Science, Service, Stewardship

2024 5-Year Review:
Summary & Evaluation of
Upper Willamette River Steelhead
Upper Willamette River Chinook Salmon

National Marine Fisheries Service
West Coast Region

5-Year Review: Upper Willamette River Species

Species Reviewed	Evolutionarily Significant Unit or Distinct Population Segment
Steelhead (*Oncorhynchus mykiss*)	*Upper Willamette River Steelhead*
Chinook Salmon (*O. tshawytscha*)	*Upper Willamette River Chinook Salmon*

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Acronyms

AIS	Aquatic Invasive Species
DIP	Demographically Independent Population
DPS	Distinct Population Segments
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
FMEP	Fisheries Management and Evaluation Plan
FMPs	Fishery Management Plans
FIPs	Functionally Independent Populations
HGMP	Hatchery Genetic Management Plan
LCM	Life-Cycle Monitoring
MMPA	Marine Mammal Protection Act
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
NWFSC	Northwest Fisheries Science Center
ODFW	Oregon Department of Fish and Wildlife
PCBs	Polychlorinated Biphenyls
PFMC	Pacific Fishery Management Council
TDG	Total Dissolved Gas
TMDL	Total Maximum Daily Loads
TRT	Technical Recovery Teams
U.S.	United States of America

USACE	United States Army Corps of Engineers
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
VSP	Viable Salmonid Population

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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 5 years. A 5-year review is a periodic analysis of a species' status conducted to ensure that the listing classification of a species as threatened or endangered on the List of Endangered and Threatened Wildlife and Plants (List) (50 CFR 17.11 – 17.12; 50 CFR 223.102, 224.101) is accurate (USFWS and NMFS 2006; NMFS 2020). After completing this review, the Secretary must determine if any species should be: (1) removed from the list; (2) have its status changed from endangered to threatened; or (3) have its status changed from threatened to endangered. If, in the 5-year review, a change in classification is recommended, the recommended change will be further considered in a separate rule-making process. The most recent 5-year review analysis for West Coast salmon and steelhead occurred in 2016. This document describes the results of the 2024 5-year reviews of the ESA-listed Upper Willamette River (UWR) steelhead and UWR Chinook salmon.

A 5-year review is:

- A summary and analysis of available information on a given species;
- The tracking of a species' progress toward recovery;
- The recording of the deliberative process used to make a recommendation on whether or not to reclassify a species;
- A recommendation on whether reclassification of the species is indicated.

A 5-year review is not:

- A re-listing or justification of the original (or any subsequent) listing action;
- A process that requires acceleration of ongoing or planned surveys, research, or modeling;
- A petition process, and
- A rulemaking.

1.1.1 Background on salmonid 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 taxonomically recognized species of Pacific salmon 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 taxonomically recognized species. We consider a group of populations to be an ESU if it is substantially reproductively isolated from other populations within the taxonomically recognized species and represents an important component in the evolutionary legacy of the species. We consider an ESU as constituting a DPS and therefore a "species" under the ESA.

Under the DPS 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 a 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: Policy on the Consideration of Hatchery-Origin Fish in Endangered Species Act Listing Determinations for Pacific Salmon and Steelhead (Hatchery Listing Policy; 70 FR 37204). 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 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). On May 26, 2016, we published our status reviews and listing determinations for 17 ESUs of Pacific salmon, 10 DPSs of steelhead, and the southern DPS of eulachon (*Thaleichthys pacificus)* (81 FR 33468).

1.2 Methodology used to complete the review

On October 4, 2019, we announced the initiation of 5-year reviews for 17 ESUs of salmon and 11 DPSs of steelhead in Oregon, California, Idaho, and Washington (84 FR 53117). We requested that the public submit new information on these species that has become available since our 2016 5-year review. 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 5-year reviews.

To complete the reviews, we first asked scientists from our Northwest and Southwest Fisheries Science Centers to collect and analyze new information about ESU and DPS viability. To evaluate viability, our scientists used the Viable Salmonid Population (VSP) concept described in the 2000 Technical Memorandum NOAA NMFS-NWFSC-42, Viable Salmonid Population and the Recovery of Evolutionarily Significant Units (hereafter referred to as McElhany et al. 2000). The VSP concept evaluates four criteria – abundance, productivity, spatial structure, and diversity – to assess species viability. Through the application of this concept, the science center considered new information on the four salmon and steelhead population viability criteria. They also considered any new information on ESU and DPS delineation. At the end of this process, the science teams prepared reports detailing the results of their analyses (Ford 2022).

To further inform the reviews, we also asked our Northwest salmon management biologists 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, new hatchery programs have started, changes in the operation of existing programs have occurred, and scientific data relevant to the degree of divergence of hatchery fish from naturally spawning fish in the same area. Finally, we consulted our Northwest and other salmon management specialists 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 and commercial information, including the work of the Northwest Fisheries Science Center (Ford 2022); the report of the regional biologists regarding hatchery programs; the UWR Chinook salmon and steelhead recovery plan (ODFW & NMFS 2011); 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 UWR steelhead and UWR Chinook salmon; information submitted by the public and other government agencies; and the information and views provided by the geographically based salmon conservation partners. 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

84 FR 53117, October 4, 2019

1.3.2 Listing history

In 1999, NMFS listed UWR steelhead and Chinook salmon under the ESA and classified them as threatened species (Table 1).

Table 1. Summary of the listing history under the Endangered Species Act for ESU and DPS in the upper Willamette River.

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
Steelhead (*O. mykiss*)	Upper Willamette River Steelhead	**FR Notice:** 64 FR 14517 **Date:** 3/25/1999 **Classification:** Threatened	**FR Notice:** 71 FR 834 **Date:** 1/5/2006 **Classification:** Threatened
Chinook Salmon (*O. tshawytscha*)	Upper Willamette River Chinook Salmon	**FR Notice:** 64 FR 14308 **Date:** 3/24/1999 **Classification:** Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 **Classification:** Threatened

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 it is listed, on which are found those physical or biological features essential to conservation of the species, and which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination by the Secretary that such areas are essential for the conservation of the species. We designated critical habitat for the UWR steelhead DPS and Chinook salmon ESU in 2005 (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, kill, 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 and to apply the take prohibitions of Section 9(a)(1) through 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 (65 FR 42421; July 20, 2000).

Table 2. Summary of rulemaking for 4(d) protective regulations and critical habitat for ESU and DPS in the upper Willamette River.

Salmonid Species	ESU/DPS Name	4(d) Protective Regulations	Critical Habitat Designations
Steelhead (*O. mykiss*)	Upper Willamette River Steelhead	**FR notice:** 65 FR 42421 **Date:** 7/10/2000 **Revised:** 6/28/2005 (70 FR 37160)	**FR notice:** 70 FR 52630 **Date:** 9/2/2005
Chinook Salmon (*O. tshawytscha*)	Upper Willamette River Chinook Salmon	**FR notice:** 65 FR 42421 **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 the UWR steelhead DPS and UWR Chinook salmon ESU. These assessments include status reviews conducted by our Northwest Fisheries Science Center and technical reports prepared in support of recovery planning for these species.

Table 3. Summary of previous scientific assessments for UWR Steelhead and Chinook Salmon.

Salmonid Species	ESU/DPS Name	Document Citation
Steelhead (*O. mykiss*)	Upper Willamette River Steelhead	Ford 2022 NWFSC 2015 Ford et al. 2011 ODFW and NMFS 2011 McElhany et al. 2007 Myers et al. 2006 WLCTRT and ODFW 2006 NMFS 2005 Good et al. 2005 Maher et al. 2005 WLCTRT 2004 WLCTRT 2003 NMFS 1999a NMFS 1999b NMFS 1998a NMFS 1997a NMFS 1997b NMFS 1997c Busby et al. 1996

Chinook Salmon (*O. tshawytscha*)	Upper Willamette River Chinook Salmon	Ford 2022 NWFSC 2015 Ford et al. 2011 ODFW AND NMFS 2011 McElhany et al. 2007 Myers et al. 2006 WLCTRT and ODFW 2006 NMFS 2005 Good et al. 2005 Maher et al. 2005 WLCTRT 2004 WLCTRT 2003 NMFS 1999b Myers et al. 1998 NMFS 1998b

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

On April 30, 2019, NMFS issued new guidelines (84 FR 18243) for assigning listing and recovery priorities. For determining a recovery priority for recovery plan development and implementation, we assess demographic risk (based on the listing status and species' condition in terms of its productivity, spatial distribution, diversity, abundance, and trends) and recovery potential (major threats understood, management actions exist under United States (U.S.) authority or influence to abate major threats, and certainty that actions will be effective) to assign a Recovery Priority number

In December 2023, NMFS issued the 2021-2022 Recovering Threatened and Endangered Species Report to Congress with updated recovery priority numbers. The numbers for UWR steelhead and UWR Chinook salmon remain unchanged (NMFS 2023)

1.3.6 Recovery Plan or Outline

Table 4. Recovery Priority Number (NMFS 2019a) and ODFW & NMFS Endangered Species Act Recovery Plan for UWR Chinook Salmon and Steelhead.

Salmonid Species	ESU/DPS Name	Recovery Priority Number	Recovery Plans/Outline
Steelhead (*O. mykiss*)	Upper Willamette River Steelhead	**3C**	**Title:** Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead Available at: https://www.fisheries.noaa.gov/resource/document/upper-willamette-river-conservation-and-recovery-plan-chinook-salmon-and **Date:** August 5, 2011 **Type:** Final **FR Notice:** 76 FR 52317
Chinook Salmon (*O. tshawytscha*)	Upper Willamette River Chinook Salmon	**3C**	**Title:** Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead Available at: https://www.fisheries.noaa.gov/resource/document/upper-willamette-river-conservation-and-recovery-plan-chinook-salmon-and **Date:** August 5, 2011 **Type:** Final **FR Notice:** 76 FR 52317

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2. Review Analysis

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

2.1 Delineation of species under the Endangered Species Act

Is the species under review a vertebrate?

ESU/DPS Name	YES	NO
Upper Willamette River Steelhead	X	
Upper Willamette River Chinook Salmon	X	

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

ESU/DPS Name	YES	NO
Upper Willamette River Steelhead	X	
Upper Willamette River Chinook Salmon	X	

Was the ESU/DPS listed prior to 1996?

ESU/DPS Name	YES	NO	Date Listed if Prior to 1996
Upper Willamette River Steelhead		X	n/a
Upper Willamette River Chinook Salmon		X	n/a

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

In 1991, NMFS issued a policy explaining how the agency would apply the definition of "species" in evaluating Pacific salmon stocks for listing consideration under the Endangered Species Act (ESA) (56 FR 58612). Under this policy a group of Pacific salmon populations is considered a "species" under the ESA if it represents an "evolutionarily significant unit" (ESU) which meets the two criteria of being 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) "distinct population segment" (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. Accordingly, in listing the UWR steelhead DPS under the DPS policy in 1999, we used the joint DPS policy to delineate the DPS under the ESA.

2.1.1 Summary of relevant new information regarding delineation of the UWR Chinook salmon ESU and steelhead DPS

ESU/DPS Delineation

This section provides a summary of information presented in Ford 2022: Biological viability assessment 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 delineation of the UWR Chinook salmon ESU (Ford 2022).

However, in the 2015 report NWFSC recommended a revision of the Lower Columbia River Steelhead DPS and Upper Willamette River Steelhead DPS delineation. Specifically, the NWFSC recommended that the Clackamas River winter steelhead demographically independent population (DIP), originally included as part of the Lower Columbia River DPS, instead be included in the Upper Willamette River DPS. Genetic research published since 2015 further supports the closer affinity of the Clackamas River winter-run steelhead DIP to Upper Willamette River steelhead DPS populations rather than Lower Columbia River steelhead DPS populations (Winans et al. 2018). The recommendation has not been carried forward. In their most recent assessment, the NWFSC restated their 2015 recommendation that the Clackamas River winter steelhead DIP should be included in the Upper Willamette River DPS (Ford 2022).

Membership of Hatchery Programs

For West Coast salmon and steelhead, many of the ESU and DPS descriptions include fish originating from specific artificial propagation programs (*e.g.,* hatcheries) that, along with their naturally produced counterparts, are included as part of the listed species. NMFS' Hatchery Listing Policy (70 FR 37204, June 28, 2005) guides our analysis of whether individual hatchery programs should be included as part of the listed species. The Hatchery Listing Policy states that hatchery programs will be considered part of an ESU/DPS if they exhibit a level of genetic divergence relative to the local natural population(s) that is not more than what occurs within the ESU/DPS.

In preparing this report, our management biologists reviewed the best available information regarding hatchery membership of this ESU and DPS. They considered changes in hatchery programs that occurred since the 2016 5-year 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 program membership. NMFS intends to address any needed changes and corrections via separate rulemaking subsequent to the completion of these 5-year status process prior to any official change in hatchery membership.

UWR Steelhead

At the time of the 2016 5-year review (NMFS 2016a), the UWR steelhead DPS was defined as including all naturally spawned anadromous winter-run *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls to and including the Calapooia River (79 FR 834, January 5, 2006). There have been no changes in the UWR steelhead hatchery programs since the 2016 5-year review. All hatchery winter-run steelhead programs were terminated in the late 1990s, and the current summer-run steelhead hatchery program within the geographic area of the DPS is not part of the DPS because it was originally derived from a non-native, out of DPS Skamania broodstock.

UWR Chinook Salmon

At the time of the 2016 5-year review (NMFS 2016a), the UWR Chinook salmon ESU was defined as including naturally spawned spring-run Chinook salmon originating from the Clackamas River and from the Willamette River and its tributaries above Willamette Falls. Also, spring-run Chinook salmon from six artificial propagation programs: the McKenzie River Hatchery Program (Oregon Department of Fish and Wildlife (ODFW) Stock #23); Marion Forks Hatchery/North Fork Santiam River Program (ODFW Stock #21); South Santiam Hatchery Program (ODFW Stock #24) in the South Fork Santiam River and Molalla River; Willamette Hatchery Program (ODFW Stock #22); and the Clackamas Hatchery Program (ODFW Stock #19) (79 FR 20802).

Since 2016, we (1) updated the name of the Marion Forks Hatchery/North Fork Santiam Hatchery Program (ODFW Stock #21), which is included in the ESU, to the North Santiam Program; (2) separated the South Santiam Hatchery Program (ODFW Stock #24) in the South Fork Santiam River and Molalla River, which is included in the ESU, into two programs named the South Santiam River Program and the Molalla River Program; and (3) removed Oregon Department of Fish and Wildlife (ODFW) stock numbers from the names of the McKenzie River Hatchery Program, Willamette Hatchery Program, and the Clackamas Hatchery Program (85 FR 81822, December 17, 2020).

2.2 Recovery Criteria

The ESA requires recovery plans to be developed for each listed species unless the Secretary finds a recovery plan would not promote the conservation of the species. Recovery plans must contain, to the maximum extent practicable, objective measurable criteria for delisting the species, site-specific management actions necessary to recover the species, and time and cost estimates for implementing the recovery plan.

Evaluating a species for potential changes in ESA listing requires an explicit analysis of population or demographic parameters (the biological criteria) and also of threats under the five ESA listing factors in ESA section 4(a)(1) (listing factor [threats] criteria). Together these make up the ―objective, measurable criteria‖ required under section 4(f)(1)(B).

For Pacific salmon, Technical Recovery Teams (TRTs), appointed by NMFS, define criteria to assess each listed Pacific salmonid species' biological viability. NMFS develops criteria to assess progress toward alleviating the relevant threats (listing factor [threats] criteria). NMFS adopted the TRT's viability criteria as the biological criteria for Pacific salmonid recovery plans, based on best available scientific information and other considerations as appropriate. NMFS also developed criteria to assess progress toward alleviating the relevant threats to a species (listing factor [threats] criteria). For the Upper Willamette River Conservation and Recovery Plan for Chinook salmon and steelhead (ODFW and NMFS 2011), NMFS adopted the viability criteria metrics defined by the Willamette-Lower Columbia Technical Recovery Team (WLCTRT) (WLCTRT and ODFW 2006) as the biological recovery criteria for the threatened UWR Chinook salmon ESU and steelhead DPS.

Biological review of the species continues as the recovery plan is implemented and additional information becomes available. This information, along with new scientific analyses, can increase certainty about whether the threats have been abated, whether improvements in population biological viability have occurred for UWR Chinook salmon and steelhead, and whether linkages between threats and changes in salmon biological viability are understood. NMFS assesses these biological recovery criteria and the delisting criteria through the adaptive management program for the recovery plan during the ESA 5-Year Review (USFWS and NMFS 2006; NMFS 2020).

2.2.1 A final, approved recovery plan with objective, measurable criteria

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

Upper Willamette River Steelhead	X	
Upper Willamette River Chinook Salmon	X	

2.2.2 Adequacy of recovery criteria

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

Upper Willamette River Steelhead	X	
Upper Willamette River Chinook Salmon	X	

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

ESU/DPS Name	YES	NO
Upper Willamette River Steelhead	X	
Upper Willamette River Chinook Salmon	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.

McElhany et al. (2000) defined an independent population as: "…a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season." For our purposes, not interbreeding to a "substantial degree" means that two groups are considered to be independent populations if they are isolated to such an extent that exchanges of individuals among the populations do not substantially affect the population dynamics or extinction risk of the independent populations over a 100-year time frame. Independent populations exhibit different population attributes that influence their abundance, productivity, spatial structure and diversity. Independent populations are the units that are combined to form alternative recovery scenarios for multiple similar population groupings and ESU/DPS viability. Dependent populations provide connectivity among independent populations, as well as temporary source populations and genetic refugia in the event of catastrophic loss of neighboring independent populations. The recovery scenario includes both independent and dependent populations.

