuson-Stevens Act Essential Fish Habitat. May 5, 2008.

NMFS (National Marine Fisheries Service). 2009. Biennial Report to Congress on the Recovery Program for Threatened and Endangered Species – October 1, 2006 - September 30, 2008. 184 p. Available at: http://www.nmfs.noaa.gov/pr/pdfs/laws/esabiennial2008.pdf

NMFS (National Marine Fisheries Service). 2010. Endangered Species Act - Section 7 Consultation Supplemental Biological Opinion. Supplemental Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin, and ESA Section 10(a)(I)(A) Permit for Juvenile Fish Transportation Program. NMFS, Portland, Oregon.

NMFS (National Marine Fisheries Service). 2012a. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation. Effects of the Pacific Coast Salmon Plan Fisheries on the Lower Columbia River Chinook Evolutionarily Significant Unit. NMFS Northwest Region. April 26, 2012. 128 p.

NMFS (National Marine Fisheries Service). 2012b. Reinitiation of Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Columbia River Navigation Channel Operations and Maintenance, Mouth of the Columbia River to Bonneville Dam, Oregon and Washington (HUCs 1708000605,1708000307, 1708000108)

NMFS (National Marine Fisheries Service). 2012c. Endangered Species Act Section 7 formal consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Port of Vancouver Terminal 5 Bulk Potash Handling Facility Project, Clark County, Washington. Columbia River-Hayden Island (5th field HUC 1709001205)

NMFS (National Marine Fisheries Service). 2013a. ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead. Northwest Region. 503 p.

NMFS (National Marine Fisheries Service). 2013b. Reinitiation of the Endangered Species Act Section 7 Formal Programmatic Conference and Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Aquatic Restoration Activities in the States of Oregon and Washington (ARBO II). Seattle, Washington.

NMFS (National Marine Fisheries Service). 2014a. Endangered Species Act Section 7(a)(2) Supplemental Biological Opinion – Consultation on Remand for Operation of the Federal Columbia River Power System, Northwest Region. Available at: http://www.westcoast.fisheries.noaa.gov/publications/hydropower/fcrps/2014_supplemental_fcrps_biop_final.pdf

NMFS (National Marine Fisheries Service). 2014b. Harbor Seal. Oregon/Washington Coast Stock Report.

NMFS (National Marine Fisheries Service). 2015a. Species in the Spotlight: Survive to Thrive – Recovering Threatened and Endangered Species FY 2013-2014 Report to Congress. 37

p. Available at: http://www.nmfs.noaa.gov/pr/laws/esa/final_biennial_report_2012-2014.pdf

NMFS (National Marine Fisheries Service). 2015b. California sea lion. U.S. Stock Report.

NMFS (National Marine Fisheries Service). 2015c. Endangered Species Act Biological Opinion and Magnuson-Stevens Act Essential Fish Habitat (EFH) Consultation – Effects of the Pacific Coast Salmon Plan on the Lower Columbia River Coho Evolutionarily Significant Unit Listed Under the Endangered Species Act. NMFS, West Coast Region. April 9, 2015. 66 p.

NMFS (National Marine Fisheries Service). 2015d. West Coast Region Conservation Banking Guidance. August 2015. Available at: http://home.nmfs.noaa.gov/organization/regions/west_coast/2_cross_div_coord/3_consrve_bank/conserv_bank_doc/8.2015_wcr_consevation_banking_guidance.pdf

NWFSC (Northwest Fisheries Science Center). 2015. Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Pacific Northwest. December 21, 2015.

ODFW (Oregon Department of Fish and Wildlife): R. Beamesderfer, L. Berg, M. Chilcote, J. Firman, E. Gilbert, K. Goodson, D. Jepsen, T. Jones, S. Knapp, C. Knutsen, K. Kostow, B. McIntosh, J. Nicholas, J. Rodgers, T. Stahl and B. Taylor. 2010. Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead. Oregon Department of Fish and Wildlife, Salem, OR.

