UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

Refer to NMFS No:
WCRO-2020-03421

March 14, 2022

Meta Loftsgaarden
Forest Supervisor
Mount Hood National Forest
16400 Champion Way
Sandy, Oregon 97055-7248

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Government Camp-Cooper Spur Land Exchange

Dear Ms. Loftsgaarden:

Thank you for your December 17, 2020, letter requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for Government Camp-Cooper Spur Land Exchange. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

The U.S. Forest Service requested consultation for Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), LCR coho salmon (*Oncorhynchus kisutch*), and LCR steelhead (*Oncorhynchus mykiss*). However, we determined that the proposed action is also likely to adversely affect: Upper Willamette River (UWR) spring-run Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer run Chinook salmon, SR fall-run Chinook salmon, Columbia River chum salmon (*Oncorhynchus. keta*), Oregon Coast coho salmon, Southern Oregon/Northern California Coasts coho salmon, SR sockeye salmon (*Oncorhynchus nerka*), UWR steelhead, Middle Columbia River steelhead, UCR steelhead, Snake River Basin steelhead, southern distinct population segment (DPS) green sturgeon (*Acipenser medirostris*), and southern DPS eulachon (*Thaleichthys pacificus*).

In this opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of the above-listed species, or result in the destruction or adverse modification of their designated critical habitat.

As required by section 7 of the ESA, NMFS is providing an incidental take statement with the opinion. The incidental take statement describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth terms and conditions, including reporting requirements, that the Federal action agency must comply with to carry out the reasonable and prudent measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) for this action. This document also includes the results of our analysis of the action's likely effects on EFH pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes four conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH conservation recommendations, the Federal action agency must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

Please contact Mischa Connine in the Willamette Branch of the Oregon/Washington Coastal Office, at 503-230-5401 or Mischa.Connine@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Kim W. Kratz. Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: Chuti Fiedler, U.S. Forest Service
Eileen Stone, U.S. Fish and Wildlife Service
Nolan Banish, U.S. Fish and Wildlife Service

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the

Government Camp-Cooper Spur Land Exchange

NMFS Consultation Number: WCRO-2020-03421

Action Agency: U.S. Forest Service

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Lower Columbia River Chinook salmon (*Oncorhynchus tshawytscha*)	Threatened	Yes	No	Yes	No
Upper Willamette River Chinook salmon	Threatened	Yes	No	Yes	No
Upper Columbia River spring-run Chinook salmon	Endangered	Yes	No	Yes	No
Snake River spring/summer run Chinook salmon	Threatened	Yes	No	Yes	No
Snake River fall-run Chinook salmon	Threatened	Yes	No	Yes	No
Columbia River chum salmon (*Oncorhynchus keta)*	Threatened	Yes	No	Yes	No
Lower Columbia River coho salmon (*Oncorhynchus kisutch*)	Threatened	Yes	No	Yes	No
Snake River sockeye salmon	Endangered	Yes	No	Yes	No
Lower Columbia River steelhead (*Oncorhynchus kisutch*)	Threatened	Yes	No	Yes	No
Upper Willamette River steelhead	Threatened	Yes	No	Yes	No
Middle Columbia River steelhead	Threatened	Yes	No	Yes	No

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Upper Columbia River steelhead	Threatened	Yes	No	Yes	No
Snake River Basin steelhead	Threatened	Yes	No	Yes	No
Southern green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No
Eulachon (*Thaleichthys pacificus*)	Threatened	Yes	No	Yes	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By:

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: March 14, 2022

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1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR 402, as amended.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600 .

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Oregon Washington Coastal Office.

1.2. Consultation History

On October 1, 2020, the U.S. Forest Service (USFS) contacted NMFS about the Congressionally-directed Government Camp-Cooper spur Land Exchange project on the Mt. Hood National Forest (MHNF) between the USFS and Mt. Hood Meadows (Meadows). On October 5, 2020, the USFS shared a draft Biological Assessment (BA) for review and comment. On October 7, 2020, we provided comments to the USFS, identifying stormwater treatment and stream buffers as concerns. We also informed the USFS of additional ESA-listed species that would be affected by the proposed action. On December 17, 2020, we received a request for ESA section consultation from the USFS, along with a final BA, which NMFS determined was incomplete as it did not include information on the proposed stormwater management measures or riparian buffers as the agencies discussed during previous conversations.

On April 7, 2021, NMFS met with the USFS, U.S. Department of Justice (DOJ), and (Meadows) to discuss options for stormwater treatment for parcels involved in the land exchange. On July 23, 2021, NMFS met again with USFS, USDOJ, and Meadows to clarify the stormwater treatment standards. On August 12, 2021, NMFS met with Clackamas County and Meadows to discuss the differences and requirements for stormwater treatment from both entities. On August 20, 2021, NMFS received an email from Meadows' consultant indicating that Meadows will treat stormwater to the standards we requested. NMFS also received confirmation, during conversations between Meadows' attorney and NOAA General Counsel in January 2022, that Meadows will provide the stream buffers we proposed and would treat stormwater as requested.

In the final BA submitted to NMFS, the USFS determined that the proposed action may affect and is likely to adversely affect Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), LCR coho salmon (*Oncorhynchus kisutch*), and LCR steelhead (*Oncorhynchus mykiss*). Although we provided comments to the USFS indicating that additional ESA-listed species would be affected, they were not included in the request for consultation. The additional species NMFS determined would be adversely affected by the proposed action include Upper Willamette River (UWR) spring-run Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer run Chinook salmon, SR fall-run Chinook salmon, Columbia River (CR) chum salmon (*Oncorhynchus. keta*), Oregon Coast (OC) coho salmon, Southern Oregon/Northern California Coasts (SONCC) coho salmon, SR sockeye salmon (*Oncorhynchus nerka*), UWR steelhead, MCR steelhead, UCR steelhead, Snake River Basin (SRB) steelhead, southern distinct population segment (DPS) green sturgeon (*Acipenser medirostris*), and southern DPS eulachon (*Thaleichthys pacificus*).

The USFS determined that the proposed action would affect essential fish habitat (EFH) for Pacific Coast salmon. Consultation was initiated on October 11, 2021. This opinion is based on the above-mentioned meetings and BA.

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02).

Under MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would. Although the land exchange does not have an effect, the proposed development after the land exchange would not occur but for this exchange and is reasonably certain to occur. Therefore, we included the proposed development, and operation as an effect of the land exchange.