The VSP concept (McElhany et al. 2000) is based on the biological parameters of abundance, productivity, spatial structure, and diversity for an independent salmonid population to have a negligible risk of extinction over a 100-year time frame. The VSP concept identifies the attributes, provides guidance for determining the conservation status of populations and larger-scale groupings of Pacific salmonids, and describes a general framework for how many and which populations within an ESU/DPS should be at a particular status for the ESU/DPS to have an acceptably low risk of extinction.

The NMFS- appointed WLC TRT developed viability criteria metrics based on the McElhaney et al. 2000 VSP concepts (McElhany et al. 2003; McElhany et al. 2006). The 2011 Upper Willamette River Recovery Plan (ODFW and NMFS 2011) adopted the criteria for achieving viability established by the WLC TRT as the biological recovery criteria for threatened UWR Chinook salmon and UWR steelhead. These criteria metrics describe a population's risk in 100 years (Figure 1). NMFS color-coded the risk assessment to help readers distinguish the various risk categories.

		VSP Criteria Metrics			
		Spatial Structure/Diversity Risk			
		Very Low	Low	Moderate	High
Abundance/Productivity Risk	Very Low (<1 percent)	Very Low Risk (Highly Viable)	Very Low Risk (Highly Viable)	Low Risk (Viable)	Moderate Risk
	Low (<5 percent)	Low Risk (Viable)	Low Risk (Viable)	Low Risk (Viable)	Moderate Risk
	Moderate (<25 percent)	Moderate Risk	Moderate Risk	Moderate Risk	High Risk
	High (>25 percent)	High Risk	High Risk	High Risk	High Risk

Figure 1. VSP criteria metrics and corresponding risk levels

For the purposes of recovery planning and development of recovery criteria, the WLC TRT identified independent populations within the UWR steelhead DPS and the UWR Chinook salmon ESU.

UWR Steelhead

The UWR steelhead DPS includes all naturally spawned anadromous winter-run *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls to and including the Calapooia River (79 FR 20802; Figure 1).

The WLC TRT identified four historical demographically independent populations for UWR winter-run steelhead: Molalla, North Santiam, South Santiam, and Calapooia (Myers et al. 2006). The WLC TRT delineated the populations on geography, migration rates, genetic attributes, life history patterns, phenotypic characteristics, population dynamics, and environmental and habitat characteristics (Myers et al. 2006).

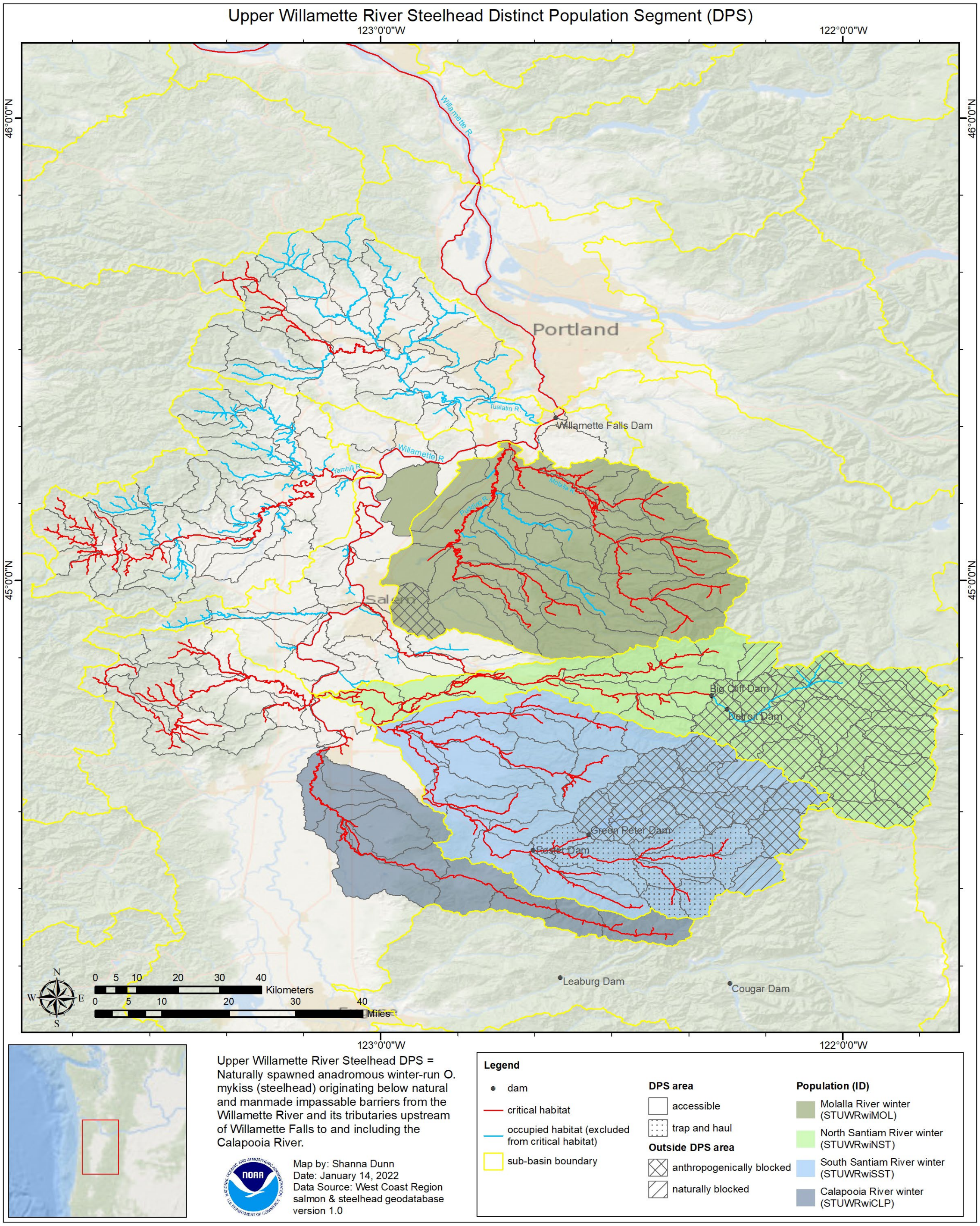
UWR Chinook Salmon

The UWR Chinook salmon ESU includes naturally spawned spring-run Chinook salmon originating from the Clackamas River and from the Willamette River and its tributaries above Willamette Falls. Also, spring-run Chinook salmon from six artificial propagation programs: the McKenzie River Hatchery Program; North Santiam River Program; South Santiam River Program; Molalla River Program; Willamette Hatchery Program; and the Clackamas Hatchery Program (85 FR 81822; Figure 2).

The WLC TRT identified seven demographically independent populations of spring-run Chinook salmon in the UWR Chinook salmon ESU: Clackamas, Molalla, North Santiam, South Santiam, Calapooia, McKenzie, and the Middle Fork Willamette (Myers et al. 2006). The WLC TRT classified the Clackamas, North Santiam, McKenzie and Middle Fork Willamette populations as "core populations" and the McKenzie as a "genetic legacy population." All the populations are part of the Cascades Tributaries Stratum for the ESU. The WLC TRT delineated the populations based on geography, migration rates, genetic attributes, life history patterns, phenotypic characteristics, population dynamics, and environmental and habitat characteristics (Myers et al. 2006).

The WLC TRT recovery criteria are hierarchical in nature, with ESU/DPS level criteria being based on the status of natural-origin salmon assessed at the population level. Recovery criteria and strategies outlined in the 2011 Upper Willamette River Recovery Plan (ODFW and NMFS 2011) are targeted on achieving, at a minimum, the WLCTRT and ODFW (2006) biological viability criteria for each MPG in the ESUs/DPS.

The WLC TRT approach calls for comparing estimates of current natural-origin abundance (measured as a 10-year geometric mean of natural-origin spawners) and productivity (estimate of return per spawner at low to moderate parent spawning abundance) against predefined viability curves. In addition, the WLC TRT developed a set of specific criteria (metrics and example risk thresholds) for assessing the spatial structure and diversity risks based on current information representing each specific population. The WLC TRT viability criteria are generally expressed relative to a particular risk threshold—5 percent risk of extinction over a 100-year period. In order to meet the biological recovery criteria for viability, the UWR steelhead DPS must have three out of four *viable* (low risk) populations, and the UWR Chinook salmon ESU must have four out of seven *viable* (low risk) populations (ODFW and NMFS 2011).



Upper Willamette River Steelhead Distinct Population Segment (DPS)

Upper Willamette River Steelhead DPS = Naturally spawned anadromous winter-run O. mykiss (steelhead) originating below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls to and including the Calapooia River.

Map by: Shanna Dunn
Date: January 14, 2022
Data Source: West Coast Region salmon & steelhead geodatabase version 1.0

Figure 2. UWR Steelhead DPS population structure.[1]

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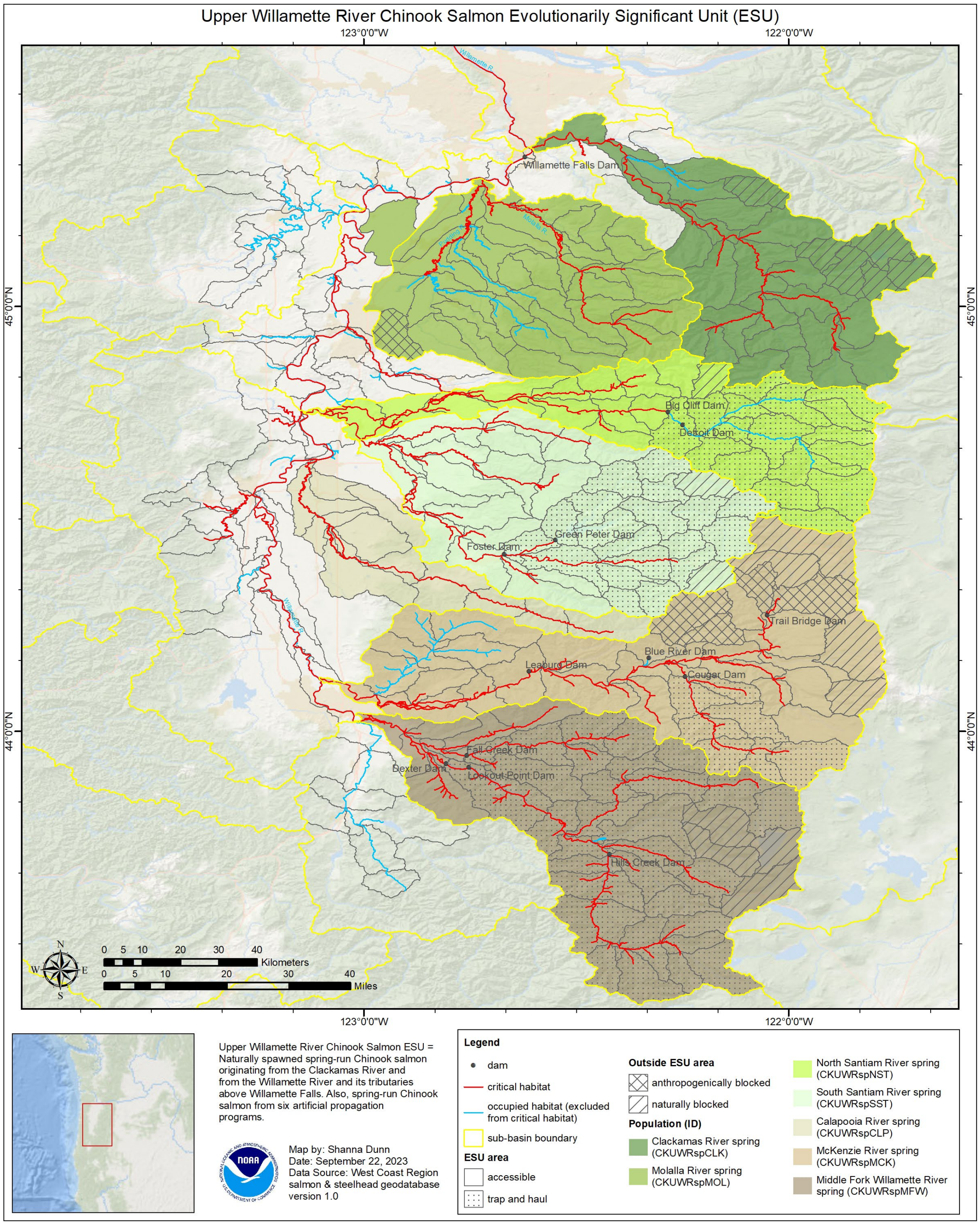
[1] The map above generally shows the accessible and historically accessible areas for UWR steelhead. The area displayed is consistent with the regulatory description of the range of the UWR steelhead DPS found at 50 CFR17.11, 223.102, and 224.102. Actions outside the areas shown can affect this DPS. Therefore, these areas 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.


Upper Willamette River Chinook Salmon Evolutionarily Significant Unit (ESU)

Upper Willamette River Chinook Salmon ESU = Naturally spawned spring-run Chinook salmon originating from the Clackamas River and from the Willamette River and its tributaries above Willamette Falls. Also, spring-run Chinook salmon from six artificial propagation programs.

Map by: Shanna Dunn
Date: September 22, 2023
Data Source: West Coast Region salmon & steelhead geodatabase version 1.0

Figure 3. UWR Chinook Salmon ESU population structure.[2]

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

2.3 Updated Information and Current Species' Status

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

2.3.1 Analysis of Viable Salmonid Population (VSP) Criteria and Status

Information provided in this section is summarized from Ford 2022 - Biological viability assessment update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest.

UWR Steelhead DPS

Biological Status Relative to Recovery Goals

Populations in this DPS have experienced long-term declines in spawner abundance. The underlying cause(s) of these declines is not well understood. Returning adult winter steelhead do not experience the same deleterious water temperatures as the spring-run Chinook salmon, and prespawn mortalities are not likely to be significant. Although the recent magnitude of these declines is relatively modest, continued declines would be a cause for concern. Improvements to Bennett Dam fish passage and operational temperature control at Detroit Dam may be providing some stability in abundance in the North Santiam River DIP. It is unclear if sufficient high-quality habitat is available below Detroit Dam to support the population reaching its VSP recovery goal, or if some form of access to the upper watershed is necessary to sustain a "recovered" population. Similarly, the South Santiam River basin may not be able to achieve its recovery goal status without access to historical spawning and rearing habitat above Green Peter Dam (Quartzville Creek and the Middle Santiam River) and/or improved juvenile downstream passage at Foster Dam.

While genetic diversity goals are partially achieved through the closure of winter-run steelhead hatchery programs in the upper Willamette River, there is some evidence that the summer-run steelhead releases in the North and South Santiam Rivers may be influencing the viability of native steelhead. Overall, none of the populations in the DPS are meeting their recovery goals.

Updated Risk Summary

Overall, the Upper Willamette River steelhead DPS continued to decline in abundance. Although the most recent counts at Willamette Falls and the Bennett Dams in 2019 and 2020 suggest a rebound from the record 2017 lows, it should be noted that current "highs" are equivalent to past lows. Uncertainty in adult counts at Willamette Falls are a concern, given that the counts represent an upper bound on DPS abundance. Radio-tagging studies suggest that a considerable proportion of "winter" steelhead ascending Willamette Falls do not enter the tributaries that are considered part of this DPS; these fish may be non-native early-winter steelhead that appear to have colonized the western tributaries, misidentified summer steelhead, late-winter steelhead that have colonized tributaries not historically part of the DPS, or hybrids between native and non-native steelhead. More definitive genetic monitoring of steelhead ascending Willamette Falls, in tandem with radio tagging work, needs to be undertaken to better estimate the total abundance of the DPS.

Spatial structure and diversity continue to limit the recovery of UWR steelhead. Introgression by non-native summer-run steelhead continues to be a concern. Genetic analysis suggests that there is introgression among native late-winter steelhead and summer-run steelhead (Van Doornik et al. 2015, Johnson et al. 2018). Reform actions have been taken to limit gene flow to less than 2% from summer steelhead and continues to be monitored in accordance with NMFS 2019b.

While the viability of the ESU appears to be declining, the recent uptick in abundance may provide a short-term demographic buffer. Furthermore, increased monitoring is necessary to provide quantitative verification of sustainability for most of the populations. In the absence of substantial changes in accessibility to high-quality habitat, the DPS will remain at “moderate-to-high” risk. Overall, the Upper Willamette River steelhead DPS is therefore at “moderate-to-high” risk, with a declining viability trend.

UWR Chinook Salmon ESU

Biological Status Relative to Recovery Goals

Abundance levels for all but one of the seven DIPs in this ESU remain well below their recovery goals. The Clackamas River DIP currently exceeds its abundance recovery goal and its pHOS goal (<10% hatchery-origin fish). Alternatively, the Calapooia River may be functionally extinct, and the Molalla River remains critically low (there is considerable uncertainty in the level of natural production in the Molalla River). Abundances in the North and South Santiam Rivers have declined since the last review, with natural-origin abundances in the low hundreds of fish. The Middle Fork Willamette River is at a very low abundance, even with the inclusion of natural-origin spring-run Chinook salmon spawning in Fall Creek. While returns to Fall Creek Dam number in the low hundreds, prespawn mortality rates are very high in the basin, and the effects of fires and high summer temperatures resulted in a recruitment failure in 2021. However, the Fall Creek program does provide valuable information on juvenile fish passage through operational drawdown. With the exception of the Clackamas River, the proportions of natural-origin spawners in the remainder of the ESU are well below those identified in the recovery goals.

While the Clackamas River appears to be able to sustain above recovery goal abundances, even during relatively poor ocean and freshwater conditions, the remainder of the ESU is well short of its recovery goals. In order to meet the biological recovery criteria for viability, the UWR Chinook salmon ESU must have four out of seven *viable* populations.