ODFW (Oregon Department of Fish and Wildlife) and WDFW (Washington Department of Fish and Wildlife). 2015. 2015 Joint staff report: stock status and fisheries for spring Chinook, summer Chinook, sockeye, steelhead, and other species, and miscellaneous regulations. Joint Columbia River Management Staff. 21 January 2015

OWRD (Oregon Water Resources Department). 2012. Oregon's Integrated Water Resources Strategy. Salem, OR. Available at: http://www.oregon.gov/owrd/LAW/docs/IWRS_Final_2.pdf

PacifiCorp. 2011. Condit Dam decommissioning history and key dates. PacifiCorp, Portland, Oregon (www.pacificorp.com/condit).

PacifiCorp. 2012a. Condit Dam decommissioning newsletter. Fall 2012. http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Hydro/Hydro_Licensing/Condit/4_NRG_Condit_FallNwsltr_CROPS2012.pdf.

PacifiCorp. 2012b. Condit Hydroelectric Project Decommissioning FERC Project No. 2342 Annual Sediment Assessment Report – 2012. Prepared by Riverbend Engineering, LLC and JR Merit Industrial Contractors. 29 p.

Pearson, W.H. and J.R. Skalski. 2011. Factors affecting stranding of juvenile salmonids by wakes from ship passage in the lower Columbia River. River Research and Applications. 27:926-936.

PFMC (Pacific Fishery Management Council). 2014. Pacific Coast Salmon Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California as Amended through Amendment 18. PFMC, Portland, OR. 91 p.

Quinn, T.P. 2005. The Behavior and Ecology of Pacific Salmon and Trout. University of Washington Press, Seattle, Washington.

Rawding, D., B. Glaser, and T. Buehrens. 2014. Lower Columbia River fisheries and escapement evaluation in Southwest Washington, 2010. Washington Department of Fish and Wildlife. FPT 14-10. 289 p.

Roegner, C., D. Bottom, A. Baptista, L. Campbell, P. Goertler, S. Hinton, R. McNatt, C. Simenstad, D. Teel, and K. Fresh. 2015. Salmon habitat use of tidal-fluvial habitats of the Columbia River estuary, 2010-2013. Final Report. Prepared for the U.S. Army Corps of Engineers, Portland District, Portland, Oregon.

Rykaczewski, R.R., J.P. Dunne, W.J. Sydeman, M. Garcia-Reyes, B.A. Black, and S.J. Bograd. 2015. Poleward displacement of coastal upwelling-favorable winds in the ocean's eastern boundary currents through the 21st century. Geophysical Research Letters. 42:6424-6431.

Salathe, E.P., A.F. Hamlet, C.F. Mass, S.Y. Lee, M. Stumbaugh, and R. Steed. 2014. Estimates of Twenty-First-Century Flood Risk in the Pacific Northwest Based on Regional Climate Model Simulations. Journal of Hydrometeorology. 15:1881-1899.

Sanderson, B.L., K.A. Barnas and A.M. W. Rub. 2009. Non-indigenous Species of the Pacific Northwest: An Overlooked Risk to Endangered Salmon? Bioscience. 59:245-256.

Sawaske, S.R. and D.L. Freyberg. 2014. An analysis of trends in baseflow recession and low-flows in rain-dominated coastal streams of the pacific coast. Journal of Hydrology. 519:599-610.

Schtickzelle, N. and T.P. Quinn. 2007. A Metapopulation Perspective for Salmon and Other Anadromous Fish. Fish and Fisheries. 8:297-314.

Smith, C.T. and R. Engle. 2011. Persistent Reproductive Isolation between Sympatric Lineages of Fall Chinook Salmon in White Salmon River, Washington. Transactions of the American Fisheries Society. 140:699-715.