Omnibus Act and Clarification Act

The U.S. Congress directed the USFS to implement the Mount Hood Cooper Spur Land Exchange in the Omnibus Public Land Management Act of March 30, 2009 (Omnibus Act) (123 Stat. 991, P.L. 111-11), and the Mount Hood Cooper Spur Land Exchange Clarification Act of January 10, 2018 (Clarification Act) (131 Stat. 2270, P.L. 115-110). The Omnibus Act as conditioned by the Clarification Act directs the USFS to convey National Forest System (NFS) lands in Government Camp to Meadows, if Meadows offers to convey to the United States certain specified private lands at Cooper Spur, and personal property including buildings, improvements, furniture, fixtures, and equipment at the Cooper Spur Mountain Resort and the Cooper Spur Ski Area (Section 1206(a))(Figure 1).

The NFS lands proposed for conveyance are in Government Camp, Oregon, in Township 3 South, Range 8 East, Sections 13 and 24, and Township 3 South, Range 8.5 East, Section 14 in

Clackamas County (Figure 2). The lands owned by Meadows proposed for acquisition by the United States are located approximately one-half mile to the west of Highway 35 in the vicinity of Cooper Spur Ski Area in Township 2 South, Range 10 East, Sections 6 and 7, Township 1 South, Range 10 East, Sections 30 and 31, and Township 1 South, Range 9 East, Section 36 in Hood River County (Figure 3).