Updated Risk Summary

Access to historical spawning and rearing areas is restricted by high-head dams in five of the historically most-productive tributaries, limiting the abundance and productivity of most populations in this ESU. Of these five dammed tributaries, only in the Clackamas River does the current system of adult trap-and-haul and juvenile collection appear to be effective enough to sustain a naturally spawning population (although current juvenile passage efficiencies are still below NMFS criteria). In the McKenzie River, the spring-run Chinook salmon population appears to be relatively stable, having reversed a short-term downward abundance trend that was of concern during the last review. The McKenzie River remains well below its recovery goal, despite having volitional access to much of its historical spawning habitat. The North and South Santiam River DIPs both experienced declines in abundance. Under current conditions, Fall Creek was likely near its capacity of several hundred fish prior to the recruitment failure in 2021, although this may no longer be true following that event. The Calapooia and Molalla Rivers are not blocked by dams but are nonetheless constrained by habitat conditions, and natural reproduction is likely extremely low. Demographic risks remain “high” or “very high” for most populations, except the Clackamas and McKenzie Rivers, which are at “low” and “low-to-moderate” risk, respectively. The Clackamas River spring-run Chinook salmon population maintains a low pHOS through the removal of all marked hatchery-origin adults at North Fork Dam. Elsewhere, hatchery-origin fish comprise the majority or, in the case of the McKenzie River, nearly half of the naturally spawning population. Genetic diversity risks therefore continue to be a concern.

Spatial structure, specifically access to historical spawning habitat, continues to be a concern. In the absence of effective passage programs, spawners in the North Santiam, Middle Fork Willamette, and to a lesser extent South Santiam and McKenzie Rivers will continue to be confined to more lowland reaches where land development, water temperatures, and water quality may be limiting. Pre-spawning mortality levels are generally high in the lower tributary reaches where water temperatures and fish densities are generally the highest. Climate change modeling predicts that in the absence of passage to colder headwater areas, some populations would be at a high risk of extinction by 2040 (Myers et al. 2018). Restoration of access to upper watersheds remains a key element in risk reduction for this ESU. A second spatial structure concern is the availability of juvenile rearing habitat in side-channel or off-channel habitat. River channelization and shoreline development have constrained habitat in the lower tributary reaches and Willamette River mainstem, in turn limiting the potential for fry and subyearling “movers” emigrating to the estuary (Schroeder et al. 2016). These impacts therefore also limit juvenile life history diversity for this ESU.

Overall, there has likely been a declining trend in the viability of the Upper Willamette River Chinook salmon ESU since the last review. The magnitude of this change is not sufficient to suggest a change in risk category, however, so the Upper Willamette River Chinook salmon ESU remains at “moderate” risk of extinction.

2.3.2 ESA Listing Factor Analysis

Section 4(a)(1) 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 man-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 habitat conditions and restore fish passage at specific locations described in the 2011 Recovery Plan. 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 with the aid of newly implemented monitoring and evaluation programs. Generally, it takes one to five decades to demonstrate such increases in viability.

Current Status and Trends in Habitat

Below, we summarize information for UWR Chinook salmon and UWR steelhead on the current status and trends in habitat conditions since our last 2016 5-year 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 independent population viability; (2) the population-specific geographic areas (e.g., independent population major/minor spawning areas) where key emergent or ongoing habitat concerns; (3) population-specific key protective measures and major restoration actions taken since the 2016 5-year review that move a population toward achieving the recovery plan viability criteria adopted by NMFS in the 2011 Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011) as efforts that substantially address a key concern noted above #1 and #2, or, that represent a noteworthy conservation strategy; (4) key regulatory measures that are either adequate or inadequate, and contributing substantially to the key concerns summarized above; (5) recommended future recovery actions over the next 5 years toward achieving population viability, 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 addressing priority habitat areas when sequencing priority habitat restoration actions.

The Willamette River has recovered to some extent from past water pollution and river channel modifications, but many of these threats continue into the future. Population in the region is expected to continue growing rapidly. Land development continues to see increasing demands for urban and residential lands while agricultural and forest industries are fighting to protect their land base. Much of the new development pressures are in the valley along the mainstem Willamette River and its floodplain. Streams and river temperatures already approach the lethal limits of native cold-water fish species, especially in the lower river near the major urban centers. Many miles of streams in the basin are listed by environmental agencies as water quality impaired because of water temperature. The climate in the basin is projected to warm by 1.0 to 3.4° C (2 to 6° F) by the middle of the century. Results of the Willamette Water 2100 Project (Oregon State 2022) suggest that the likelihood of occurrence of native cold-water species, such as juvenile Chinook salmon, would decrease substantially if future river temperature increases by 2° C (3.6° F) or more.

One of the greatest challenges for the Willamette River is to create a scientifically sound vision of the new river, a river that is changing because of its altered flow regimes and sediment supply, a river that is changing because of social changes in the towns and communities along its banks (Wallick et al., 2013). Water management authorities are facing increasing demands to store water in reservoirs and withdraw more water during low flow seasons when the needs of the aquatic ecosystem also are most acute. Flood control reservoirs already have reduced sediment transport to the mainstem by 60 percent, and peak flows in the river are reduced roughly 30 to 70 percent. The momentum of current trends and uncertainty of future changes make it critical for our region to anticipate the future Willamette River (Williams 2014).

In the marine environment, climate change appears to be shifting sea temperatures, salinity, and acidity, each of which separately and in combination may be disruptive to prey species' presence and abundance. Climate concerns are addressed in Section 2.3.2: Listing Factor E: Other natural or manmade factors affecting its continued existence.

Systemic Habitat Concerns

Systemic habitat concerns that influence each species evaluated in this 5-year review, UWR Chinook salmon and UWR steelhead, both at the time of our 2016 review and currently, include:

Habitat access/passage. Access to spawning and/or rearing habitat remains impaired for UWR Chinook and UWR steelhead. The Willamette Valley Flood Control Project (Willamette Project) consists of 13 dams in the Upper Willamette Basin. Most of these are "high head" dams that are over 250 feet tall, impairing passage of UWR Chinook and UWR steelhead and blocking access to a large amount of their historical habitat upstream of the dams (https://www.nwp.usace.army.mil/Locations/Willamette-Valley/). Although the U.S. Army Corps is undertaking operational and structural fish passage programs at some of these high head dams, many of these are currently insufficient to support a self-sustaining population or are potentially decades away from construction of structural passage.

Other factors impairing access to habitat throughout the Upper Willamette Basin include impassable culverts, dewatered stream channels, limited floodplain connectivity and river disconnection from off-channel habitats.

Habitat complexity and floodplain connectivity. The Upper Willamette River Recovery Plan (ODFW and NMFS 2011) identifies floodplain connectivity as a priority habitat action for all populations of UWR Chinook salmon and steelhead. Years of reduced peak flows as well as reduced flooding due to dam building in the Willamette River basin have caused a reduction in channel habitat complexity of the Willamette River and its tributaries. The more complex a streams channel is (i.e., the existence of logs, many channels and pools, and a winding path), the higher ability the stream has to hold a healthy fish population. Streams are often straightened and simplified when they become urbanized and this along with reduced peak flows often decreases channel complexity, as it has in the Willamette River Basin (Gregory et al. 2019). Causes for reduced habitat complexity and floodplain connection include the construction of upstream dams that have modified flows and raised water temperatures, construction of revetments that reduce channel migration and the formation of habitats, development of the floodplain, removal of riparian vegetation, removal of wood from the river channels, blocking access to off-channel habitats, and the widespread presence of non-native species (https://ecoreportcard.org/report-cards/willamette-river/.

Degradation of downstream habitat. The downstream effects of the Willamette Project and other dams are prevalent in the basin as well. Altered seasonal flow patterns result in limited flows that affect UWR steelhead outmigration and adult UWR Chinook migration (Hansen et al 2017). Altered geomorphic processes result in winter flood damage reduction: fewer channel-forming flows, loss of floodplain connectivity and loss of large wood and gravel from reservoirs. And temperatures downstream of dams are often too cold during the summer, preventing adult salmon from migrating to spawning grounds; too warm in the fall /winter which causes salmon eggs in gravel to die or hatch too early.

Instream Flows. Flood control and hydropower management have reduced instream flow volume throughout the Upper Willamette Basin (Jaeger et al. 2018). There were three dry years in the recent past, in 2016, 2018, and 2021. Two of these also had unusually hot temperatures, with Oregon reporting 2021 their warmest summer on record (https://www.weather.gov/wrh/Climate?wfo=pqr). These low flow very hot conditions overlapped with UWR Chinook migration over Willamette Falls and into their natal tributaries. Most of these tributaries have Corps of Engineers dams and reservoirs, with minimum tributary flow objectives. During these drier years, the minimum flows were missed in some months, affecting migration, rearing and spawning conditions. The higher water temperatures were at times exacerbated by lower flows, and the combination lead to increased pre-spawning mortality.

Degraded Water Quality is an ongoing habitat concern for UWR Chinook and UWR steelhead when they are present in the mainstem Columbia and lower Willamette rivers as they migrate up and down the river. All salmon and steelhead species pass through the lower Columbia River as they migrate up or down the mainstem. The mainstem Columbia River is impaired by some contaminants, and nearly the entire river from McNary Dam to the mouth of the estuary is impaired for more than one toxic pollutant. For example: EPA developed a basin-wide Dioxin TMDL that covers the lower mainstem Columbia River, though no implementation plan was ever developed, inorganic arsenic impairs most of the lower Columbia River from the Willamette River confluence to the mouth of the estuary, the estuary is impaired by DDT and PCBs from the mouth of the Kalama to the Ocean, and the Columbia River estuary below Puget Island is impaired for methylmercury (EPA 2020). Toxic contamination arises 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. In addition, the Columbia River regularly has temperatures that exceed safe conditions for salmonids.

Below we describe habitat concerns in more specific detail, by species and by their component populations.

UWR Chinook Salmon

1) Population-Specific Key Emergent or Ongoing Habitat Concerns Since the 2016 5-Year Review

The primary habitat concerns for populations in the UWR Chinook salmon ESU, as reported in the 2016 5-year review (NMFS 2016a), continue to be:

Blocked Access/Impaired passage - Access to the majority of historical spawning and rearing habitat is blocked.

- Lack of safe and effective upstream passage at high-head dams (South Santiam and Middle Fork populations)
- Lack of safe downstream passage through high-head dams (North Santiam, South Santiam, McKenzie, and Middle Fork populations)
- Migrating adults are restricted to river reaches that are currently too warm to support successful spawning, or predicted to become too warm in the coming decades (South Santiam and Middle Fork populations)
- Multiple small passage barriers restricting historical habitat access (Calapooia population)

Degraded Water Quality - at the upper extent of their current range below the dams, water quality is impaired largely due to

- high temperatures from reservoir releases during key migration, spawning, and incubation life stages (North Santiam, South Santiam, and Middle Fork populations), and
- total dissolved gas (TDG) from dam spill operations at key times of the year (North Santiam, South Santiam and McKenzie populations).

Insufficient Instream Flows – in reaches downstream of high-head dams due to altered hydrograph from reservoir operations, resulting in instream flows that are not cool enough or of sufficient volume to support successful spawning (North Santiam, South Santiam, McKenzie, and Middle Fork populations)

Lack of Floodplain Habitat - Juvenile Chinook salmon are exposed to channelized habitat with poor floodplain connectivity in much of the accessible habitat in the lower reaches of the tributaries, which provides poor rearing conditions (all populations).

Reduced quantity and quality of spawning and incubation substrates in the lower mainstem reaches - caused by modification of the flow regime downstream of high-head dams, resulting in gravel recruitment and deposition in the lower river and gravel entrapment above dams (North Santiam, South Santiam, McKenzie, and Middle Fork populations).

Degraded or Reduced Habitat – lack of riparian cover caused by wildfires (Clackamas population) or land use practices (Molalla population) causing elevated summer water temperatures which decrease the survival and growth of juvenile UWR Chinook.

2) Population-Specific Geographic Areas of Habitat Concern Since the 2016 5-Year Review

Specific geographic areas of concern include:

- High-head dams continue to limit habitat access (Ford 2022):
    - Detroit and Big Cliff dams on the North Santiam River
    - Foster and Green Peter dams on the South Santiam River
    - Cougar and Trail Bridge dams on the McKenzie and South Fork McKenzie Rivers
    - Dexter, Hills Creek, and Lookout Point dams on the Middle Fork Willamette River
- Reaches immediately below high-head dams listed above (water quality, specifically TDG and temperature)

3) Population-specific Key Protective Measures and Major Restoration Actions Taken Since the 2016 5-Year Review

The key protective measures and major restoration actions addressing population-specific habitat concerns implemented since the 2016 5-year review are:

Modified spill to reduce water temperatures (North Santiam population) - Operational temperature control has included spill of surface water when Detroit Reservoir elevation is above the spillway to reduce the volume of warm water that would be released in the fall when the dams are evacuated to provide flood risk reduction (USACE 2021). Beginning in 2021 under the Court-ordered injunction measures (U.S. District Court 2021), the use of the regulating outlets (ROs) were tested. The RO intakes are lower than the turbines, and can access cooler water until the reservoir ‘turns over’ and mixes the various water levels resulting in relatively uniform temperatures.

Habitat Restoration Actions –

- *South Santiam population:* The Willamette National Forest and Bureau of Land Management along with project partners continue to implement habitat restoration on the South Santiam River, including:
    - The Cool-Soda Habitat Improvement Project. This long-term project includes large wood tipping to retain gravels and store cool water; replacement of undersize culverts to restore fish passage; and decommissioning unstable roads and limiting year-round vehicle access on others in order to decrease sediment inputs to the streams.
    - In 2021, native plant establishment and invasive knotweed removal along Crabtree Creek and Roaring River occurred.
- *Clackamas population:* The Clackamas Focused Investment Partnership Strategic Restoration Action Plan (Clackamas Partnership) was developed by more than fifteen Portland metropolitan region organizations committed to working collaboratively to improve watershed health. Examples of 2 projects already implemented under this 6 year investment are:
    - River Island Natural Area Restoration: Large wood placement, riparian and floodplain native planting and side channel reconnection.

    - Badger Creek Fish Passage Restoration: Replacement of undersized culverts with a larger pipe culvert to better accommodate natural stream conditions. Restored access to 1.5 miles of stream.
- *Mainstem:* Oregon Watershed Enhancement Board funded the Upper and Middle Willamette Mainstem Anchor Habitats Initiative from 2016 through 2021 to complete a number of projects which seek to restore native fish habitats, including planting native riparian vegetation Willamette Mission State Park, Calapooia Population, controlling aquatic invasive weeds, reconnecting historic side channels, modifying artificial barriers (Pudding-Molalla Confluence, Molalla Population), levees and road crossings to increase floodplain inundation; and reconnecting former gravel pits (Green Island, McKenzie Population) to serve as functionally beneficial fish habitat.

Re-established Floodplain Connectivity –

- *McKenzie population:* Valley-scale, "Stage Zero Restoration" process-based restoration approach aims to re-establish depositional environments and maximize connection in wetland-stream complexes. Combined partners have implemented many of these projects and improving habitats. McKenzie Chinook salmon have benefited from:
    - The 2016 Deer Creek Floodplain Enhancement Project, connecting the lower 1.6 miles with adjacent 42 acres of floodplain habitat.
    - The 2018 South Fork McKenzie River Floodplain Enhancement Project, reconnecting 4.5 miles of floodplain at the confluence of Cougar Creek and the South Fork of the McKenzie River.
- *Middle Fork population*: In 2017 and 2018, the Staley Creek Floodplain Enhancement Project (Using Stage Zero Restoration) reconnected 46 acres of floodplain along one stream mile.

4) Key Regulatory Measures Since the 2016 5-Year Review

The UWR Recovery Plan (ODFW and NMFS 2011) and the 2016 5-year review (NMFS 2016a) identified regulatory mechanisms as a priority issue affecting salmon recovery for all of the populations in the UWR Chinook salmon ESU. 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 5 years. However, the implementation and effectiveness of regulatory mechanisms has not been adequately documented. ***See Listing Factor D: Inadequacy of Existing Regulatory Mechanisms in this document for details.***

5) Recommended Future Actions Over the Next 5 Years Toward Achieving Population Viability

The greatest opportunity to advance the recovery of UWR Chinook salmon is to:

- Provide effective passage and revise reservoir operations to promote access to historical spawning and rearing areas currently blocked by high-head dams (North Santiam, South Santiam, McKenzie, and Middle Fork Populations).
- Revise dam operations to minimize anthropogenic impacts to water temperatures and TDG (North Santiam population).

- Restore riparian vegetation cover and re-establish connection to off-channel habitats and floodplains in the lower tributaries to provide suitable spawning and rearing habitat and cooler water temperatures (all populations).
- Implement Carmen-Smith's Aquatic Management Strategy to provide upstream and downstream passage for Chinook salmon under the terms of Eugene Water & Electric Board's license agreement (McKenzie population).
- Identify and eliminate fish passage barriers other than high-head dams, restoring access to the upper watersheds (Calapooia population).
- Continue the work of the Clackamas Focused Investment Partnership to reconnect isolated UWR Chinook habitats and protect high quality areas (Clackamas population).

UWR Steelhead

1) Population-Specific Key Emergent or Ongoing Habitat Concerns Since the 2016 5-Year Review

The primary habitat concerns, as reported in the 2016 5-year review (NMFS 2016a), continue to be:

Blocked Access/Impaired passage - Access to the majority of their historical spawning and rearing habitat is blocked.

  - Lack of safe and effective passage at high-head dams (North Santiam and South Santiam populations).
  - Lack of safe downstream passage through high-head dams (North Santiam and South Santiam populations).
  - Migrating adults are restricted to river reaches that are currently too warm to support successful spawning, or predicted to become too warm in the coming decades.
  - Multiple small passage barriers restricting historical habitat access (Molalla and Calapooia populations).

Degraded Water Quality -At the upper extent of their current range below the dams, water quality is impaired largely due to

  - harmful temperatures from reservoir releases during key migration, spawning, and incubation life states (North Santiam and South Santiam populations).
  - total dissolved gas (TDG) from dam spill operations at key times of the year (North Santiam population).