Stansell, R.J., B.K. van der Leeuw, K.M. Gibbons, and W.T. Nagy. 2014. Evaluation of pinniped predation on adult salmonids and other fish in the Bonneville Dam tailrace. U.S. Army Corps of Engineers.

Stelle, W.W. 2015. Letter from NMFS West Coast Regional Administrator to Dorothy Lowman, Chair of the Pacific Fisheries Management Council, regarding ESA consultation standards and guidance on the effects of the 2015 fishing season on ESA listed species. March 3, 2015. Available online at: http://www.pcouncil.org/wp-content/uploads/2015/03/F3c_Sup_NMFS_Rpt_GuidanceLtr_MAR2015BB.pdf

TAC (U.S. v Oregon Technical Advisory Committee). 2011. TAC Annual Report. Abundance, Stock Status and ESA Impacts. 2011 Summary, May 31-June 1, 2012.

TAC (U.S. v Oregon Technical Advisory Committee). 2012. TAC Annual Report. Abundance, Stock Status and ESA Impacts. 2012 Summary, May 30-31, 2013.

TAC (U.S. v Oregon Technical Advisory Committee). 2013. TAC Annual Report. Abundance, Stock Status and ESA Impacts. 2013 Summary, May 29-30, 2014.

TAC (U.S. v Oregon Technical Advisory Committee). 2014. TAC Annual Report. Abundance, Stock Status and ESA Impacts. 2014 Summary, May 13-14, 2015.

TAC (U.S. v Oregon Technical Advisory Committee). 2015. TAC Annual Report. Abundance, Stock Status and ESA Impacts. 2015 Summary - Draft Report.

Wade, A.A., T.J. Beechie, E. Fleishman, N.J. Mantua, H.Wu, J.S. Kimball, D.M. Stoms, and J.A. Stanford. 2013. Steelhead vulnerability to climate change in the Pacific Northwest. Journal of Applied Ecology. 50:1093-1104.

Wainwright, T.C. and L.A. Weitkamp. 2013. Effects of Climate Change on Oregon Coast Coho Salmon: Habitat and Life-Cycle Interactions. Northwest Science. 87:219-242.

Waples, R.S., R.W. Zabel, M.D. Scheuerell, and B.L. Sanderson. 2008. Evolutionary responses by native species to major anthropogenic changes to their ecosystems: Pacific salmon in the Columbia River hydropower system. Molecular Ecology. 17(1): 84-96.

Wargo Rub, A.M. 2014. Preliminary report on survival and run timing of adult spring/summer Chinook salmon through the lower Columbia River to Bonneville Dam. PowerPoint presentation to Northwest Power and Conservation Council (October 27, 2014).

WDFW (Washington Department of Fish and Wildlife). 2015. Lower Columbia Conservation and Sustainable Fisheries Plan. December 4, 2015. 365 p.

Weitkamp, L. A., T. C. Wainwright, G. J. Bryant, G. B. Milner, D. J. Teel, R. G. Kope, and R. S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-24, 258 p.

WLCTRT (Willamette/Lower Columbia Technical Recovery Team). 2003. Interim Report on Viability Criteria for Willamette and Lower Columbia Basin Pacific Salmonids. March 31, 2003.

WLCTRT (Willamette/Lower Columbia Technical Recovery Team). 2004. Status Evaluation of Salmon and Steelhead Populations in the Willamette and Lower Columbia River Basin.

WLCTRT (Willamette/Lower Columbia Technical Recovery Team) and ODFW (Oregon Department of Fish and Wildlife). 2006. Revised Viability Criteria for Salmon and Steelhead in the Willamette and Lower Columbia Basins Review Draft. April 1, 2006.

Wright, B., T. Murtagh, R. Brown, A. Barnes, B. Moser, C. Owen, T. Parsons, T. Tillson, and T. Wise. 2015. Willamette Falls Pinniped Monitoring Project. Oregon Department of Fish and Wildlife.

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

Approve: [signature] Date: 26 May 2016

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