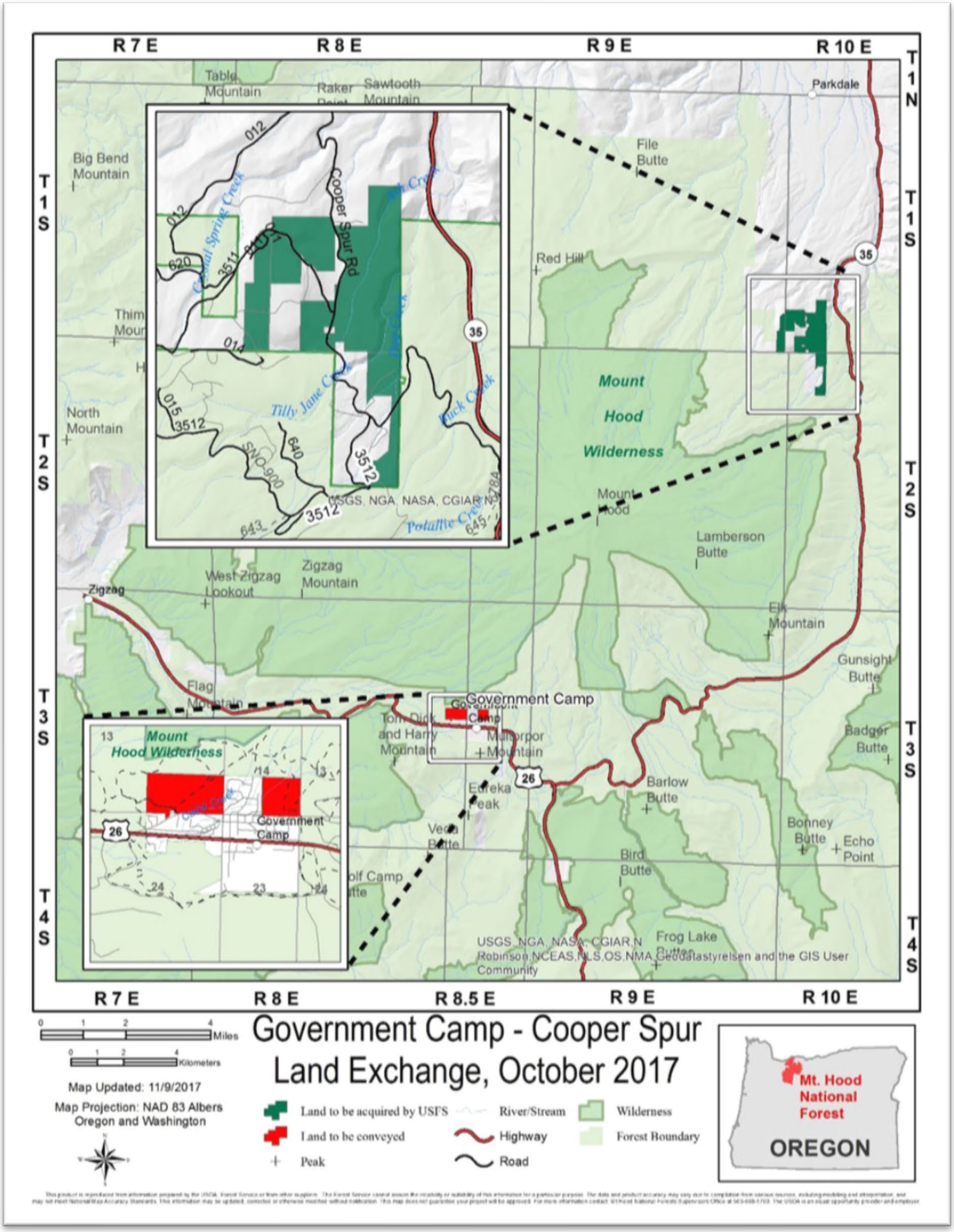

Figure 1. Overview map of the Government Camp-Cooper Spur Land Exchange Proposal

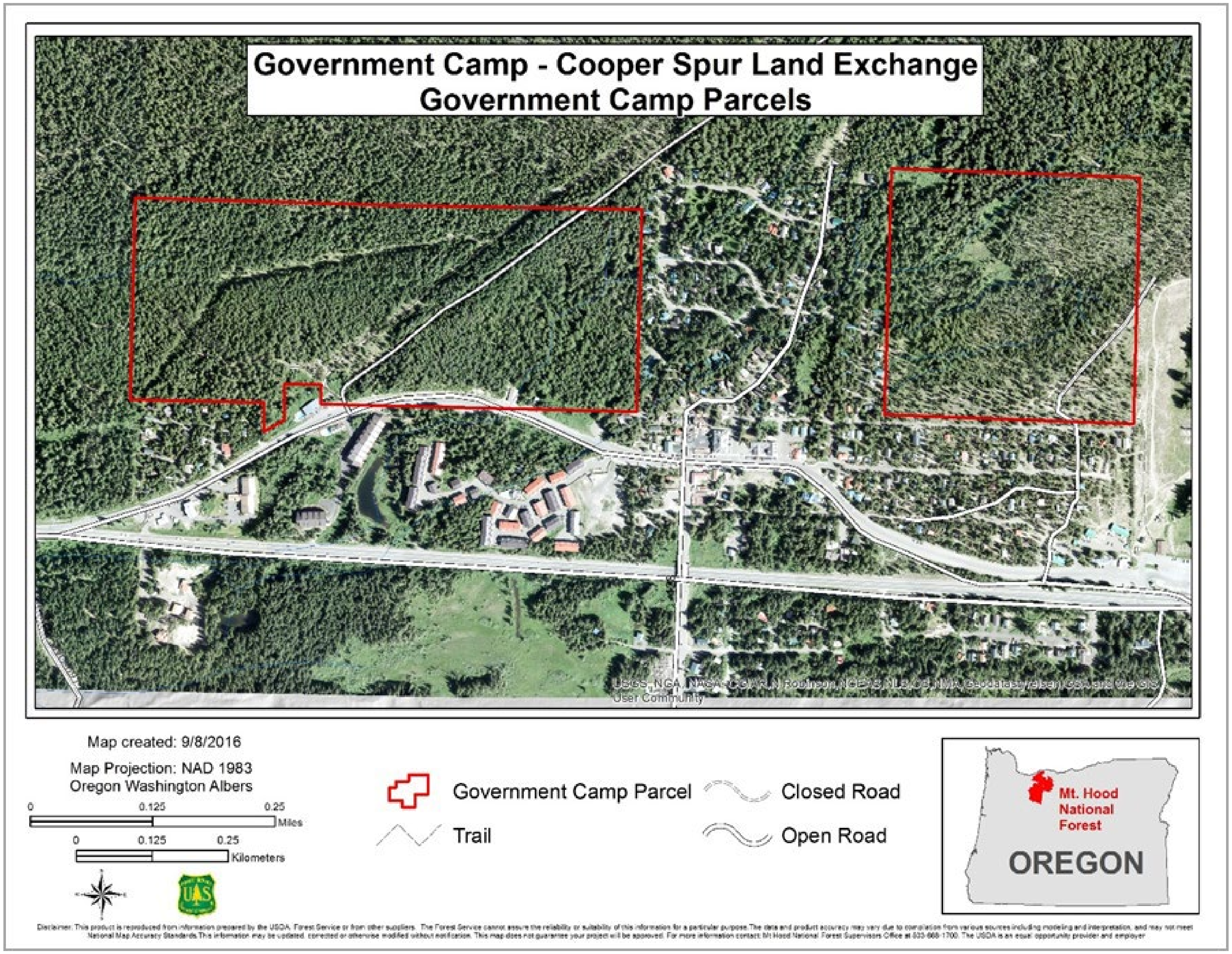

Figure 2. Federal land parcels at Government Camp, Oregon.

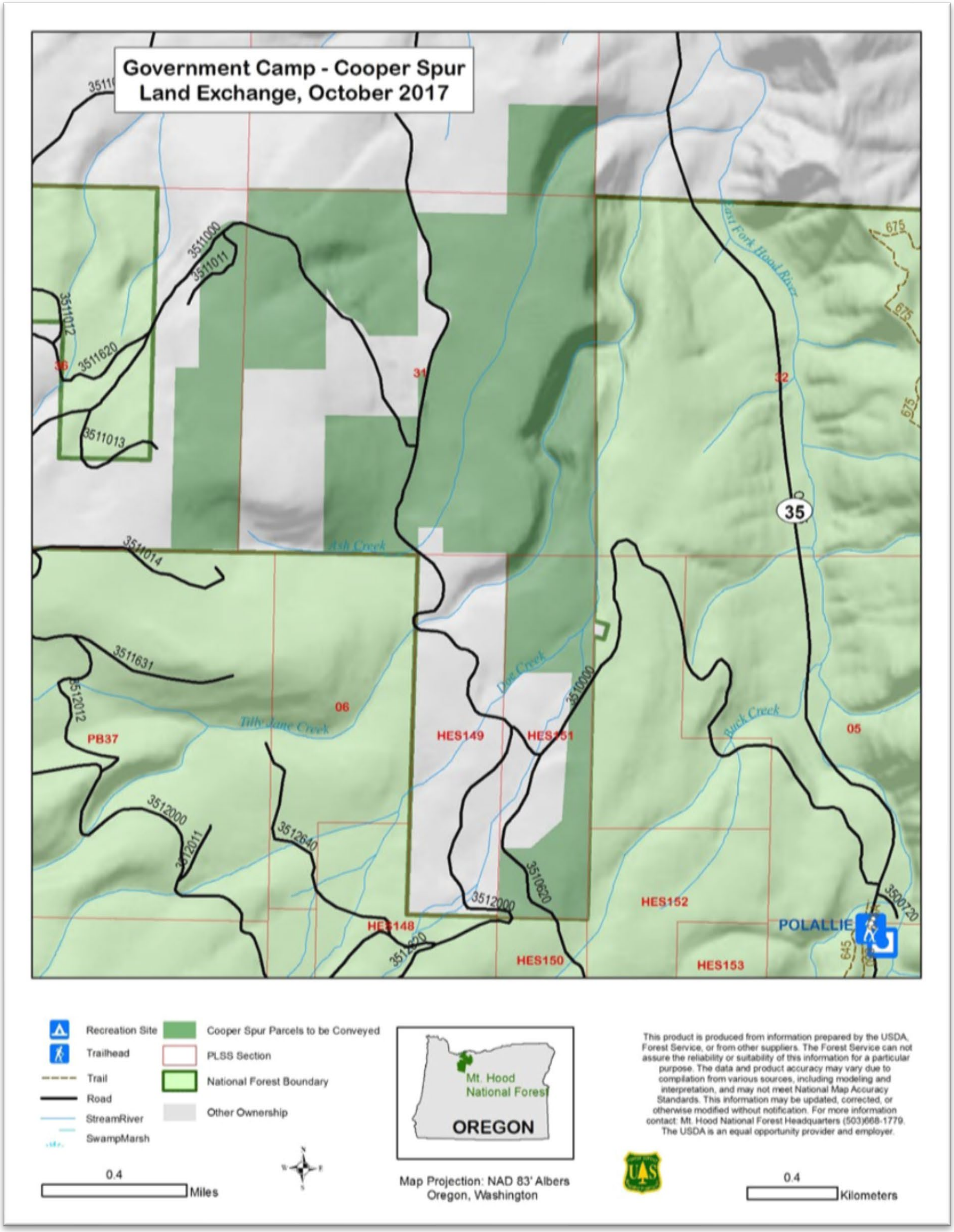

Figure 3. Non-federal parcels at Cooper Spur portion of the project area.