Lack of Floodplain Habitat – Juvenile steelhead are exposed to channelized habitat with poor floodplain connectivity in much of the accessible habitat in the lower reaches of the tributaries, which provides poor rearing conditions (all populations).

Reduced quantity and quality of spawning and incubation substrates in the lower mainstem reaches - caused by modification of the flow regime downstream of high-head dams, resulting in gravel recruitment and deposition in the lower river and gravel entrapment above dams (North Santiam and South Santiam populations).

Degraded or Reduced Habitat - New climate change modeling of projected water temperatures in the Willamette Basin (Oregon State 2022) estimated that the majority of currently accessible habitat will become unsuitably warm within the next 50 years (North Santiam and South Santiam populations). ***More detailed information on climate change effects are described in Listing Factor E.***

2) Population-Specific Geographic Areas of Habitat Concern Since the 2016 5-Year Review

Specific geographic areas of concern include:

- High-head dams continue to limit habitat access (Ford 2022):
    - Detroit and Big Cliff dams on the North Santiam River
    - Foster and Green Peter dams on the South Santiam River
- Reaches immediately below high-head dams listed above (water quality, specifically TDG and temperature).

3) Population-specific Key Protective Measures and Major Restoration Actions Taken Since the 2016 5-Year Review

In the 2016 5-year review (NMFS 2016a), NMFS made recommendations for future recovery actions focused on habitat.

Specifically, we made the following recommendations regarding habitat in 2016:

- Implement effective passage programs and revision of reservoir operations that will promote access to historical spawning and rearing areas currently blocked by the large dams in the four historically most productive tributaries (North and South Santiam, Middle Fork Willamette, and McKenzie rivers).
- NMFS and ODFW should convene the Willamette River Coordination Team described in the UWR Recovery Plan (ODFW and NMFS 2011) and develop 1- and 3-year implementation plans to include as high priority action items:
    - Protection and restoration of floodplain connection and function, off-channel habitat, and channel migration processes to improve rearing habitat.
    - Removal of non-essential levees and other bank armoring structures along the Willamette River that reduce habitat complexity and therefore rearing habitat.
- Systematically review and analyze the amount of habitat addressed against those high priority upper Willamette River mainstem and tributary areas identified in the ODFW and NMFS 2011 Upper Willamette River Recovery Plan.

Since 2016, a diverse suite of habitat protection and restoration actions in the Upper Willamette Basin were completed. However, habitat access and effective fish passage programs have not been realized.

Modified spill to reduce water temperatures (North Santiam population) –

Operational temperature control has included spill of surface water when Detroit Reservoir elevation is above the spillway to reduce the volume of warm water that would be released in the fall when the dams are evacuated to provide flood risk reduction (USACE 2021). Beginning in 2021 under the Court-ordered injunction measures (U.S. District Court 2021), the use of the ROs were tested. The RO intakes are lower than the turbines, and can access cooler water until the reservoir 'turns over' and mixes the various water levels resulting in relatively uniform temperatures.

Habitat Restoration Actions –

- *South Santiam population*: The Willamette National Forest and Bureau of Land Management along with project partners continue to implement habitat restoration in the South Santiam, including:
    - The Cool-Soda Habitat Improvement Project. This long-term project includes large wood tipping to retain gravels and store cool water; replacement of undersize culverts to restore fish passage; and decommissioning unstable roads and limiting year-round vehicle access on others in order to decrease sediment inputs to the streams.
    - The Moose Creek Steelhead Habitat Improvement Project. In order to increase spawning gravels and create habitat, trees were tipped into the stream and many others placed to increase complexity.
    - Information on both accomplishments can be found at South Santiam Watershed Council – Sweet Home, Oregon (sswc.org)
- *Re-established Floodplain Connectivity* (all populations) - The Calapooia Watershed Council and Oregon Parks and Recreation have been working since 2020 on restoration at Bowers Rock State Park. This includes: upgrading culverts; improving connection between the Willamette River, an adjacent pond and Coon Creek to provide salmon and steelhead refugia; and invasive species control and native plant establishment (https://www.calapooia.org/).
- *Habitat Protection* (Molalla population) - In March of 2019, the Molalla River was designated a Wild and Scenic River, protecting 21 miles of the upper Molalla for preservation.

4) Key Regulatory Measures Since the 2016 5-Year Review

The UWR Recovery Plan (ODFW and NMFS 2011) and the previous 5-year review did identify regulatory mechanisms as a priority issue affecting salmon recovery for all of the populations in the UWR steelhead populations. 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 5 years. However, the implementation and effectiveness of regulatory mechanisms has not been adequately documented. ***See Listing Factor D: Inadequacy of Existing Regulatory Mechanisms in this document for details.***

5) Recommended Future Actions Over the Next 5 Years Toward Achieving Population Viability

- Provide effective passage and revise reservoir operations to promote access to historical spawning and rearing areas currently blocked by high-head dams (North Santiam and South Santiam populations).
- Revise dam operations to decrease water temperatures and TDG (North Santiam population).
- Restore riparian vegetation cover and re-establish connection to off-channel habitats and floodplains in the lower tributaries to provide suitable spawning and rearing habitat and cooler water temperatures (all populations).

Listing Factor A Conclusion

Throughout the Willamette River basin, listed UWR Chinook salmon and UWR steelhead have been impacted by urban and natural resource utilization through impaired water quality; degraded instream and floodplain habitats; and restricted fish passage. Information available since the last 5-year review indicates site specific improvements in habitat conditions throughout the range of UWR Chinook and UWR steelhead.

However, for both the UWR Chinook salmon ESU and UWR steelhead ESU, blocked access to historical upstream habitats and effective upstream and downstream passage are ongoing concerns, degraded water quality is an ongoing concern, and lack of floodplain connectivity is an ongoing concern. The lack of safe downstream passage for juveniles at high-head dams continues to be a primary factor limiting recovery for both species.

We remain concerned by lack of access to high quality upstream habitat due to the presence of the Willamette Project dams throughout the range of the steelhead DPS and spring-run Chinook salmon ESU. We also recognize degraded habitat conditions, particularly with regard to land use and development activities that affect the quality and accessibility of habitats and habitat-forming processes such as riparian condition and floodplain function, as well as water quality. Overall, despite site specific restoration, major passage concerns remain, while water quality and habitat quality continue to decline commensurate with increase in human resource demands, and risk to the listed UWR species persistence because of habitat degradation is increasing.

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

Harvest

UWR Steelhead

There is no retention of winter-run steelhead allowed in the upper Willamette River. Due to differences in return timing between native winter-run steelhead, introduced hatchery summer-run steelhead, and hatchery spring-run Chinook salmon the encounter rates for winter-run fish in the recreational fishery are low (ODFW and NMFS 2011). Steelhead were historically taken in tribal and non-tribal gillnet fisheries, and in recreational fisheries in the mainstem Columbia River and in tributaries. In the 1970s, retention of steelhead in non-tribal commercial fisheries was prohibited, and in the early 1990's, tributary recreational fisheries in the Willamette River adopted mark-selective regulations. Sport fishery mortality rates since ESA listing is estimated at 0-3 percent (ODFW and NMFS 2011; NMFS 2019b). There is additional incidental mortality in the commercial net fisheries for Chinook salmon and steelhead in the lower Columbia River. Tribal fisheries occur above Bonneville Dam and do not impact UWR steelhead (Ford 2022).

UWR Chinook Salmon

UWR spring-run Chinook salmon are taken in ocean fisheries primarily in Canada and Alaska. They are also taken in lower mainstem Columbia River commercial gillnet fisheries to some extent, and in recreational fisheries in the mainstem Columbia River and the Willamette River. These fisheries are directed at hatchery production, but historically could not discriminate between natural and hatchery fish. In the late 1990s, ODFW began mass-marking the hatchery production, and recreational fisheries within the Willamette River switched over to retention of only hatchery fish, with mandatory release of unmarked fish in 2001. Overall exploitation rates reflect this change in fisheries dropping from the 50-60 percent range in the 1980s and early 1990s to less than 30 percent since 2000 in both ocean and freshwater fisheries. Hooking mortalities are generally estimated at 10-13 percent, although river temperatures likely influence this rate. Illegal take of unmarked fish is thought to be low (Ford 2022).

Research and Monitoring

The quantity of UWR steelhead and Chinook salmon take authorized under ESA sections 10(a)(1)(A) and 4(d) for scientific research and monitoring remains low, and much of the work being conducted is done for the purpose of fulfilling state and Federal agency obligations under the ESA to ascertain the species’ status. Authorized mortality rates associated with scientific research and monitoring are generally capped at 0.5 percent across the West Coast Region for all listed salmonid ESUs and DPSs. As a result, the mortality levels that research causes are very low throughout the region. In addition, and as with all other listed salmonids, the effects research has on UWR steelhead and Chinook salmon are spread out over various reaches, tributaries, and areas across the species’ ranges, and thus no area or population is likely to experience a disproportionate amount of loss. Therefore, the research program, as a whole, has only a very small impact on overall population abundance, a similarly small impact on productivity, and no measurable effect on spatial structure or diversity.

Any time we seek to issue a permit for scientific research, we consult on the effects that the proposed work would have on each listed species' natural- and hatchery-origin components. However, because research has never been identified as a threat or a limiting factor for any listed species, and because most hatchery fish are considered excess to their species' recovery needs, examining the quantity of hatchery fish taken for scientific research would not inform our analysis of the threats to a species' recovery. Therefore, we only discuss the research-associated take of naturally-produced fish in these sections. From 2015 through 2019, researchers were approved to take a yearly average of fewer than 270 adult (<18 lethally) and fewer than 50,300 juvenile (<1,200 lethally) UWR Chinook salmon. During the same period, researchers were approved to take a yearly average of fewer than 290 adult (<10 lethally) and fewer than 7,900 juvenile (<210 lethally) UWR steelhead (NMFS APPS database; https://apps.nmfs.noaa.gov/).

For the vast majority of scientific research permits, history has shown that researchers generally take far fewer salmonids than the number authorized every year. From 2015 through 2019, actual yearly reported take averaged fewer than 5 adults for both species (two or fewer lethally for UWR Chinook salmon and zero lethally for UWR steelhead). During that same period, the yearly average reported juvenile take was less than 14,100 (<200 lethally) for UWR Chinook salmon and less than 200 (5 or fewer lethally) for UWR steelhead on average per year. The majority of the requested research take for juvenile UWR Chinook and steelhead has been (and is expected to continue to be) capture via screw traps, electrofishing units, beach seines, and at dam bypasses, with smaller numbers being captured via fyke nets, gill nets, minnow traps, hoop nets, trawls, hook and line angling, and other seines and nets. Adult take from both species has primarily been (and is expected to continue to be) requested as capture via adult fish ladders and weirs, with smaller numbers being captured by trawls, hook and line sampling, and other methods intended to target juveniles (NMFS APPS database; https://apps.nmfs.noaa.gov/). Our records indicate that mortality rates for screw traps are typically less than one percent and rates for backpack electrofishing are typically less than three percent. Unintentional mortality rates from seining, hand or hoop netting, fyke nets, minnow traps, weirs, and hook and line methods are also limited to no more than three percent. Also, a small number of adult fish may die as an unintended result of research because of interactions with trawl sampling equipment.

The quantity of take authorized over the past 5 years has decreased substantially for UWR Chinook salmon and remained relatively stable for UWR steelhead compared to the prior 5 years: the total take authorized for naturally produced adults and juveniles from 2015 through 2019 was 54 percent lower for UWR Chinook and 8 percent higher for UWR steelhead than the total take authorized from 2010 through 2014. Lethal take authorized from 2015 through 2019 was lower for both species, with 32 percent fewer mortalities for UWR Chinook and 7 percent fewer mortalities for UWR steelhead than what had been authorized from 2010 through 2014. Actual reported total take from 2015 through 2019 also decreased for UWR Chinook salmon, with reported non-lethal take decreasing 57 percent and lethal take decreasing 27 percent compared to the prior 5 years. For UWR steelhead the total non-lethal and lethal take reported from 2015 through 2019 more than doubled compared to the take reported from 2010 through 2014, although absolute numbers remain low; the non-lethal take that occurred over 5 years increased from a total of 393 to 967 individuals, and lethal take increased from a total of 10 to 25 individuals between these two time periods.

Overall, research impacts remain minimal due to the low mortality rates authorized under research permits and the fact that research is spread out geographically throughout the Willamette River Basin and Lower Columbia Basin. In addition, and because the authorized take and mortalities for UWR Chinook salmon have decreased and absolute numbers of UWR steelhead taken remain low, we conclude that the risk to the species' persistence because of utilization related to scientific studies remains essentially unchanged since the last 5-year review (NMFS 2016a).

Listing Factor B Conclusion

Harvest-related impacts on natural-origin spring-run Chinook salmon and steelhead remain low on all populations in the ESU and DPS. For UWR steelhead, there is no retention of winter-run steelhead in the upper Willamette River. In the mainstem Columbia River, sport fishery mortality rates are less than 2 percent (TAC 2023). Further, there is additional incidental mortality in the commercial net fisheries for Chinook salmon and steelhead in the lower Columbia River. The UWR Chinook salmon are taken in the lower mainstem Columbia River commercial gillnet fisheries and the recreational fisheries in the mainstem Columbia River and the Willamette River. Although these fisheries are directed at hatchery production, hooking mortalities are generally estimated at 10-13 percent and river temperatures likely influence this rate (Ford 2022). Overall, the risk to species persistence due to harvest remains low.

Scientific research impacts authorized through the West Coast Region have decreased for UWR Chinook salmon and remained relatively unchanged for UWR steelhead compared to the past 5 years (NMFS APPS database; https://apps.nmfs.noaa.gov/). Impacts from these sources of mortality are still not considered to be major limiting factors for this ESU or DPS. Therefore, we conclude that the risk to the species' persistence because of utilization related to scientific studies remains low and essentially unchanged since the 2016 5-year review (NMFS 2016a).

Listing Factor C: Disease or Predation

Predation

Predation on UWR Chinook salmon and UWR steelhead occurs among birds, other fishes, and marine mammals.

Birds

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 Biological Opinion (NMFS 2010), avian predation by Caspian terns and double-crested cormorants continue to affect Upper Willamette River Chinook salmon and steelhead.

Hostetter et al. (2021) found that body size affects susceptibility to tern predation. Yearling and subyearling Chinook salmon and yearling coho are smaller than steelhead, so predation rates have been relatively low. Estimated annual predation rates on UWR Chinook salmon by East Sand Island Caspian terns were consistently the lowest of all salmon ESUs evaluated, ranging from just 0.4% (0.1–1.5%) to 4.4% (3.2–6.7%) during 2007–2018. No estimates of predation rates are available for UWR steelhead because no or very few fish were available for analyses of predation rates (Roby et al 2021).

Marine Mammals

The four main marine mammal predators of salmonids in the eastern Pacific Ocean are harbor seals (*Phoca vitulina richardii*), fish-eating killer whales (*Orcinus orca*), California sea lions (*Zalophus californianus*), and Steller sea lions (*Eumetopias jubatus*).

Recent research suggests that predation pressure on ESA-listed salmon and steelhead from seals, sea lions, and killer whales has been increasing in the northeastern Pacific over the past few decades (Chasco et al. 2017). Models developed by Chasco et al. (2017) estimate that consumption of Chinook salmon in the eastern Pacific Ocean by three species of seals and sea lions and fish-eating (Resident) killer whales may have increased from 5 to 31.5 million individual salmon of varying ages since the 1970s, even as fishery harvest of Chinook salmon has declined during the same time period (Marshall et al 2016; Chasco et al 2017; Ohlberger 2019). This same modeling suggests that these increasing trends have continued across all regions of the northeastern Pacific. The potential predation impacts of specific marine mammal predators of ESA-listed salmonids on the West Coast are discussed individually below.

Pinnipeds

The three main seal and sea lion (pinniped) predators of ESA-listed salmonids in the eastern Pacific Ocean are harbor seals, California sea lions, and Steller sea lions. With the passing of the Marine Mammal Protection Act (MMPA) in 1972, these pinniped stocks along the West Coast of the United States have steadily increased in abundance (Carretta et al. 2019). With their increasing numbers and expanded geographical range marine mammals are consuming more Pacific salmon and steelhead, and some are having an adverse impact on some ESA-listed species (Chasco et al. 2017; Thomas et al. 2016; Marshall et al. 2016).

- California Sea Lion (United States Stock)

  The current population size of California sea lions (CSL) is 257,606 (Carretta et al. 2019). The stock is estimated to be approximately 40% above its maximum net productivity level (183,481 animals, Carretta et al. 2019), and has been determined to be within the its optimum sustainable population (OSP) range (Laake et al. 2018).

  In the Columbia Basin, estimates (number of seasonal animals) of CSL in the Columbia River Basin since 2016, based on surveys in the East Mooring Basin, Astoria, Oregon, for the years 2016 through 2023 have ranged from 580 animals (2022) to 3,834 animals (2016). However, in the last 5 years (2019-2023) the average number has been 784 animals. In the Columbia River Basin, CSL are generally present from December through April.

- Steller Sea Lion (Eastern United States Stock)

  The current population size of Steller sea lions (SSL) is 71,562 (52,139 non-pups and 19,423 pups) (Muto et al. 2019). Muto et al. (2017) conclude that the eastern stock of SSL is likely within its OSP range; however, NMFS has made no determination of its status relative to OSP.

  In the Columbia River Basin, the number of SSL at Bonneville Dam (number of seasonal animals) since 2016 has ranged from 45 animals (2020) to 66 animals (2018) with an average of 57 animals (2016-2022) (Tidwell et al. 2023).

- Harbor Seals (Oregon and Washington Coast Stock)

  The current population size of the Oregon and Washington Coast stock of harbor seals (HS) is 15,533 (Pearson and Jeffries 2018). This stock's status relative to OSP is unknown.

Management efforts are underway to reduce pinniped predation on Pacific salmon and steelhead in the Columbia River Basin, including the Willamette River. Since 2018, NMFS has issued authorizations under Marine Mammal Protection Act Section 120 and 120(f) to remove sea lions at Willamette Falls. Under the Section 120 authorization, the state removed (killed) 37 CSL. Under the Section 120(f) authorization, which is for the Columbia River Basin (not just Willamette Falls), the state and tribes have removed (killed) 68 CSL and 78 SSL. The current removal authorization expires on August 14, 2025.

Since implementation of the sea lion removal program, sea lion predation on UWR steelhead has fallen from a high of 24.7 percent in 2017 to a low of 0.9 percent in 2023, and sea lion predation on UWR Chinook salmon has fallen from a high of 9.1 percent in 2015 to a low of 1.9 percent in 2023.

Killer Whales

The only whale predators with notable impacts to ESA-listed salmon and steelhead in the northeastern Pacific Ocean are fish-eating killer whales (*Orcinus orca*), which include the Northern and Southern Resident populations. Resident killer whales consume a variety of fish species, but salmon are identified as their primary prey, particularly Chinook salmon (Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016; Hanson et al. 2021). Southern Resident Killer Whales (SRKWs) occur seasonally throughout the coastal waters off Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as Southeast Alaska (NMFS 2008d; Hanson et al. 2013). The number of Chinook salmon required to maintain the endangered SRKW population is estimated to be substantial, and large enough to warrant explicit treatment in endangered species recovery (Williams et al. 2011); this population of whales, however, has been declining. The SRKW population has declined from 83 individuals in 2016 to 74 in 2021 (Center for Whale Research 2021). SRKW are known to feed at and near the mouth of the Columbia, and critical habitat was designated for them along the Oregon and Washington Coasts in 2021 (86 FR 41668), affording greater recognition that salmonids originating in the Columbia River ESUs (primarily Chinook and chum) are also biological elements of their critical habitat.

Indigenous and Non-indigenous Fish, and Invasive Species

A variety of non-indigenous fishes to the Upper Willamette River recovery domain affect salmon and their ecosystems. A number of studies have concluded that many established non-indigenous species (e.g., largemouth bass, walleye, crappie and Northern Pikeminnow) 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). Largemouth bass, walleye, White crappie and Northern Pikeminnow are documented predators (Murphy et al 2021).

Non-indigenous fishes are the main consumers of juvenile salmonids in reservoirs. Construction of dams in the Willamette River created an unnatural overlap of coldwater fish and non-native warmwater fish. Researchers found evidence for predation by non-native warmwater fishes in Lookout Point and Hills Creek (Murphy et al. 2021) which further reduces the population abundance and productivity beyond that caused by unsafe dam passage (Murphy et. al 2021).

Disease

Disease rates since the 2016 5-year review are believed to have remained consistent. In the Columbia River estuary, the parasite *Ceratonova shasta* was detected in 9.6 percent and 12 percent of juvenile Chinook salmon in 1983 and 2001, respectively, and a strain of infectious haematopoietic necrosis virus (IHNV) was detected on along the Pacific Coast that originated in the Columbia River was reported in 2011 (Kurath 2012). Recent studies also suggest that a freshwater parasite, *Ceratonova shasta*, may be limiting the survival of juvenile chum salmon (WDFW and ODFW 2019). The prevalence of IHNV across the CRB and coastal watersheds of Washington and Oregon is currently reported as 29.1 percent in steelhead trout, 21.9 percent in sockeye salmon, and 20.1 percent in Chinook salmon (Breyta et al. 2017; Hernandez et al. 2021).

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 suppress salmonid immune systems and lead to increased disease rates.

Listing Factor C Conclusion

The prevalence of disease has not resulted in notable levels of injury or mortality since the 2016 5-year review, but it is reasonable to assume that warming trends have increased the risk of predation and disease (*C. shasta*) to ESU or DPS viability (pers. comm. J. Myers, NWFSC, 12/20/2021). The information available since the last 5-year review clearly indicates that predation by pinnipeds on Pacific salmon and steelhead continues to pose an adverse impact on the recovery of these ESA-listed fish species.

Evidence from recent studies on other Columbia Basin salmon species suggests that pinniped predation could be an important factor impacting the Upper Willamette River ESU and DPS. However, recent sea lion removal efforts in the Lower Columbia and Upper Willamette Rivers appear to have reduced pinniped predation pressure on Upper Willamette River species (see Listing Factor D). Avian predation also appears to continue to negatively impact juvenile salmon and steelhead survival in the lower Columbia River, and recent changes to avian predation management do not appear to have altered the overall impacts to these species. We, therefore, conclude that the risk to the species' persistence due to predation has not changed since the last 5-year review.

Disease rates have continued to fluctuate within the range observed in past review periods. We, therefore, conclude that the risk to the species' persistence due to disease has increased slightly since the last 5-year review.

Listing Factor D: Inadequacy of Existing Regulatory Mechanisms

Various federal, state, county, and tribal regulatory mechanisms are in place to reduce habitat loss and degradation caused by human use and development, as well as harvest impacts. For this 5-year review, we focus our analysis on regulatory mechanisms for habitat and for harvest that have either improved for UWR Chinook salmon or UWR steelhead, or that are still causing the most concern in terms of providing adequate protection for these species.

Habitat

Habitat concerns are described throughout Listing Factor A as having either a system-wide influence, or more localized influence, on the populations that comprise the two species. The habitat conditions across all habitat components (tributaries, mainstems, estuary, and marine) necessary to recover listed UWR Chinook salmon and UWR steelhead are influenced by a wide array of federal, state, and local regulatory mechanisms. The influence of regulatory mechanisms on listed salmonids and their habitat resources is largely based on the underlying ownership of the land and water resources as federal, state, or private holdings.

One factor affecting habitat conditions across all land or water ownerships is climate change, the effects of which are discussed under Section 2.3.2.5 (Listing Factor E: Other natural or manmade factors affecting its continued existence). We reviewed summaries of national and international regulations and agreements governing greenhouse gas emissions, which indicate that while the number and efficacy of such mechanisms have increased in recent years there has not yet been a substantial deviation in global emissions from the past trend, and upscaling and acceleration of far-reaching, multilevel, and cross-sectoral climate mitigation will be needed to reduce future climate-related risks (IPCC 2021; IPCC 2022). These findings suggest that current regulatory mechanisms, both in the U.S. and internationally, are not currently adequate to address the rate at which climate change is negatively impacting habitat conditions for many ESA-listed salmon and steelhead.

According to NMFS' Geographic Information System (GIS) database, the majority of the upper Willamette River basin is in private ownership (61 percent), with the remaining 39 percent under Federal ownership [approximately 33 percent U.S. Forest Service (USFS) and 5 percent Bureau of Land Management (BLM) with small percentage ownership by the Bureau of Indian Affairs, Bureau of Reclamation, Department of Defense, and FWS]. Most of the landscape in Federal ownership is high quality USFS headwater habitats located in the higher elevations of the Cascade and Coast ranges and vital to the conservation of the UWR Chinook salmon ESU and UWR steelhead DPS.

Regulatory Mechanisms Resulting in Adequate or Improved Protection

New information available since the 2016 5-year review indicates that the adequacy of some habitat regulatory mechanisms has improved and has increased protection of UWR Chinook and steelhead. These include both federal and state land and water management regulatory mechanisms:

1. Northwest Forest Plan

The Northwest Forest Plan (NWFP) is a series of federal policies and guidelines governing land use on federal lands in the Pacific Northwest region of the United States (USDA and USDI 1994). It covers 10 million hectares within Western Oregon and Washington and a small part of Northern California. A retrospective on 25 years of the Northwest Forest Plan reviewed the scientific literature published since the inception of the NWFP. It reports several key findings, including that conservation of at-risk species within national forests is challenging in the face of threats that are beyond the control of federal managers, even while the NWFP made substantial progress toward meeting several of its goals. The NWFP protected remaining old-growth forests from clearcutting and enabled growth and development of vegetation conditions to support threatened species, including salmonids and riparian-associated organisms (Spies et al. 2019). However, the number of ESA-listed salmonid species and population units has increased (Reeves et al. 2018). Management of riparian and stream habitat under this plan offers greater protection for UWR Chinook salmon and steelhead on federal lands than under state regulatory mechanisms.

2. BLM Revised Resource Management Plan

The 2016 BLM Resource Management Plan (RMP) governing management of 2.6 million acres of Western Oregon included highly protective hydrology and riparian reserve management direction for protection of water quality and fish. Such action included 120’ no-touch inner buffers on all perennial streams, and additional high protections for intermittent streams based on a key watershed strategy. In addition, the BLM has been implementing an aquatic habitat restoration program; although the number of restoration projects has been much lower than originally anticipated.

In 2019, a District of Columbia district court found that the 2016 BLM RMP violated the Oregon and California Railroad and Coos Bay Wagon Road Grant Lands Act (“O&C Act”). *American Forest Resource Council v. Hammond*, 422 F. Supp. 3d 184 (D.D.C. 2019), appeals docketed, No. 20-5008 (D.C. Cir. Jan. 24, 2020). In November 2021, the court vacated the 2016 RMP but the court left it in place until BLM develops and implements a revised RMP “consistent with the O&C Act and [the] Court’s Memorandum Opinions.” *American Forest Resource Council v. Nedd*, No. CV 15-01419 (RJL), 2021 WL 6692032, at *8 (D.D.C. Nov. 19, 2021). As a result, how the BLM will manage the riparian reserves into the future is now uncertain.

3. Oregon Fish Passage Guidance (ORS 509.585)

ODFW developed new fish passage policy guidance in July 2021 and project review procedures for instream habitat restoration projects designed to specifically mimic instream natural habitat features created by beavers and beaver dams. The primary goal of this new policy guidance bulletin is to streamline and expedite the state’s fish passage review and approval procedures for instream habitat restoration projects designed and implemented to specifically mimic natural habitat features created by beaver and beaver dams. This guidance is expected to benefit habitat complexity for UWR Chinook salmon and UWR steelhead in Oregon streams.

4. Willamette Wildlife Mitigation Program

Implementation of the 25-year 2010 Memorandum of Agreement (MOA) between the State of Oregon and the Bonneville Power Administration (BPA) to permanently settle wildlife mitigation responsibilities for the Willamette Project, under which BPA agreed to acquire at least an additional 16,880 acres of wildlife mitigation property and to protect 26,537 acres (or more) by the end of 2025, is currently underway. Under the MOA, at least 10% of BPA funding dollars provide habitat protection and restoration with significant fish benefits for UWR Chinook salmon and UWR steelhead.

Between 2017 and 2021, the Willamette Wildlife Mitigation Program acquired and supported restoration of 316 riparian and flowing water acres of that improved habitat for UWR Chinook salmon and UWR steelhead.

5. State Water Management

In December 2017, the Water Resources Commission adopted Oregon’s Integrated Water Resources Strategy, a framework for better understanding and meeting instream and out-of-stream water needs, including water quantity, water quality, and ecosystem needs. The IWRS 2017-2022 progress report highlights clean water restoration plans developed for 5,000 miles of impaired streams and 187,000 acres of impaired waterbodies throughout the state; support for the removal of 96 fish passage barriers; and 2000+ investigations of water use compliance. Thus, improvements in flows and water quality are being realized through the implementation of the new strategy.

Regulatory Mechanisms Resulting in Inadequate or Decreased Protection

Although some habitat regulatory mechanisms have improved, we remain concerned about the adequacy of existing habitat regulatory mechanisms with regard to passage at high head dams, water quality and habitat complexity. The following programs comprise the most significant of these regulatory mechanisms negatively affecting UWR species.

1. Endangered Species Act Section 7 Biological Opinions

Willamette River Basin Flood Control and Hydroelectric Project (Willamette Project) 2008 Biological Opinion

The Willamette River Basin Flood Control and Hydroelectric Project in the Willamette River subbasin (the Willamette Project) is operated and maintained by the U.S. Army Corps of Engineers (USACE) and includes 13 multipurpose dams and reservoirs, as well as about 43 miles of revetments, in the upper Willamette River basin and subbasins. Bonneville Power Administration (BPA) markets power generated at some of the Willamette Project dams, and the U.S. Bureau of Reclamation (USBOR) sells a portion of the water stored in Willamette Project reservoirs for irrigation purposes. In 2008, NMFS issued a Biological Opinion (NMFS 2008b) on the impact of the Willamette Project on species listed for protection under the Endangered Species Act and proposed an RPA with additional measures which, combined with the Proposed Action, would allow for survival of the species with an adequate potential for recovery, and avoid destruction or modification of critical habitat. These RPA measures include coordination, flow management, a water contract program, fish passage, water quality, hatcheries, habitat, and research, and a temperature control tower at Cougar Dam (USACE 2014). While some progress has been made towards adult Chinook and steelhead upriver passage, implementation of the RPAs by the USACE has been slow to be achieved – most notably lack of permanent downstream passage structure operation.

In March 2018, conservation groups sued the USACE and NMFS for Endangered Species Act violations related to the implementation of the 2008 Opinion. After finding that the agencies needed to reinitiate consultation, in September 2021 the U.S. District Court for Oregon issued interim measures the USACE must do to “sufficiently mitigate irreparable harm” to UWR Chinook and steelhead while working with NMFS to prepare a new opinion. The array of measures ordered by the Court includes expedited plans for fish passage and out plantings, prioritizing dam operations such as increased spill and cool water discharges; and deep reservoir drawdowns at Detroit, Cougar, Fall Creek, and Lookout Point dams to aid fish passage.

Inadequate implementation of the 2008 Opinion and its mitigation measures for UWR Chinook salmon and UWR steelhead has led to their delayed recovery. This ESA consultation mechanism therefore continued to be inadequate to fully reduce the risks posed by the Willamette Project to the survival and recovery of these species. However, implementation of new interim measures and reinitiation of the Biological Opinion may eventually improve the adequacy of this mechanism depending on the outcomes of the consultation.[3]

2. Oregon Forest Practices Act and Forest Practice Rules

Oregon Forest Practices Act stream rules were amended in 2017 for southwestern Oregon to increase buffer widths by 10 feet and retain more trees on private forestlands (Oregon Administrative Rule 629-645-0000). These rules became effective July 1, 2017, and might improve water quality by increasing shade and reducing sedimentation. Some of the highest quality UWR Chinook salmon and UWR steelhead rearing habitat is on private forestlands, making these rule changes particularly important for salmon survival and recovery. However, we remain concerned that rules regarding road maintenance and density on private forest lands are still not adequate to address these activities’ ongoing impacts on water quality. While buffer widths were recently increased it is also not yet known whether they are now sufficient to adequately protect water quality in UWR steelhead and UWR Chinook salmon critical habitat.

3. Oregon Water Quality Regulation and Management

Water quality management occurs in Oregon pursuant to a combination of state and federal regulation. The Federal Clean Water Act (CWA) addresses the development and implementation of water quality standards, the development of Total Maximum Daily Loads (TMDLs)[4], filling of wetlands, point source permitting, the regulation of stormwater, and other provisions related to the protection of U.S. waters. The U.S. Environmental Protection Agency (EPA) has delegated CWA implementation to the State of Oregon, which sets water quality standards to protect

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[3] USACE Willamette Valley System Operations and Maintenance Draft Programmatic Environmental Impact Statement. Located here: https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll7/id/22208

[4] 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.

beneficial uses, which include several categories of salmonid use. Together the State and Federal Clean Water Acts regulate the level of pollution within streams and rivers in Oregon.

Oregon has a water quality certification program (CWA section 401) that reviews projects that will discharge dredged or fill materials into waters of the U.S., and issues certification 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 under section 402 of the CWA for discharges from industrial point sources, waste-water treatment plants, construction sites, and municipal stormwater conveyances, with established parameters for the allowance of mixing zones if the discharges constituent(s) do(es) not meet existing water quality standards at the 'end of the pipe.' TMDLs are prepared to develop actions actions to reduce concentrations of specific contaminants or natural constituents recognized within a waterbody that fail to meet water quality standards in repeated testing.[5] 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;[6] or physical measures of water such as temperature for which numeric water quality standards have been developed.

The USACE regulates dredging and filling in the waters of the United States through the Federal CWA Section 404 Program. The USACE program is implemented through the issuance of a variety of individual, nationwide, and emergency permits. Permitted activities should not "cause or contribute to significant degradation of the waters of the United States." A variety of factors, including inadequate staffing, training, and in some cases regulatory limitations on land uses (e.g., agricultural activities) and policy direction, resulted in ineffective protection of aquatic habitats important to migrating, spawning, or rearing Chinook salmon and steelhead. The deficiencies of the current program are particularly acute during large-scale flooding events, such as those associated with El Niño conditions, which can put additional strain on the administration of the Clean Water Act Section 404 and 401 programs. The Clean Water Act is not effectively protecting fishery resources, particularly regarding non-point sources of pollution. USACE guidelines do not specify a methodology for assessing cumulative impacts or how much weight to assign them in decision-making. USACE continues to lack a comprehensive and consistent process to address the cumulative effects of the continued development of waterfront, riverine, coastal, and wetland properties.

The Federal government has a "no net wetland loss" policy under the Clean Water Act; however, in California, the land use regulation of coastal wetlands has been most directly administered under the State of Oregon's Federally certified Coastal Zone Management Program. However,

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[5] 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.

[6] The Toxic Substances Control Act (TSCA) of 1976 provides the U.S. Environmental Protection Agency 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.

the Federal government's "no net wetland loss" regulations have been largely ineffective at preserving the amount and, more importantly, the ecological functions of wetland habitat in the U.S. (Dahl and Stedman 2013).

The various state and federal water quality regulatory programs have not been sufficient to prevent pollution of the Upper Willamette 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 enter the Columbia River in wastewater treatment plant effluent, stormwater runoff, and nonpoint source pollution remains a growing concern (Morace 2012; Nilsen and Morace 2014).