Operation of the Cooper Spur Ski Area

The private lands to be acquired at the Cooper Spur Ski area include approximately 251 acres located within and 514 acres outside of the current National Forest System administrative boundary. Additionally, the private structures and personal property at the Cooper Ski Area, and all development at the Cooper Spur Mountain Resort, would be transferred to the USFS. As the underlying land at the Cooper Spur Ski area is already federally owned and administered, only the following described infrastructure is considered to be conveyed: ski lifts, a day lodge, A-frame cabin, first-aid station, four multi-purpose buildings, instructor's hut, and pump house. There is also a private well water system, irrigation system, and septic system.

There would be no change in the current use and operation of the Cooper Spur Ski area. The proposed action includes issuing a new Special Use Permit (SUP) for the operation and maintenance for the Cooper Spur Ski Area and Cooper Spur Mountain Resort after the private lands are transferred to the USFS. Thus, the permittee of the SUP may change. The private lands acquired will become managed under the Mt. Hood Forest Plan as a new land use allocation (A14 Crystal Springs Watershed Special Resources Management Plan). These lands will be designated as Administratively Withdrawn (not used to produce timber outputs) and Riparian Reserves under the Northwest Forest Plan.

Doe Creek runs adjacent to the Cooper Spur Ski Area, but does not contain ESA-listed fish. The only possible adverse effect could be stormwater inputs that would travel downstream. The USFS states that the parking lot is gravel, and there is a 100-foot vegetated buffer at the narrowest point between the parking area and Doe Creek. Based on this, there will not be any stormwater runoff to Doe Creek.

Development of Government Camp

The effects analysis in the BA and the Draft Environmental Impact Statement (DEIS; USDA 2016) for this action focus on the potential development of the Government Camp parcels. Specific development plans have not been finalized and/or approved by Clackamas County or any other applicable State permitting authorities. The DEIS therefore identified assumptions about how the Government Camp parcels would be developed and used, which are primarily based on zoning regulations of Clackamas County. The DEIS also assumed all required State and Federal laws regarding the protection of streams and wetlands would be followed.

Based on information provided by Meadows' consultant, 66.19 acres of the Government Camp parcel would be developed. After removing land to account for the Government Camp Open Space Management Zoning (13.82 acres), Fire Station Lots (0.47 acres), and Oregon State Highway Right of Way (1.72 acres), the engineering firm of DOWL, retained by Meadows computed a gross site area of 50.18 acres. This included non-buildable areas due to slopes (4.81 acres) and wetlands and associated buffers (7.35 acres), resulting in a maximum physical area that could possibly be developed, including roads, of 38.02 acres. Of this area, 1.5 acres are included in the trail easements retained by the USFS, which reduces the physical area subject to development to 36.52 acres (Espinosa 2021).

Based on this information, DOWL concluded that the site could accommodate a maximum of 146 dwellings. The average lot size will be approximately 10,890 square feet (1/4 acre), the lot coverage (impervious surface) would not exceed 50%. This includes a total of 23.68 acres of new impervious surface (18.25 acres from lot development), plus (5.43 acres from road development). Meadows will treat stormwater from impervious surfaces with a combination of NMFS SLOPES V Stormwater Transportation and Utilities (STU) March 14, 2014, stormwater standards, and Clackamas County stormwater standards, whichever treatment element is more stringent.

The DEIS states that the 109 acres of land to be conveyed north of Government Camp is currently fully vegetated by a mature, conifer overstory, and lush understory. Two segments of a non-motorized trail system pass through the parcels. These trails are used for hiking and biking in summer and for Nordic skiing, winter fat biking and snow-shoeing in winter. The assumed future development of the property would include the removal of overstory and understory vegetation, excavation of building sites, roads, and driveways; and the construction of housing, and associated supporting infrastructure. Camp Creek runs through the corner of the Government Camp property. As discussed in more detail below, Meadows has agreed to provide a 150-foot buffer on Camp Creek.

Under the Omnibus Act, the USFS is required to reserve a trail easement on the Federal land that allows non-motorized use by the public of existing trails; roads, utilities, and infrastructure facilities to cross the trails; and improvement or relocation of the trails to accommodate development of the Federal land. USFS trails 755, 755A, and 755B cross the Federal parcels and were included in the easement. This is an exclusive easement that would provide the USFS full authority to manage the location and maintenance of the trails per USFS standards. An exclusive easement would enable the USFS to retain a 32-foot-wide trail easement, enforce USFS regulations, and keep the easement in a fixed location. However, under the Clarification Act the easement size is changed to 24-feet, and is non-exclusive, meaning the landowner holds the authority to change the location of the trails, and to cross the trails at any location they choose with roads, utilities, and other infrastructure (within the conveyed parcels). While retaining a 24-foot-wide, non-exclusive trail easement may be a condition of the conveyance, the USFS would have limited ability to manage the trail in the same manner and level as on the adjacent USFS lands because it would not have full authority of the trails.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, increases winter flows, and advances the timing of spring melt (Mote et al. 2014; Mote et al 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Tague et al. 2013; Mote et al. 2014).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F in some seasons (based on average linear increase per decade; Abatzoglou et al. 2014; Kunkel et al. 2013). Recent temperatures in all but two years since 1998 ranked above the 20th century average (Mote et al. 2014). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014).

Decreases in summer precipitation of as much as 30 % by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 2013). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014).

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015 this resulted in 3.5-5.3ºC increases in Columbia Basin streams and a peak temperature of 26ºC in the Willamette (NWFSC 2015).

Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009).

Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Mantua et al. 2010; Isaak et al. 2012). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer et al. 1999; Winder and Schindler 2004; Raymondi et al. 2013). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Wainwright & Weitkamp 2013; Raymondi et al. 2013).

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode et al. 2013). Earlier peak stream flows will also alter migration timing for salmon smolts, and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (McMahon and Hartman 1989; Lawson et al. 2004).