4. Section 10 Rivers and Harbors Act

Often executed concurrently with section 404 of the Clean Water Act (discussed above) the Rivers and Harbors Act of 1899 (33 U.S.C. 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. This section authorizes the USACE to permit construction of any structure in or over any navigable water of the United States, or any other work affecting the course, location, condition, or physical capacity of such waters. It includes, without limitation, any wharf, dolphin, weir, boom breakwater, jetty, groin, bank protection (e.g. riprap, revetment, bulkhead), mooring structures such as pilings, aerial or subaqueous power transmission lines, intake or outfall pipes, permanently moored floating vessel, tunnel, artificial canal, boat ramp, aids to navigation, and any other permanent, or semi-permanent obstacle or obstruction. These structures generally have a design life of 30-75 years and constitute a long-term detrimental modification to rearing and migration habitat values in UWR and its tributaries.

5. National Flood Insurance Program (NFIP)

The NFIP is a federal insurance benefits program that extends access to federal monies or other benefits, such as federally backed homeownership loans for dwellings located in floodplains, flood disaster funds, and subsidized flood insurance, in exchange for communities adopting local land use and development criteria consistent with federally established minimum standards. Under this program, development within floodplains continues to be a concern because it allows development of private property in floodplains without mitigation for impacts on natural habitat values.

Nearly all west-coast salmonid species, including the 27 of the 28 species listed under the ESA, are negatively affected by an overall loss of floodplain habitat connectivity and floodplain habitat complexity; the reduction and degradation in total habitat through the loss of habitat complexity has progressed over decades as flood control and wetland filling occurred to support agriculture, silviculture, or conversion of natural floodplains to urbanized uses. Loss of habitat through conversion was identified among the factors for decline. "NMFS believes altering and hardening stream banks, removing riparian vegetation, constricting channels and flood plains, and regulating flows are primary causes of anadromous fish declines" (65 FR 42421), "Activities affecting this habitat include…wetland and floodplain alteration" 64 FR 50394).

Development proceeding in compliance with NFIP minimum standards ultimately results in impacts to floodplain connectivity, flood storage/inundation, hydrology, and to habitat forming processes. Development consequences of levees, stream bank armoring, stream channel alteration projects, and floodplain fill, combine to prevent streams from functioning properly and result in degraded habitat. Most communities (counties, towns, cities) in Washington and Oregon are NFIP participating communities, applying the NFIP minimum criteria. For this reason, it is important to note that, where it has been analyzed, floodplain development that occurs consistently with the NFIP's minimum criteria has been found to jeopardize 19 listed anadromous fish species (Chinook salmon, steelhead, chum salmon, coho salmon, sockeye salmon, green sturgeon, eulachon) and the Southern Resident killer whale DPS (NMFS 2008d; NMFS 2016b). The Reasonable and Prudent Alternative provided in NMFS 2016b (for Columbia River species, OC coho, and SRKW) has not yet been implemented.

6. Beaver Management in Oregon

Beaver removal in Oregon over the last 250 years has resulted in profound changes to stream and wetland conditions. Some of the characteristics most pertinent to salmonids include channel simplification, loss of wetted area, increased water velocity, decreased invertebrate production, and decreased floodplain connection (Naiman et al. 1988). While beaver populations have rebounded the last few decades (Pollock et al. 2017), the effects of their removal persist throughout Oregon. Currently, it is illegal for anyone to move beaver in Oregon without a permit from ODFW, (ORS 497.308) and ODFW has published beaver relocation guidelines relative to beavers and their dams on private property at https://www.dfw.state.or.us/wildlife/living_with/docs/beaver.pdf

However, on private land in Oregon, landowners may lethally remove beaver on sight, without a permit from ODFW or requirement to report such removal. ODFW also manages a trapping season for beavers. On public land, beaver are classified as a protected furbearer (ORS 496.004 and OAR 635-050- 0050). ODFW requires a permit to take protected furbearers. For beaver, this permit includes the designated trapping season, but does not limit the numbers of beaver taken. New legislation introduced in January 2024 (HB 3464) instructs the State Fish and Wildlife Commission to adopt new rules related to the taking of beavers on or before the end of the calendar year.

Beaver dams and ponds create habitat complexity that serves all UWR Chinook salmon and UWR steelhead populations. All current protective efforts in Oregon are voluntary, and there is low certainty they will be fully implemented. Beaver removal and beaver dam removal under Oregon law impair natural establishment of complex instream habitat conditions that would promote additional rearing habitat for all salmonid species.

Harvest

1. Pacific Salmon Treaty

Ocean fisheries in Southeast Alaska, British Columbia, and off the coasts of Washington and most of Oregon are managed under the Pacific Salmon Treaty (PST), which was initially ratified by the United States and Canada in 1985. The PST is implemented by the Pacific Salmon Commission, which negotiates, facilitates, and monitors the implementation of fishing regimes developed under the treaty. In the United States south of the Canadian border, the Pacific Fisheries Management Council (PFMC) is responsible for regulating regimes agreed to by the

Pacific Salmon Commission, while the North Pacific Fisheries Management Council (NPFMC) has jurisdiction for ocean fisheries off Alaska.

2. Pacific Fisheries Management Council

Since 1977, salmon fisheries in the exclusive economic zone (EEZ) (three to 200 miles offshore) off Washington, Oregon, and California have been managed under salmon Fishery Management Plans (FMPs) of the PFMC. While all species of salmon fall under the jurisdiction of the current plan (PFMC 2021), the FMP currently contains fishery management objectives only for Chinook salmon, coho, pink (odd-numbered years only), and any salmon species listed under the ESA that is measurably impacted by PFMC fisheries.

The effects of the salmon fisheries on ESA listed salmonids is limited by fishery management measures implemented under the MSA, as well as terms and conditions and reasonable and prudent alternatives developed by NMFS through consultations under ESA section 7. These measures 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 annually issues a guidance letter to the PFMC reflecting the most current information for developing management objectives (e.g., Thom 2021).

3. U.S. v. Oregon Management Agreement

Pursuant to a September 1, 1983, order of the U.S. District Court, the allocation of harvest in the Columbia River was established under the Columbia River Fish Management Plan and implemented in 1988 by the parties to U.S. v. Oregon. Since 2008, 10-year management agreements have been negotiated through U.S. v. Oregon (NMFS 2008c, 2018). Harvest impacts on ESA-listed species in Columbia River commercial, recreational, and treaty fisheries are currently managed under the 2018 to 2027 U.S. v. Oregon Management Agreement (NMFS 2018). The parties to the agreement are the United States; the states of Oregon, Washington, and Idaho; and the Columbia River Treaty Tribes (the Warm Springs, Yakama, Nez Perce, Umatilla, and Shoshone-Bannock Tribes). The agreement sets harvest rate limits on fisheries that impact ESA-listed species, and these harvest limits are managed annually by the fisheries co-managers (TAC 2015, 2016, 2017, 2018, 2019, 2020). The current U.S. v. Oregon Management Agreement has, on average, maintained reduced impacts of fisheries on the Willamette River species as these fish interact with fisheries in the lower Columbia River (TAC 2015, 2016, 2017, 2018, 2019, 2020), and we expect that to continue with the abundance-based framework incorporated into the regulatory regime. The current Management Agreement runs through 2027. As a signatory to the current Agreement, NMFS participates in the US v. Oregon forum in order to monitor impacts to listed species and to advise the parties as they seek to manage these impacts.

Listing Factor D Conclusion

When taken together, regulatory mechanisms for water quantity, forest practices, fish passage in tributary streams, harvest, and floodplain restoration activities in the Upper Willamette have slightly decreased the risk of these threats to the Upper Willamette River species’ persistence since the last 5-year review.

However, despite this slight improvement, there remain concerns regarding continued risk from the inadequacy of other regulatory mechanisms to protect these species and their habitats, such as the CWA, slowed implementation of the NFIP, and implementation of the ESA to limit the impacts of the Corps' Willamette Project and improve high head dam passage. These current regulatory inadequacies, and the fact that future climate conditions will make key regulatory mechanisms less effective at protecting suitable water quality and passage conditions, suggest that risk to these species' persistence due to inadequate regulatory mechanisms is increasing.

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

Climate Change

Major ecological realignments are already occurring in response to climate change (Crozier et al. 2019). As observed by Seigel and Crozier in 2019, long-term trends in warming have continued at global, national and regional scales. Globally, 2014-2018 were the 5 warmest years on record, both on land and in the ocean (2018 was the 4th warmest). Events such as the 2013-2016 marine heatwave (Jacox et al. 2018) have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring et al. 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality. These two factors are often examined in isolation, but likely have interacting effects on ecosystem function (Seigel and Crozier 2019). Conservation strategies now need to account for geographical patterns in traits sensitive to climate change, as well as climate threats to species-level diversity.

To provide such information, Crozier et al. 2019, conducted a climate vulnerability assessment that included all anadromous Pacific salmon and steelhead (*Oncorhynchus* spp.) population units listed under the U.S. Endangered Species Act. Using an expert-based scoring system, they ranked 20 attributes for the 28 listed units and 5 additional units. Attributes captured biological sensitivity, or the strength of linkages between each listing unit and the present climate; climate exposure, or the magnitude of projected change in local environmental conditions; and adaptive capacity, or the ability to modify phenotypes to cope with new climatic conditions. Each listing unit was then assigned one of four vulnerability categories. Five Chinook, one coho, and one sockeye salmon DPSs ranked very high in total vulnerability to climate change due to a combination of high and very high scores for sensitivity and exposure. Bootstrap analyses indicated that two additional DPSs, Southern Oregon/Northern California Coast coho and Mid-Columbia spring-run Chinook, were borderline between high and very high. Among species, Chinook salmon had the highest vulnerability rankings overall (mostly very high and high rankings), followed by coho and sockeye. Steelhead and chum DPS scores were generally lower and nearly equally spread across high and moderate vulnerability categories. Units ranked most vulnerable overall were the California Central Valley Chinook, California and southern Oregon coho, the Snake River sockeye, interior Columbia Spring Chinook, and Willamette River Basin Spring Chinook (Crozier et al. 2019).

Projected Climate Change

Climate change is systemic, influencing ocean temperatures, ocean salinity, ocean acidity, and the composition and presence of a vast array of oceanic species. Other systems are also being influenced by changing climatic conditions. Seigel and Crozier (2019) provide the following observations: As stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species. Changes in flow regimes may alter the amount of habitat available for spawning. This could lead to a restriction in the distribution of juveniles, further decreasing productivity through reduced density dependence.

Along with warming stream temperatures and concerns about sufficient groundwater to recharge streams, Seigel and Crozier (2019) observe that a newer study projects nearly complete loss of existing tidal wetlands along the U.S. West Coast due to sea-level rise (Thorne et al. 2018). California and Oregon showed the greatest threat to tidal wetlands (100 percent), while 68 percent of Washington tidal wetlands are expected to be submerged. Coastal development and steep topography prevent horizontal migration of most wetlands, causing the net contraction of this crucial habitat.

Updated projections of change are similar to or greater than previous projections. NMFS is increasingly confident in our projections because every year brings stronger validation of previous predictions in both physical and biological realms. Actions that retain and restore habitat complexity, increase access to climate refuges (both flow and temperature), and improve growth opportunities in both freshwater and marine environments are strongly advocated in the recent literature (Seigel and Crozier 2019).

Impacts on Salmon

As Seigel and Crozier (2019) describe, for salmon, correlations between freshwater and marine survival have important consequences for population dynamics. Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation, and river discharge) has increased in spatial scale, causing the highest levels of synchrony in the last 250 years (Black et al. 2018). Salmon productivity (recruits/spawner) has also become more synchronized across 24 wild Chinook populations from Oregon to the Yukon (Dorner et al. 2018). Contrary to previous summaries, which found that northern and southern stocks had inverse responses to ocean temperatures, the current analysis found positive pairwise correlations between nearly all stocks. Although a few populations tended to be less correlated with others, there was no latitudinal trend in correlations. Nearly all listing units faced high exposures to projected increases in stream temperature, sea surface temperature, and ocean acidification, but other aspects of exposure peaked in particular regions. Anthropogenic factors, especially migration barriers, habitat degradation, and hatchery influence, have reduced the adaptive capacity of most steelhead and salmon populations. (Crozier et al. 2019).

At the individual scale, 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 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).

At the population level, the ability of organisms to genetically adapt to climate change depends on how selection on multiple traits interact and whether those traits are linked genetically. Upper thermal limits and hypoxia tolerance are likely to be important traits in determining the effects of climate change on fish populations. For example, Healy et al. (2018) compared genetic diversity associated with thermal and hypoxia tolerance in two sub-species of Atlantic killifish, *Fundulus heteroclitus*, which have previously been shown to differ in these traits. Single nucleotide polymorphisms (SNPs) were found related to each trait independently, but none were shared between both traits. These results suggest that, at least in Atlantic killifish, thermal and hypoxia tolerance are genetically independent traits. At present, more than half of all anadromous Pacific salmon and steelhead DPSs remaining in the contiguous U.S. are threatened with extinction. Suboptimal climate conditions within the historical range of climate variability have been associated with detectable declines in many of these DPSs, highlighting their sensitivities to climatic drivers. In some cases, the synergistic effects of suboptimal climate conditions and intense anthropogenic stressors precipitated the population declines that led to these listing decisions (Crozier et al. 2019).

Another potential limitation in the ability of salmon populations to adapt to climate change is the reduced level of existing genetic diversity compared to historic levels. Johnson et al. (2018) compared genetic variation in Chinook salmon from the Columbia River basin between contemporary and ancient samples. A total of 84 samples determined to be Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples. Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes and reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook from the mid-Columbia than those from the Snake River basin.

Relative to sockeye, three or four-year cycles are common in sockeye salmon stocks, with returns varying by an order of magnitude or more between high and low points in the cycles. Longer-term cycles are also apparent but less regular. These seem to be associated with changes in ocean conditions that affect survival during the feeding migration (Phillips and Perez-Ramirez, eds 2018); accordingly, shifting ocean conditions may shift the range of the highs and lows downward.

Terrestrial and Ocean Conditions and Marine Survival

The following is excerpted from Seigel and Crozier (2019), who present a review of recent scientific literature evaluating the effects of climate change.

“Cooper et al. (2018), examined whether the magnitude of low river flows in the western U.S., which generally occur in September or October, are driven more by summer conditions or the prior winter’s precipitation. They found that while low flows were more sensitive to summer evaporative demand than to winter precipitation, interannual variability in winter precipitation was greater. Malek et al. (2018) predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation. Their results suggest that low summer flows are likely to become lower, more variable, and less predictable."

The effect of climate change on ground water availability is likely to be uneven. Sridhar et al. (2018) coupled a surface-flow model with a ground-flow model to improve predictions of surface water availability with climate change in the Snake River Basin. Combining the VIC and MODFLOW models (VIC-MF), they predicted flow for 1986-2042. Comparisons with historical data show improved performance of the combined model over the VIC model alone. Projections using RCP 4.5 and 8.5 emission scenarios suggested an increase in water table heights in downstream areas of the basin and a decrease in upstream areas. Such assessments will help stakeholders manage water supplies more sustainably.

Forests

Climate change will impact forests of the western U.S., which dominate the landscape of many watersheds in the region. Forests are already showing evidence of increased drought severity, forest fire, and insect outbreak. Additionally, climate change will affect tree reproduction, growth, and phenology, which will lead to spatial shifts in vegetation. Halofsky et al. (2018b) projected that the largest changes will occur at low- and high-elevation forests, with expansion of low-elevation dry forests and diminishing high-elevation cold forests and subalpine habitats. Halofsky et al. (2018a) also assessed climate adaptation strategies for forest management in the region.

Forest fires affect salmon streams by altering sediment load, channel structure, and stream temperature through the removal of canopy. Holden et al. (2018) examined environmental factors contributing to observed increases in the extent of forest fires throughout the western U.S. They found strong correlations between the number of dry-season rainy days and the annual extent of forest fires, as well as a significant decline in the number of dry-season rainy days over the study period (1984-2015). Consequently, predicted decreases in dry-season precipitation, combined with increases in air temperature, will likely contribute to the existing trend of more extensive and severe forest fires.

Beyond environmental factors, management practices have left forests more dense and less diverse, which increases vulnerability to fire damage. Attempting to restore forest composition to a state more similar to historical conditions would likely increase fire resiliency, though methods to do so are often contentious (Johnston et al. 2018).

Agne et al. (2018) reviewed the literature on insect outbreaks and other pathogens affecting coastal Douglas-fir forests in the Pacific Northwest and examined how future climate change may influence disturbance ecology. They suggest that Douglas-fir beetle and black stain root disease could become more prevalent with climate change, while other pathogens will be more affected by management practices. Agne et al. (2018) also suggested that due to complex interacting effects of disturbance and disease, climate impacts will differ by region and forest type."

Freshwater environments

As cited in Seigel and Crozier (2019), Isaak et al. (2018) examined recent trends in stream temperature across the Western U.S. using a large regional dataset. Stream warming trends paralleled changes in air temperature and were pervasive during the low-water warm seasons of 1996-2015 (0.18-0.35°C/decade) and 1976-2015 (0.14-0.27°C/decade). Their results show how continued warming will likely affect the cumulative temperature exposure of migrating sockeye salmon (*O. nerka*) and the availability of suitable habitat for brown trout (*Salmo trutta*) and rainbow trout (*O. mykiss*). Isaak et al. (2018) concluded that most stream habitats will likely remain suitable for salmonids in the near future, with some becoming too warm.

Streams with intact riparian corridors that lie in mountainous terrain are likely to be more resilient to changes in air temperature. These areas may provide refuge from climate change for a number of species, including Pacific salmon. Krosby et al. (2018) identified potential stream refugia throughout the Pacific Northwest based on a suite of features thought to reflect the ability of streams to serve as such refuges. Analyzed features include large temperature gradients, high canopy cover, large relative stream width, low exposure to solar radiation, and low levels of human modification. They created an index of refuge potential for all streams in the region, with mountain area streams scoring highest. Flat lowland areas, which commonly contain migration corridors, were generally scored lowest, and thus were prioritized for conservation and restoration.

Seigel and Crozier (2019) express concern that, for some salmon populations, climate change may drive mismatches between juvenile arrival timing and prey availability in the marine environment. However, phenological diversity can contribute to metapopulation-level resilience by reducing the risk of a complete mismatch. Carr-Harris et al. (2018) explored the phenological diversity of marine migration timing in relation to zooplankton prey for sockeye salmon (*O. nerka*) from the Skeena River of Canada. They found that sockeye migrated over a period of more than 50 days. Populations from higher elevation and further inland streams arrived in the estuary later, and different populations encountered distinct prey fields. They recommended that managers maintain and augment such life-history diversity.

Marine survival

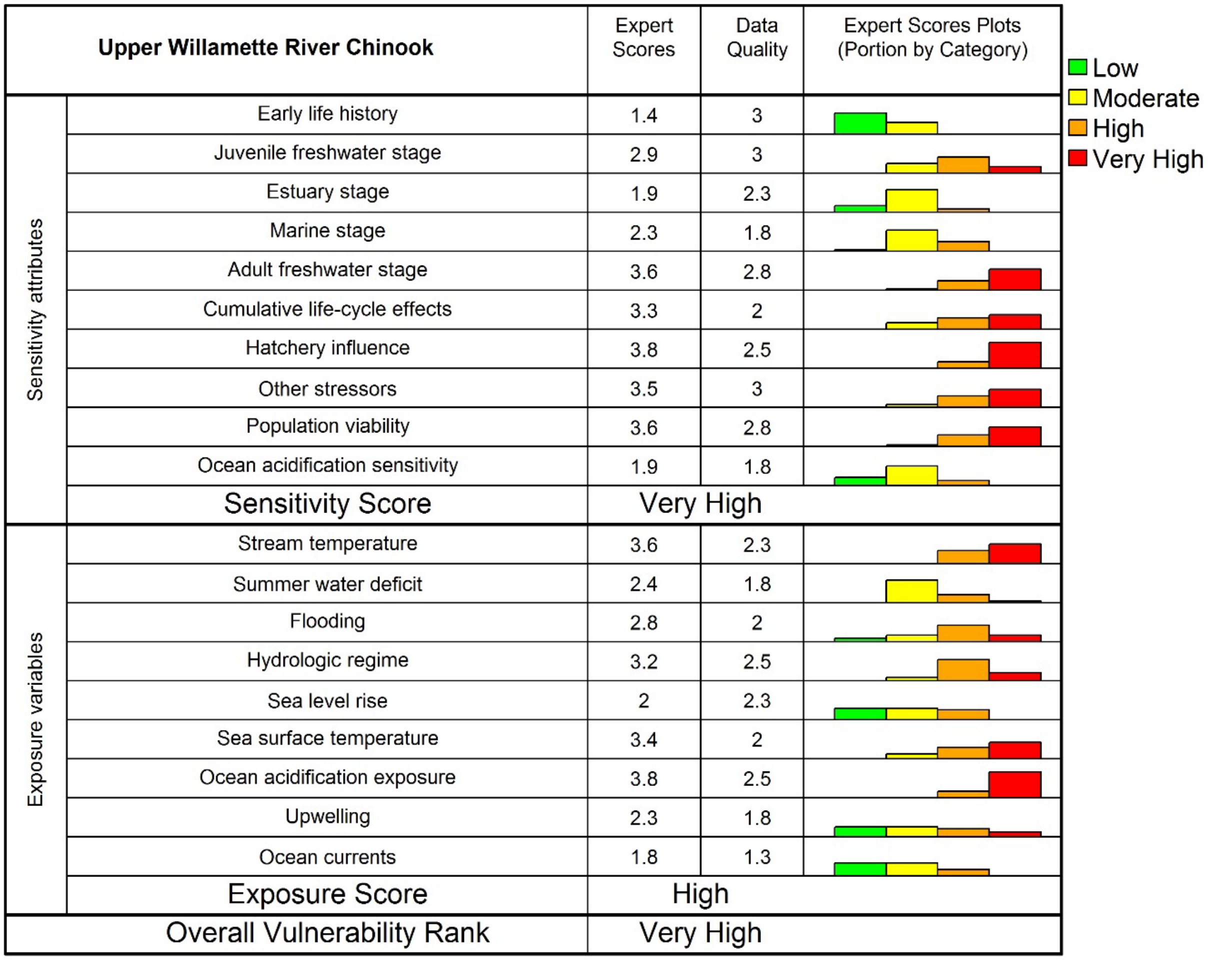
Marine survival of salmonids is affected by a complex array of factors, including prey abundance, predator interactions, and the physical condition of salmon within the marine environment. Seigel and Crozier 2019, observe that changes in marine temperature are likely to have a number of physiological consequences on fishes themselves. For example, in a study of small planktivorous fish, Gliwicz et al. 2018 found that higher ambient temperatures increased the distance at which fish reacted to prey. Numerous fish species (including many tuna and sharks) demonstrate regional endothermy, which in many cases augments eyesight by warming the retinas. However, Gliwicz et al. 2018 suggest that ambient temperatures can have a similar effect on fish that do not demonstrate this trait. Climate change is likely to reduce the availability of biologically essential omega-3 fatty acids produced by phytoplankton in marine ecosystems. Loss of these lipids may induce cascading trophic effects, with distinct impacts on different species depending on compensatory mechanisms (Gourtay et al. 2018). Reproduction rates of many marine fish species are also likely to be altered with temperature (Veilleux et al. 2018).

The ecological consequences of these effects and their interactions add complexity to predictions of climate change impacts in marine ecosystems.

Species Specific Climate Effects (from Crozier et al. 2019)

Climate Effects on Abundance and Distribution of Upper Willamette River Chinook
Exposure attributes for Upper Willamette River Chinook salmon were ranked high overall, due to very high scores for ocean acidification and stream temperature. Mean August temperature was projected to increase 1.4°C by the 2040s, and 2.4°C by the 2080s. Other high exposure attributes included sea surface temperature and hydrologic regime shift. Although approximately 90% of the basin is already rain-dominated, the remaining 10% is very likely to change to rain-dominated by the 2040s. Scores for ocean acidification and sea surface temperature were similar to those of most DPSs.

Sensitivity attributes for this DPS were ranked very high due to a host of factors, including its very high vulnerability in the adult freshwater stage and very high cumulative life-cycle effects reflecting threats to the species' entire life cycle and to its life history diversity.



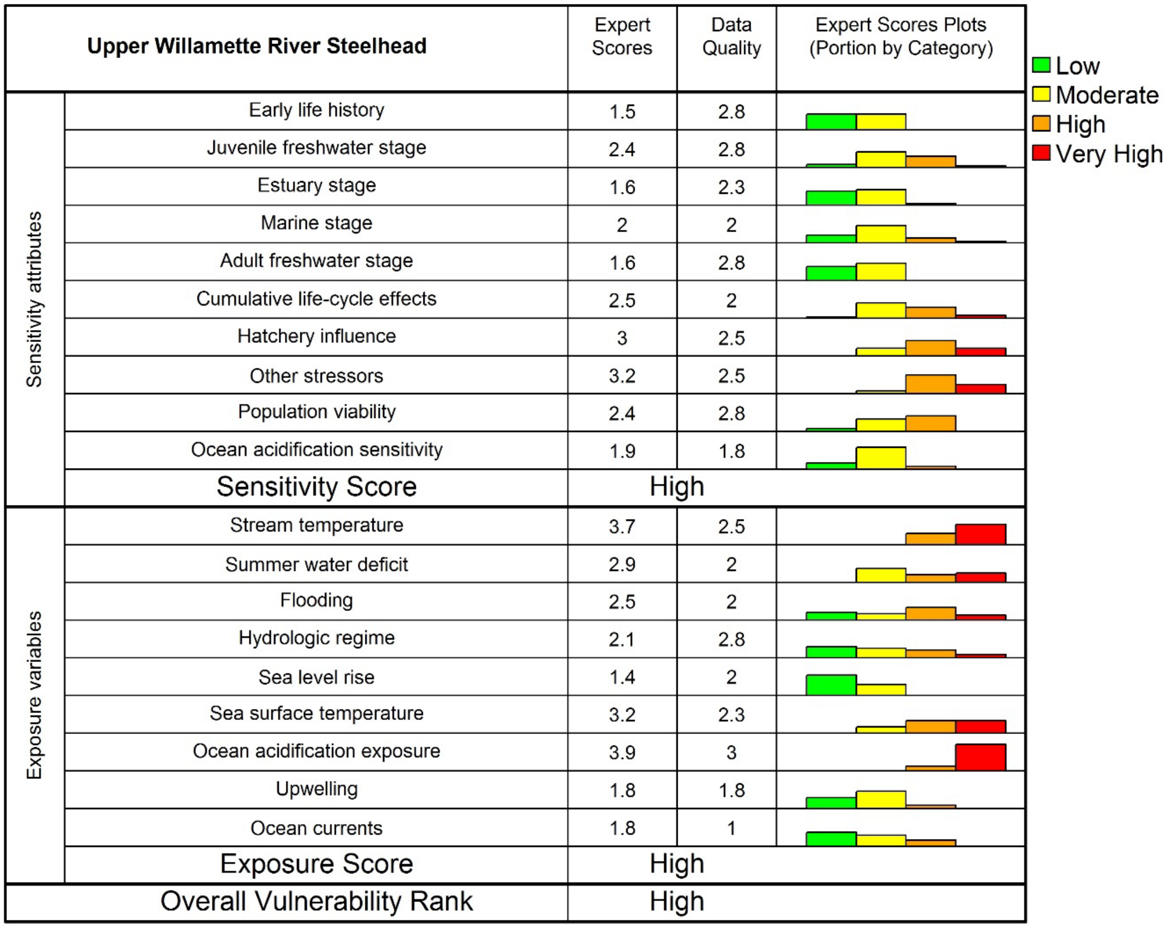
Upper Willamette River Chinook		Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Early life history	1.4	3	
	Juvenile freshwater stage	2.9	3	
	Estuary stage	1.9	2.3	
	Marine stage	2.3	1.8	
	Adult freshwater stage	3.6	2.8	
	Cumulative life-cycle effects	3.3	2	
	Hatchery influence	3.8	2.5	
	Other stressors	3.5	3	
	Population viability	3.6	2.8	
	Ocean acidification sensitivity	1.9	1.8	
	Sensitivity Score	Very High		
Exposure variables	Stream temperature	3.6	2.3	
	Summer water deficit	2.4	1.8	
	Flooding	2.8	2	
	Hydrologic regime	3.2	2.5	
	Sea level rise	2	2.3	
	Sea surface temperature	3.4	2	
	Ocean acidification exposure	3.8	2.5	
	Upwelling	2.3	1.8	
	Ocean currents	1.8	1.3	
	Exposure Score	High		
Overall Vulnerability Rank		Very High		

Figure 4. An Image of the Chinook Climate Change Vulnerability Table from Crozier et al., 2019

Climate Effects on Abundance and Distribution of Upper Willamette River Steelhead

For Upper Willamette River steelhead, two of the three contributors to high exposure scores were attributes of the marine environment: ocean acidification and sea surface temperature. Sensitivity of upper Willamette River steelhead to ocean acidification, however, was ranked just below moderate. Similarly, sensitivity of upper Willamette River steelhead to sea surface temperature was ranked moderate. However, data quality scores for sensitivity attributes indicated that information is lacking.

Stream temperature was the most important freshwater exposure factor for this DPS because steelhead juveniles generally rear for one or more years in fresh water before migrating (Busby et al. 1996). Of the four recognized populations of winter steelhead in the Upper Willamette River Basin (Myers et al. 2006), all inhabit rivers that drain the west slopes of the Cascade Range. However, only the North Santiam River extends to the high Cascades region, where snow melt and ground water contribute significantly to stream flows (Chang et al. 2018). Access to much of this historical spawning habitat in the North Santiam is blocked by impassable dams (NWFSC 2015). Studies of steelhead in other basins have shown warmer summer temperatures associated with development of anadromy, whereas a resident life history type was more prevalent in streams with colder summer water temperatures (McMillan et al. 2012). In contrast, the distribution of native steelhead in the upper Willamette Basin is not cleanly associated with gradients in summer stream temperature.



	Upper Willamette River Steelhead	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Early life history	1.5	2.8	
	Juvenile freshwater stage	2.4	2.8	
	Estuary stage	1.6	2.3	
	Marine stage	2	2	
	Adult freshwater stage	1.6	2.8	
	Cumulative life-cycle effects	2.5	2	
	Hatchery influence	3	2.5	
	Other stressors	3.2	2.5	
	Population viability	2.4	2.8	
	Ocean acidification sensitivity	1.9	1.8	
	Sensitivity Score	High		
Exposure variables	Stream temperature	3.7	2.5	
	Summer water deficit	2.9	2	
	Flooding	2.5	2	
	Hydrologic regime	2.1	2.8	
	Sea level rise	1.4	2	
	Sea surface temperature	3.2	2.3	
	Ocean acidification exposure	3.9	3	
	Upwelling	1.8	1.8	
	Ocean currents	1.8	1	
	Exposure Score	High		
Overall Vulnerability Rank		High		

Figure 5. An Image of the Steelhead Climate Change Vulnerability Table from Crozier et al., 2019.

In the Willamette River Basin, native late-winter migrating populations occur in watersheds draining the Cascade Mountains on the eastern edge of the basin. Interestingly, native steelhead populations are not believed to inhabit the upper extremes of the basin, nor the tributaries of its western edge, which drain the Coastal Range, although steelhead are known to migrate much longer distances to reach spawning grounds in other watersheds (Busby et al. 1996). In other systems, longer steelhead migrations are associated with adult returns in summer. Thus, the late winter entry of Willamette River steelhead, which is believed to be an adaptation to allow historical passage over Willamette Falls (Busby et al. 1996), may pose a temporal constraint on the migration distance that native steelhead can attain prior to spawning. Such time constraints may be more important than temperature in terms of the distribution of steelhead in the Willamette Basin.

Hatcheries

The effects of hatchery fish on the status of an ESU or DPS depends upon which of the four key attributes -- abundance, productivity, spatial structure, and diversity -- are currently limiting the ESU/DPS, and how the hatchery fish within the ESU/DPS affect each of the attributes (70 FR 37204). Hatchery programs can provide short-term demographic benefits, such as increases in abundance during periods of low natural abundance. They also can help preserve genetic resources until limiting factors can be addressed. However, the long-term use of artificial propagation may pose risks to natural productivity and diversity. Effects of hatchery programs are often concentrated within a particular population, but the magnitude and type of the risk to the ESU or DPS depends on the severity of impacts, on the status of affected populations and on specific practices in the hatchery program. This latter point may be bifurcated between integrated hatchery programs (including UWR Chinook hatchery programs) which are managed to blend hatchery and wild fish both in the hatchery broodstock and in the naturally spawning populations, versus segregated programs (such as the UWR steelhead program) which intend to operate separately, with minimal genetic influence on the wild population. The goals of these two categories of hatchery management are different, as further described below.

UWR steelhead

Winter-run steelhead hatchery programs were terminated in the late 1990s and their effects to the UWR steelhead DPS, while established in the species history, become less detectable over time. Currently, the only ongoing steelhead program affecting the upper Willamette River is the segregated summer steelhead program which was originally initiated from the Skamania stock from the lower Columbia River. This program has collected broodstock from adult summer steelhead returning to the Santiam River; where hatchery smolt releases still occur presently. Annual total releases have been relatively stable at around 600,000 from 2015-2023 and are expected to continue at this level, although the distribution has changed some with fewer fish being released in the North Santiam River and corresponding increases in the South Santiam River (the only releases within the DPS). There has been some concern regarding the effect of introduced summer-run steelhead on native late winter-run steelhead. NMFS (2019b), the latest evaluation of this hatchery program, implemented further reform actions to lessen the effects of hatchery summer steelhead on winter steelhead including reductions in smolt releases in the North Santiam River where introgression has been higher than other populations, and broodstock spawning selection of summer steelhead to further reduce the potential for interbreeding. Gene flow from summer steelhead to native steelhead populations was estimated to be less than 2% in all populations of the DPS (NMFS 2019b). Further monitoring has been implemented to continue to assess the effectiveness of these hatchery reform actions, but the results are not yet available.

UWR Chinook salmon

Hatchery production of Chinook salmon has remained relatively stable since the initial status review (Myers et al. 1998); with the exception of hatchery releases in the McKenzie River. In general, production levels are based on mitigation agreements related to the construction of dams in the Willamette River Basin. There have been a number of operational changes made to the integrated Chinook hatchery programs. Mass marking of hatchery-origin Chinook salmon began in 1997, with all returning adults being marked by 2002. Off-station releases have been curtailed in an effort to limit natural spawning by hatchery-origin fish. Releases of juvenile Chinook salmon into the Coast Fork Willamette River have been made in an effort to maintain a harvestable hatchery return in an area with no wild fish recovery objectives. A review of hatchery operations by the Hatchery Science Review Group (HSRG) in 2009 identified a number of modifications to improve the status of Chinook salmon. Foremost was an increase in the proportion of naturally-produced fish into the hatchery broodstock; however, in many basins the abundance of naturally-produced Chinook salmon was critically low precluding their use as broodstock (HSRG 2009). Natural-origin returns in many populations (e.g. North Santiam River) have increased since this time and natural-origin salmon have been integrated into the hatchery broodstocks in order to promote a hatchery stock more similar to the natural population and reduce domestication effects (NMFS 2019b). Recent improvements at the Cougar (2010), Minto (2012), Foster (2014), and Fall Creek (2019) fish collection facilities offer the potential for collecting more hatchery origin adults and removing them from the natural-spawning component of the populations. Increased collection efficiency has been observed at the Cougar and Minto facilities, with additional reforms implemented at the Foster facility to improve collection efficiency. Ultimately, these facilities should be able to reduce the proportion of hatchery origin spawners (pHOS) in both the North and South Santiam populations. Plans are being developed for improvements at the Dexter Dam facility.