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7ºC by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011; Reeder et al. 2013).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. A 38 % to 109 % increase in acidity is projected by the end of this century in all but the most stringent CO_2 mitigation scenarios, and is essentially irreversible over a time scale of centuries (IPCC 2014). Regional factors appear to be amplifying acidification in Northwest ocean waters, which is occurring earlier and more acutely than in other regions and is already impacting important local marine species (Barton et al. 2012; Feely et al. 2012). Acidification also affects sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al. 2012; Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10-32 inches by 2081-2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011; Reeder et al. 2013). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al. 2007). Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005; Zabel et al. 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2015 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Tillmann and Siemann 2011; Reeder et al. 2013).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these ESUs (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

2.2.1 Status of the Species

For Pacific salmon, steelhead, and certain other species, we commonly use the four "viable salmonid population" (VSP) criteria (McElhany et al. 2000) to assess the viability of the populations that, together, constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits (McElhany et al. 2000).

"Abundance" generally refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment (e.g., on spawning grounds).

"Productivity," as applied to viability factors, refers to the entire life cycle (i.e., the number of naturally-spawning adults produced per parent). When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is declining. McElhany et al. (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species' populations has been determined, we assess the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al. 2000).

The summaries that follow describe the status of ESA-listed species and their designated critical habitats that occur within the geographic area of this proposed action and are considered in this opinion. More detailed information on the status and trends of these listed resources, and their biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register (Table 1).

Table 1. Listing status, status of critical habitat designations and protective regulations, and relevant Federal Register (FR) decision notices for ESA-listed species considered in this opinion. Listing status: 'T' means listed as threatened; 'E' means listed as endangered; 'P' means proposed for listing or designation.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon *(Oncorhynchus tshawytscha)*			
Lower Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Columbia River spring-run	E 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	ESA section 9 applies
Snake River spring/summer-run	T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Snake River fall-run	T 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	6/28/05; 70 FR 37160
Chum salmon *(O. keta)*			
Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Coho salmon *(O. kisutch)*			
Lower Columbia River	T 6/28/05; 70 FR 37160	2/24/16; 81 FR 9252	6/28/05; 70 FR 37160
Sockeye salmon *(O. nerka)*			
Snake River	E 8/15/11; 70 FR 37160	12/28/93; 58 FR 68543	ESA section 9 applies
Steelhead (*O. mykiss*)			
Lower Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Middle Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	2/1/06; 71 FR 5178
Snake River Basin	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Green sturgeon (*Acipenser medirostris*)			
Southern DPS	T 4/07/06; 71 FR 17757	10/09/09; 74 FR 52300	6/2/10; 75 FR 30714
Eulachon *(Thaleichthys pacificus)*			
Southern DPS	T 3/18/10; 75 FR 13012	10/20/11; 76 FR 65324	Not applicable

Status of LCR Chinook Salmon

Background. On March 24, 1999, NMFS listed the LCR Chinook salmon ESU as a threatened species (64 FR 14308), and in 2016, concluded that this ESU should retain its threatened status (81 FR 33468). Critical habitat was designated on September 2, 2005 (70 FR 52630). The summary that follows describes the status of LCR Chinook salmon. More information can be found in the recovery plan (NMFS 2013a) and the most recent status review (NMFS 2016a).[1]

The LCR Chinook salmon ESU includes all naturally spawned populations from the mouth of the Columbia River upstream to and including the White Salmon River in Washington and the Hood River in Oregon. It also includes the Willamette River upstream to Willamette Falls (exclusive of spring-run Chinook salmon in the Clackamas River), and 15 artificial propagation programs (70 FR 37160).[2] This ESU comprises 32 independent populations, which are grouped into the following six MPGs based on combinations of ecoregions (Coast, Cascade, Gorge) and life-history type (spring, fall, late fall): Coast fall, Cascade spring, Cascade fall, Cascade late-fall, Gorge fall, and Gorge spring.[3] According to the most recent status review, twenty-seven populations are at very high risk of extinction, two populations are at high risk of extinction, one population is at moderate risk of extinction, and two populations are at very low risk of extinction (NMFS 2016a).

Life-History and Factors for Decline. LCR spring Chinook salmon populations are stream-type, while LCR early-fall and late-fall Chinook salmon populations are ocean-type. Stream-type populations have a longer freshwater residency, perform extensive offshore migrations, and are most commonly found in headwater streams of large river systems. Ocean-type populations are more commonly found in coastal streams and typically migrate to sea within the first 3 months of life. Other life-history differences among run types include the timing of spawning, incubation, emergence in freshwater, migration to the ocean, maturation, and return to freshwater. This life-history diversity allows different runs of Chinook salmon to use streams as small as 10 feet wide and rivers as large as the mainstem Columbia (NMFS 2013a). Stream characteristics determine the distribution of run types among LCR streams. Depending on run

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[1] In addition, a technical memo prepared for the status review contains detailed information on the biological status of the species (NWFSC 2015).

[2] Big Creek Tule Fall Chinook, Astoria High School (Salmon and Trout Enhancement Program also known as STEP) Tule Fall Chinook, Warrenton High School (STEP) Tule Fall Chinook, Cowlitz Tule Fall Chinook Salmon Program, North Fork Toutle Tule Fall Chinook, Kalama Tule Fall Chinook, Washougal River Tule Fall Chinook, Spring Creek National Fish Hatchery (NFH) Tule Chinook, Cowlitz spring Chinook salmon (two programs), Friends of Cowlitz spring Chinook, Kalama River Spring Chinook, Lewis River Spring Chinook, Fish First Spring Chinook, and Sandy River Hatchery Spring Chinook salmon (ODFW stock #11). In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including LCR Chinook salmon (81 FR 72759) and published final revisions in 2020 (85 FR 81822). The final changes for hatchery program inclusion in this ESU were to add the Klaskanine Hatchery Program Fall, Deep River Net Pens-Washougal Program Fall, Bonneville Hatchery Program Fall, and Cathlamet Channel Net Pens Program Spring. For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005).

[3] The Willamette-Lower Columbia Technical Recovery Team (W/LC TRT) used the term "strata" to refer to these population groupings, which are significant in identifying delisting criteria. The strata are analogous to the "major population groups" defined by the Interior Columbia Technical Recovery Team (ICTRT). For consistency, we use the term "major population group" throughout this opinion.

type, juvenile LCR Chinook salmon may rear for a few months to a year or more in freshwater streams, rivers, or the estuary before migrating to the ocean in spring, summer, or fall. This diversity is an important characteristic of the ESU.