The Chinook hatchery programs have also been used to reintroduce salmon back into their historic habitats above the impassable dams to increase the abundance, productivity, and spatial structure of the natural populations. These efforts have increased the natural production of salmon in all of these areas, with the extent of the improvement dependent upon downstream passage survival conditions for juvenile salmon (NMFS 2008a; NMFS 2019b). Genetic pedigree studies have shown the extent of the benefits from hatchery salmon supplementation efforts (NMFS 2019b). As natural-origin salmon returns increase, the number of hatchery salmon needed for outplanting above the dams has been reduced. In recent years, the substantial increase in natural-origin salmon returns in the North Santiam River, and verified through genetic pedigree analyses, has allowed natural-origin salmon to be placed upstream of Detroit Dam back into habitats where this fish originated which is a significant recovery accomplishment facilitated through the integrated hatchery program in the North Santiam River. Similar efforts are occurring in the Middle Fork, McKenzie, and South Santiam population areas.

Listing Factor E Conclusion

Climate Change

The effects of climate change extend to every habitat and every life history phase of listed UWR salmonids. Effects range from decreasing predictability of annual events such as spring freshets and timing of prey abundance, to increasing stream and ocean temperatures and setting the stage for increased competition with warm-water adapted non-native species. These challenges tend to amplify and exacerbate other threats experienced by listed UWR salmonids and are expected to increase in magnitude as climate change progresses.

Hatcheries

For UWR steelhead, the genetic diversity goals are improving as hatchery steelhead reforms continue to be implemented over the last 25 years with the elimination of the winter steelhead hatchery program and continued management actions to reduce the effects of the summer steelhead program in the North Santiam River and South Santiam River. The genetic effects of the summer steelhead program on winter steelhead are currently at the lowest level since the program began in the 1950s (NMFS 2019b). Continued monitoring is occurring to verify whether the reform actions are performing as expected.

For UWR Chinook salmon, hatchery production has remained relatively stable since the initial status review, with the exception of releases in the McKenzie River. The recent improvements at the Cougar (2010), Minto (2012), Foster (2014), and Fall Creek (2019) fish collection facilities offer the potential for collecting more hatchery origin adults and removing them from the natural-spawning component of the populations, and safer handling of natural and hatchery salmon for outplanting above the impassable dams. Ultimately, these facilities should be able to reduce the pHOS in both the North and South Santiam populations (NWFSC 2015). Broodstock management has improved as natural-origin returns have improved enough to allow some of these fish to be integrated into the broodstock to improve the genetics and reduce domestication effects. The Chinook hatchery programs are providing important VSP benefits in the areas above impassable federal dams into historic habitats by increasing spawning abundance, productivity, and spatial distribution of salmon in these populations (NMFS 2019b).

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 5 years. While conducting these reviews, we apply the provisions of ESA section 4(a)(1) and NMFS's implementing regulations at 50 CFR part 424.

We review the status of the species and evaluate whether any one of the five factors, as identified in ESA section 4(a)(1) suggests that a reclassification is warranted: (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; or (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.

Viability Summary

Overall, there has likely been a declining trend in the viability of the UWR Chinook salmon ESU since the last review. The magnitude of this change is not sufficient to suggest a change in risk category, however, so the Upper Willamette River Chinook salmon ESU remains at "moderate" risk of extinction (Ford 2022).

While the viability of the UWR Steelhead DPS appears to be declining, the recent uptick in abundance may provide a short-term demographic buffer. Furthermore, increased monitoring is necessary to provide quantitative verification of sustainability for most of the populations. In the absence of substantial changes in accessibility to high-quality habitat, the DPS will remain at “moderate-to-high” risk, with a declining viability trend (Ford 2022).

Listing Factor Summary

Listing Factor A (Habitat):

Habitat restoration has occurred throughout the geography of the UWR Chinook ESU and UWR steelhead DPS. Despite these efforts, systemic habitat conditions are still not sufficient to fully support recovery of the UWR species. Overall, despite site-specific restoration, major passage concerns remain, while water quality and habitat quality continue to decline commensurate with increase in human resource demands. We therefore conclude risk to the listed UWR species persistence because of habitat degradation has increased since the prior 5-year review, and remains high.

Listing Factor B (Overutilization):

Harvest-related impacts on natural-origin spring-run Chinook salmon and steelhead remain low on all populations in the ESU and DPS, with few mortalities associated with both recreational and commercial fisheries. Although these fisheries are directed at hatchery production, hooking mortalities are generally estimated at 10 percent and river temperatures likely influence this rate (Ford 2022). Overall, the risk to species persistence remains low.

Scientific research impacts authorized have decreased for UWR Chinook salmon and remained relatively unchanged for UWR steelhead compared to the past 5 years. Impacts from these sources of mortality are still not considered to be major limiting factors for this ESU or DPS. Therefore, we conclude that the risk to the species’ persistence because of utilization related to scientific studies remains low.

Listing Factor C (Disease and Predation):

The prevalence of disease has not resulted in notable levels of injury or mortality since the last 5-year review, but it is reasonable to assume that warming trends have increased the risk of disease (*C. shasta*) to ESU or DPS viability (pers. comm. J. Myers, NWFSC, 12/20/2021). The disease rates have continued to fluctuate within the range observed in past review periods but may affect the extinction risk of UWR species. At this time, avian predation continues to negatively affect juvenile salmon and steelhead survival rates as they migrate through the Lower Columbia River and Estuary, although recent changes to pinniped removal programs appear to have decreased marine mammal predation to some extent. We therefore conclude that the risk to the species’ persistence because of disease and predation for UWR Chinook salmon and UWR steelhead has increased slightly, due to the increased risk of disease and no overall improvement among all sources of mortality, since the last 5-year review, but overall remains low to moderate.

Listing Factor D (Regulatory Mechanisms):

When taken together, regulatory mechanisms for water quantity, forest practices, fish passage in tributary streams, predator management, harvest, and floodplain restoration activities in the Upper Willamette have slightly decreased the risk of these threats to the Upper Willamette River species’ persistence since the last 5-year review.

However, despite this slight improvement, there remain concerns regarding continued risk from the inadequacy of other regulatory mechanisms to protect these species and their habitats, such as the CWA, slowed implementation of the NFIP, and implementation of the ESA to limit the impacts of the Corps' Willamette Project and improve high head dam passage. These current regulatory inadequacies, and the fact that future climate conditions will make key regulatory mechanisms less effective at protecting suitable water quality and passage conditions, suggest that risk to these species' persistence due to inadequate regulatory mechanisms is increasing.

Listing Factor E (Other Natural and Manmade Factors):
The effects of climate change extend to every habitat and every life history phase of listed UWR salmonids. Effects range from increasing sea surface temperatures and ocean acidification exposure, to increasing stream temperatures. These challenges tend to amplify and exacerbate other threats experienced by listed UWR salmonids and are expected to increase in magnitude as climate change progresses.

There are no winter-run steelhead hatchery programs in the Upper Willamette River, though concern remains regarding introgression of summer steelhead into ESA-listed winter steelhead populations in the North and South Santiam Rivers from summer steelhead spawning in the wild. The level of risk posed to UWR Chinook salmon persistence by hatcheries has decreased slightly since the 2016 5-year review because of the continuing program changes made over the last 5 years to reduce hatchery effects on natural-origin populations within the UWR ESU.

Summary
Overall, the information analyzed for this 5-year review indicates an increased level of concern in the risk status for UWR Chinook salmon and UWR steelhead. The basis for this concern includes: (1) Declining population trends across the ESU/DPS; (2) Limited accessibility to historical spawning habitat; (3) Climate change impacts on increased stream temperatures and competition with warm-water tolerant invasive species; and (4) Lack of floodplain habitat. However, the risk to both species' persistence has not increased to the extent that a change in listing status is warranted. We recommend maintaining the current classification of Threatened for both UWR Chinook salmon and UWR steelhead, but recommend closely monitoring abundance and productivity metrics. If trends in these metrics continue to decline, initiating a new status review prior to the next 5-year review may be warranted.

2.4.1 ESU/DPS Delineation and Hatchery Membership

Upper Willamette River Steelhead DPS

Delineation
Genetic information described in the NWFSC assessments (2015 and Ford 2022) finds a closer affiliation of the Clackamas River winter steelhead population with the UWR winter steelhead populations than the Lower Columbia River steelhead populations, and supports the recommendation to consider revising the UWR steelhead DPS to include the Clackamas River population.

Hatchery Membership

The West Coast Regional Office's review of new information since the 2016 5-year review regarding the ESU/DPS membership status of various hatchery programs indicates that no hatchery programs warrant inclusion in the UWR Steelhead DPS.

Upper Willamette River Chinook salmon

Delineation

The Northwest Fisheries Science Center's review (Ford 2022) found that no new information had become available that would justify a change in the delineation of the UWR Chinook salmon ESU.

Hatchery Membership

A review of new information since the 2016 5-year review regarding the ESU/DPS membership status of various hatchery programs indicates that no changes are warranted for membership in the UWR Chinook salmon ESU. In 2020, consistent with the 2016 5-year review recommendations, membership was formally revised to reflect name changes of several hatchery programs (85 FR 81822, December 17, 2020). No new revisions are recommended at this time.

2.4.2 ESU/DPS Viability and Statutory Listing Factors

The Northwest Fisheries Science Center's review of updated information (Ford 2022) does not indicate a change in the biological risk category for either the UWR Chinook salmon ESU nor the UWR steelhead DPS since the time of the last viability assessment (NWFSC 2015).

Our analysis of the ESA section 4(a)(1) factors indicates that the collective risk to UWR Chinook salmon and UWR steelhead's persistence has increased since our previous 5-year review (NMFS 2016a), but not to the extent that a change in listing status is recommended for either species.

3. Results

3.1 Classification

Listing Status:

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

- The UWR steelhead DPS should remain listed as threatened.
- The UWR Chinook salmon ESU should remain listed as threatened.

ESU/DPS Delineation:

UWR steelhead DPS

The NWFSC 2015 report recommended a revision of the Lower Columbia River Steelhead DPS and Upper Willamette River Steelhead DPS delineation. Specifically, NMFS recommends that the Clackamas River winter steelhead demographically independent population (DIP) originally included as part of the Lower Columbia River DPS instead be included in the Upper Willamette River DPS. Genetic research published since 2015 further supports the closer affinity of the Clackamas River winter-run steelhead DIP to Upper Willamette River steelhead DPS populations rather than Lower Columbia River Steelhead DPS populations (Winans et al. 2018). The NWFSC (Ford 2022) finds that the rationale for revising the placement of the Clackamas River winter steelhead DIP originally stated in the NWFSC 2015 report is still accurate and appropriate and does not need further review or revision.

While considering whether to adjust the population membership, we will consider additional biological, genetic, and ecological criteria that would assist in making a future determination. If we move forward with this recommendation, related modifications to any associated critical habitat designations, recovery plans, and hatchery programs may be necessary.

UWR Chinook Salmon ESU

The Northwest Fisheries Science Center’s review (Ford 2022) found that no new information has become available that would justify a change in the delineation of the UWR Chinook salmon ESU.

Hatchery Membership:

A review of new information since the 2016 5-year review indicates that no changes are warranted for hatchery program membership in the UWR Chinook salmon ESU or UWR steelhead DPS.

3.2 New Recovery Priority Number

Since the 2016 5-year review, NMFS revised the recovery priority number guidelines in 2019 and reevaluated the numbers most recently in the 2021-2022 Recovering Threatened and Endangered Species Report to Congress (NMFS 2023). Table 4 indicates the numbers in place for the UWR Chinook salmon ESU and UWR steelhead DPS at the beginning of the current review [3C].

As part of this 5-year review, we reevaluated the number based on the best available information, including the new viability assessment (Ford 2022), and concluded that the current recovery priority numbers remain 3C for both species.

4. Recommendations for Future Actions

In our review of the listing factors and the Northwest Fisheries Science Center's biological viability assessment, we identified many recommended actions to improve factors influencing the status of the UWR Chinook salmon ESU and the UWR steelhead DPS. Here we present those actions that provide the greatest opportunity to improve the VSP parameters, and advance the recovery of UWR Chinook salmon and UWR steelhead. Specifically, we recommend the following actions:

Habitat Actions

UWR Chinook salmon and UWR steelhead recommended future recovery actions over the next 5 years include:

- Provide effective upstream and downstream passage through revised reservoir operations. Provide access to historical spawning and rearing areas currently blocked by high head dams in the Willamette Basin. Priority actions include:
    - McKenzie River Basin:
        - Implement Carmen-Smith's Aquatic Management Strategy to provide upstream and downstream passage for UWR Chinook salmon under the terms of Eugene Water & Electric Board's license agreement.
        - Continue Cougar downstream passage in the South Fork via drawdowns to within 25 feet of the ROs. Begin testing the existing diversion tunnel, with deeper drawdowns to operate when peak juvenile fish movement is noted at higher elevation. Provide the disposition study, and request funds for and carry out feasibility studies for this operation in the South Fork McKenzie.
        - Continue outplanting all returning natural origin UWR Chinook salmon spawners from the Cougar Dam Ladder, without returning any downstream, unless surplus returns arrive after September 1.
        - Coordinate salmon spawning surveys with USFS and ODFW for the floodplain restoration below Cougar Dam, and fund or conduct spawner surveys above Cougar Dam.
    - Middle Fork Willamette River Basin:
        - Continue deep drawdowns at Lookout Point and ongoing review of concept, and of juvenile fish responses, along with monitoring temperature, TDG, and sediment transport. As needed change outflows to reduce temperature effects at and below Dexter adult fish facility.
        - Outplant Chinook spawners in habitat above Hills Creek, in addition to the North Fork Middle Fork, and fund or conduct spawner surveys to monitor changes during and after replacement of Dexter adult fish facility.
    - South Santiam River Basin:
        - Deep drawdown at Green Peter for fall outmigration began in 2023. This continuing operation requires ongoing review of juvenile fish responses. Similarly spill operations in the spring at Green Peter should have timely monitoring of juvenile outmigration, with tagged natural origin and study

        fish that use both current radio telemetry infrastructure, and over the longer term, the PIT antenna at Lebanon Dam.
        - Continue outplanting of adult Chinook above Green Peter Reservoir. Fund or carry out spawning surveys in the Middle Santiam River, and continue the spawning surveys in Quartzville Creek.
    - North Santiam River Basin:
        - Operations between Detroit and Big Cliff should be coordinated to ensure safer routes for UWR Chinook salmon and steelhead are available.
        - Continue temperature operations that provide safer holding and spawning conditions, along with operations to reduce warmer temperatures for incubation downstream of Big Cliff Dam.
        - Continue outplanting natural origin spawners into Minto -Big Cliff reach, and in the reaches with high quality habitat above Detroit Reservoir. Fund or conduct spawner surveys in outplanting areas above Detroit Reservoir.

- Revise dam operations to modify water temperatures and reduce TDG below the project dams.

- Coordinate and provide support for efforts to maintain or add to PIT reading infrastructure at the Willamette Falls ladder and in accessible downstream passage areas.

- Coordinate funding to speed up pedigree analyses required in the NMFS 2019b Hatchery Biological Opinion, beginning the next cycle of these in 2024.

- Restore riparian vegetation cover and re-establish connection to off-channel habitats and floodplains in the lowland reaches, to provide suitable spawning and rearing habitat and cooler water temperatures.

- Complete consultation regarding Willamette Valley System operations to implement and/or revise the priority actions listed here.

Research, Monitoring and Evaluation

- Quantitatively analyze net habitat loss and restoration/protective efforts and evaluate the effectiveness of existing land-use regulatory mechanisms, land-use management plans, and fisheries harvest management regulations.

- Assess population abundance and survival, evaluation of success of implemented projects, identification of factors limiting fish production, and assess the extent of habitat restoration needed to reach viability.

- Prioritize the implementation of a Willamette Basin-wide PIT tag detection array, as it is critical to much of the fish passage and life history work being done for UWR Chinook salmon and UWR steelhead recovery planning. Scenarios might include: monitoring arrays at dams, mainstem bridges or installing detector barges in the mainstem

Willamette. Currently, the adult and juvenile detectors alone at Willamette Falls are in a state of disrepair and need funding and repair. Active tag studies are being done, but only in some places and the coverage is limited.

- Restore funding for ‘boots on the ground’ above-dam spawner surveys in order gather information about the numbers of successful adult spawners, general fish and habitat health and effectiveness of restoration activities.

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5.1 Federal Register Notices

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 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.

July 10, 2000 (65 FR 42421). Final Rule: Endangered and Threatened Species; Final Rule Governing Take of 14 Threatened Salmon and Steelhead Evolutionarily Significant Units (ESUs).

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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.

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August 22, 2011 (75 FR 52317). Notice of availability: Endangered and Threatened Species; Recovery Plans.

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW

Upper Willamette River Steelhead DPS & Upper Willamette River Chinook Salmon ESU

Current Classification: Threatened

Recommendation resulting from the 5-Year Review

- ☐ Downlist to Threatened
- ☐ Uplist to Endangered
- ☐ Delist
- ☒ No change is needed

Review Conducted By (Name and Office):

West Coast Region Upper Willamette River Evaluation Team

REGIONAL OFFICE APPROVAL:

Lead Regional Administrator, NOAA Fisheries

Approve QUAN.JENNIFER.LEIGH.1536293139 Digitally signed by QUAN.JENNIFER.LEIGH.1536293139 Date: 2024.06.13 16:57:16 -07'00' Date: ________

Cooperating Regional Administrator, NOAA Fisheries

☐ Concur ☐ Do Not Concur ☐ N/A

Signature____ Date: _______

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

☒ Concur ☐ Do Not Concur

Signature RAUCH.SAMUEL.DEAN.1365850948 Digitally signed by RAUCH.SAMUEL.DEAN.1365850948 Date: 2024.06.24 09:21:31 -04'00' Date: _______