LCR spring Chinook salmon spawn primarily in upstream, higher elevation portions of large subbasins. Adults enter the lower Columbia River from March through June, well in advance of spawning in August and September. Fall Chinook salmon, commonly referred to as "tules," spawn in moderate-sized streams and large river mainstems, including most tributaries of the lower Columbia River. Most LCR fall Chinook salmon enter freshwater from August to September and spawn from late September to November, with peak spawning activity in mid-October. Late-fall Chinook salmon, commonly referred to as "brights," generally return later than tule fall Chinook salmon, are less mature when they enter the Columbia River, and spawn later in the year. Late-fall Chinook salmon enter the Columbia River from August to October and spawn from November to January, with peak spawning in mid-November (NMFS 2013a).
By the time of listing, populations of LCR Chinook salmon had declined substantially from historical levels. Of the 32 populations in the ESU, only the two late-fall runs—the North Fork Lewis and Sandy—were considered viable. Most (26 out of 32) had a very high extinction risk (and some were extirpated or nearly so) (NMFS 2013a). Low abundance, poor productivity, losses of spatial structure, and reduced diversity all contributed to the very high extinction risk for most LCR Chinook salmon populations. Many of the populations were believed to have very low abundance of natural-origin spawners (100 fish or fewer), which subjected them to genetic and demographic risks. Other populations had higher total abundance, but several of these also had high proportions of hatchery-origin spawners. Spatial structure had been substantially reduced in several populations. Low abundance, past broodstock transfers, and other legacy hatchery effects, and ongoing hatchery straying, may have reduced genetic diversity within and among LCR Chinook salmon populations. Hatchery-origin fish spawning naturally may also have reduced population productivity (LCFRB 2010, ODFW 2010).

Recovery Plan. The ESA recovery plan for LCR Chinook salmon (NMFS 2013a) includes delisting criteria for the ESU, along with identification of factors currently limiting its recovery, and management actions necessary for recovery. The biological delisting criteria are based on recommendations by the Willamette-Lower Columbia Technical Recovery Team (W/LC TRT).[4] They are hierarchical in nature, with ESU-level criteria based on the status of natural-origin LCR Chinook salmon assessed at the population level. The plan identifies ESU- and MPG-level biological criteria, and within each MPG, it identifies a target risk status for each population, consistent with the MPG-level criteria. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the ESU will require sufficient improvement in its abundance, productivity, spatial structure, and diversity.

Abundance, Productivity, Spatial Structure, and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within an ESU based on parameters of

[4] The recovery plan also includes "threats criteria" for each of the listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

abundance, productivity, spatial structure, and diversity (these parameters are referred to as the viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans and based on recommendations of the W/LC TRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each MPG to be considered at low extinction risk. For LCR Chinook salmon, recovery requires improving all six MPGs to a high probability of persistence or a probability of persistence consistent with their historical condition.

NMFS' most recent status review (NMFS 2013a) found that overall, there had been little change in status from the previous review. Table 6 lists the MPGs and populations in this ESU and summarizes their abundance/productivity, spatial structure, diversity, and overall population risk status at the time of the most recent status review; it also summarizes their target risk status for delisting (NMFS 2013a, 2016c; NWFSC 2015). Abundance and productivity risk ratings for LCR Chinook salmon populations were high to very high for most populations, except for spring Chinook salmon in the Sandy River (moderate) and late-fall Chinook salmon in the North Fork Lewis and Sandy Rivers (very low for both)(Table 2).

Table 2. LCR Chinook salmon population-level risk for abundance/productivity (A/P), spatial structure, diversity, overall extinction risk as of the most recent status review (NWFSC 2015, NMFS 2013a), and recovery plan target status (NMFS 2013a). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH). The populations that spawn upstream of Bonneville Dam are highlighted in gray.

MPG		Population	A/P Risk Rating	Diversity Risk Rating	Spatial Structure Risk Rating	Overall Extinction Risk Rating	Recovery Plan Target Extinction Risk Rating
Ecological Subregion	**Run Timing**						
Cascade	**Spring**	Cowlitz (WA)	VH	M	H	VH	VL
		Cispus (WA)	VH	M	H	VH	VL
		Tilton (WA)	VH	VH	VH	VH	VH
		Toutle (WA)	VH	H	L	VH	M
		Kalama (WA)	VH	H	L	VH	H
		Lewis (WA)	VH	M	H	VH	L
		Sandy (OR)	M	M	M	M	L
	Fall	Lower Cowlitz (WA)	VH	M	L	VH	L
		Upper Cowlitz (WA)	VH	M	VH	VH	H
		Toutle	VH	M	L	VH	VL

MPG		Population	A/P Risk Rating	Diversity Risk Rating	Spatial Structure Risk Rating	Overall Extinction Risk Rating	Recovery Plan Target Extinction Risk Rating
Ecological Subregion	**Run Timing**						
		Coweeman (WA)	H	L	L	H	VL
		Kalama (WA)	VH	M	L	VH	M
		Lewis (WA)	VH	L	L	VH	VL
		Salmon Creek (WA)	VH	M	L	VH	H
		Clackamas (OR)	VH	H	VL	VH	M
		Sandy (OR)	VH	H	M	VH	M
		Washougal (WA)	VH	M	L	VH	VL
	Late-fall	NF Lewis (WA)	VL	L	L	VL	VL
		Sandy (OR)	VL	M	M	L	VL
Columbia Gorge	**Spring**	White Salmon (WA)	VH	VH	VH	VH	M
		Hood (OR)	VH	VH	VL	VH	VL
	Fall	Lower Gorge (WA & OR)	VH	H	M	VH	M
		Upper Gorge (WA & OR)	VH	H	M	VH	M
		White Salmon (WA)	VH	H	H	VH	M
		Hood (OR)	VH	H	VL	VH	L
Coast Range	**Fall**	Youngs Bay (OR)	H	H	VL	H	H
		Grays/Chinook (WA)	VH	VH	L	VH	L
		Big Creek (OR)	VH	H	L	VH	H
		Elochoman/ Skamokawa (WA)	VH	H	L	VH	L
		Clatskanie OR)	VH	H	VL	VH	L

MPG		Population	A/P Risk Rating	Diversity Risk Rating	Spatial Structure Risk Rating	Overall Extinction Risk Rating	Recovery Plan Target Extinction Risk Rating
Ecological Subregion	Run Timing						
		Mill/Abernathy /Germany (WA)	VH	H	L	VH	L
		Scappoose (OR)	H	H	L	H	L

The most recent status review did note some positive trends. It noted increases in abundance in about 70 percent of the fall-run populations and decreases in hatchery contributions for several populations. Overall, there had been some improvement in the status of a number of fall-run populations, although most were still far from recovery goals (Table 2, Figure 4) (NWFSC 2015, NMFS 2016a).

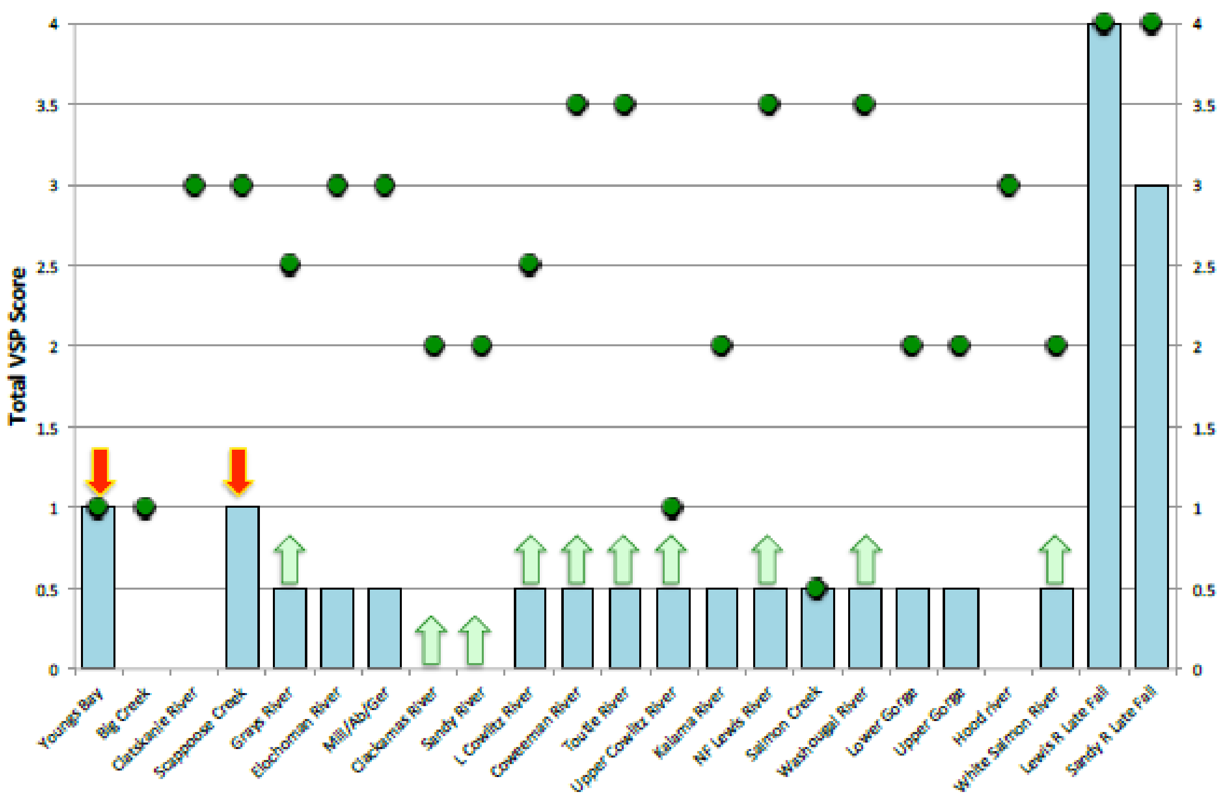

Figure 4. VSP status of fall-run and late-fall-run, demographically independent populations in the LCR Chinook salmon ESU. Bars indicate the initial viable salmonid population (VSP) status (as identified in the recovery plan; NMFS 2013a); green circles indicate the recovery goals. Arrows indicate the general direction, but not the magnitude, of any VSP score based on new data reviewed in NWFSC (2015). VSP scores represent a combined assessment of population abundance and productivity, spatial structure, and diversity (McElhany et al. 2006). A VSP score of 3.0 represents a population with a 5 percent risk of extinction within a 100-year period.

Spring-run populations in the ESU were generally unchanged, with most of the populations remaining at a high or very high risk of extinction due to low abundances and high proportion of hatchery origin fish spawning naturally. In contrast, the Sandy River spring-run Chinook salmon population was considered at moderate risk of extinction. Many of the spring-run populations rely on passage programs at tributary dams, and insufficient juvenile passage systems at these dams remain an impediment to establishing and maintaining self-sustaining natural populations. The removal of Condit Dam on the White Salmon River provided an opportunity for the reestablishment of a spring-run population with volitional access to historical spawning grounds. Overall, there had been some improvement in the status of a number of spring-run populations, although most were still far from recovery goals (Figure 5) (NWFSC 2015, NMFS 2013a).

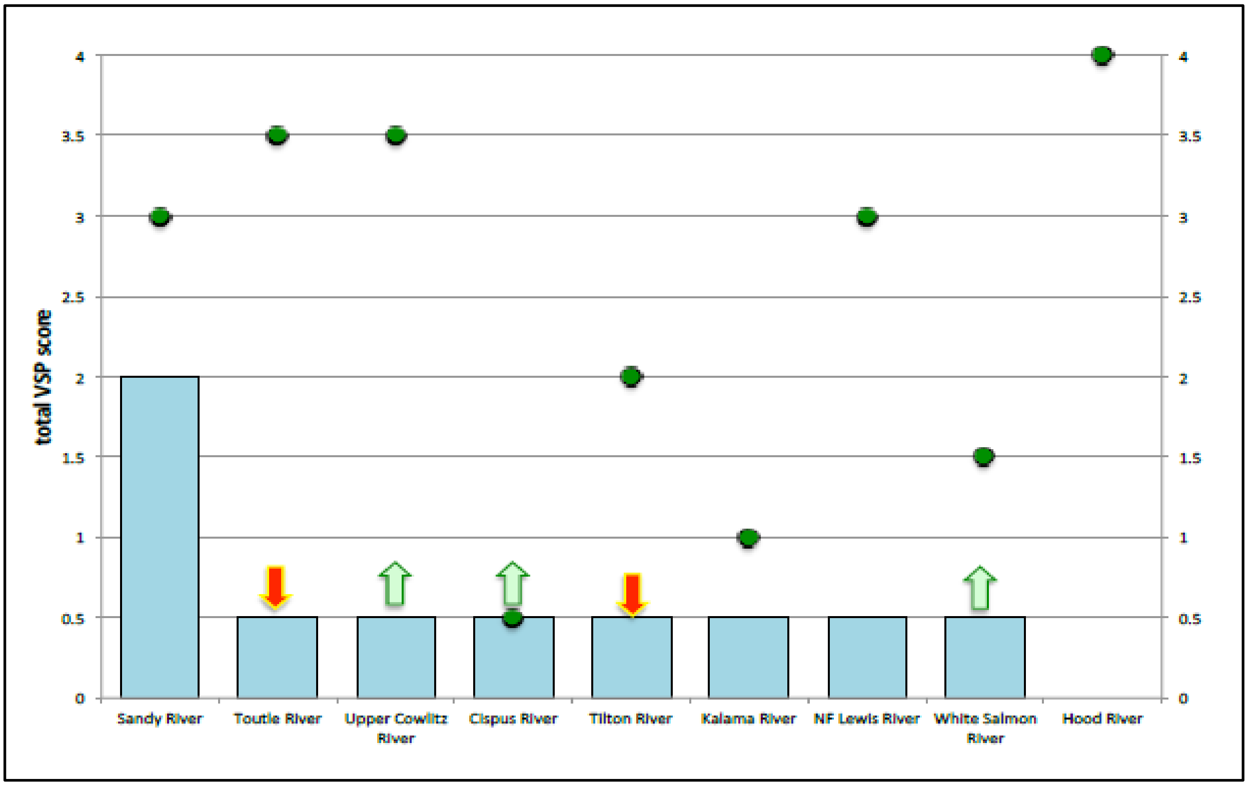

Figure 5. VSP status of spring-run, demographically independent populations in the LCR Chinook salmon ESU. Bars indicate the initial viable salmonid population (VSP) status (as identified in the recovery plan; NMFS 2013a); green circles indicate the recovery goals. Arrows indicate the direction, but not the magnitude, of the VSP score change based on new data reviewed in NWFSC (2015). VSP scores represent a combined assessment of population abundance and productivity, spatial structure, and diversity (McElhany et al. 2006). A VSP score of 3.0 represents a population with a 5 percent risk of extinction within a 100-year period.

Limiting Factors. Understanding the limiting factors and threats that affect the LCR Chinook salmon ESU provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed.

LCR Chinook salmon have been—and continue to be—affected by a legacy of widespread habitat degradation in both tributaries and the estuary; the effects of both tributary and mainstem dams; a history of high harvest rates; large-scale hatchery production with associated reductions in productivity and loss of genetic diversity; and predation by native fish, birds, and marine mammals (NMFS 2013a).

Degraded habitat conditions are a primary limiting factor for most LCR Chinook salmon populations. Tributary channel complexity, side channel and floodplain connectivity, water quality, and hydrologic patterns have been degraded by urbanization, agriculture, timber practices, and other land uses. Estuary habitat conditions are important for LCR fall Chinook salmon, and altered hydrology and flow timing in the estuary, as well as loss of side channel and wetland habitat are considered a primary limiting factor for this life-history component of the ESU. Exposure to toxic contaminants in the estuary is also identified as a concern for the entire ESU (NMFS 2013a).

One of the largest factors limiting the spring component of the LCR Chinook salmon ESU has been the existence of tributary dams that block access to core headwater spawning areas in upper subbasins (NMFS 2013a). There have also been a number of notable efforts to restore access to areas upstream of tributary dams. The removal of Condit Dam, Marmot Dam, and Powerdale Dam have not only improved/provided access but also allowed for the restoration of hydrological processes that may improve downstream habitat conditions. Efforts to improve juvenile passage in the Cowlitz and Lewis River subbasins are underway, and it is unlikely that there will be significant improvements in the status of LCR spring-run Chinook salmon populations until these efforts are successful (NMFS 2013a).

Five LCR Chinook salmon populations (Upper Gorge, Hood, and White Salmon fall Chinook and Hood and White Salmon spring Chinook) spawn above Bonneville Dam and are negatively affected to varying degrees by passage issues at Bonneville Dam and inundation of historical spawning habitat by Bonneville Reservoir (NMFS 2013a).

The effects of harvest as a limiting factor began to decline even before LCR Chinook salmon were listed in 1999. The exploitation rate[5] for LCR spring Chinook salmon averaged 51 percent from 1980 to 1991. Since then, harvest rates have been reduced in both ocean and in-river fisheries. Since 2012, LCR fall Chinook salmon (the most heavily harvested component of the ESU) have been managed to an exploitation rate limit that varies from 30 to 41 percent depending on abundance, in line with the recovery plan (NMFS 2018a).

Limiting factors for LCR Chinook salmon include concerns about adverse effects to diversity and productivity as a result of high proportions of hatchery-origin spawners in select basins, with many populations containing over 50 percent hatchery fish spawning naturally. In addition, the release of out-of-ESU stocks remains a concern for this ESU (NWFSC 2015, NMFS 2013a). Pinniped numbers have increased in the Columbia River basin (Wright 2018), which has led to an increase in predation on LCR Chinook salmon. More than 70,000 fish from listed and unlisted salmon and steelhead stocks were consumed by sea lions in the vicinity of Bonneville Dam from

[5] Exploitation rate is the proportion of the total number of fish from a given natural-origin population(s) or hatchery stock(s) that die from the result of fishing activity in a given year.

2002 through 2019 (Tidwell et al. 2020). California sea lions have historically accounted for the highest pinniped abundance and consequently the most predation on adult salmonids, but Steller sea lion numbers have increased substantially since the early 2000s and are also a source of mortality for LCR Chinook salmon. Most California sea lions arrive at Bonneville Dam in early April and leave by the end of May. Steller sea lions are not as abundant as California sea lions in the Columbia River; however, in the last 5 years more Steller sea lions were observed consuming both spring and fall Chinook salmon at Bonneville Dam.

The risk posed to LCR Chinook salmon by pinniped predation has not been quantified, but we can make inferences based on studies looking at predation rates for all ESUs and run timing of the LCR Chinook salmon populations. The spring-run stocks are at greatest risk, because their run timing coincides with the period of greatest density of pinnipeds in the Columbia River and below Bonneville Dam (discussed further in the Environmental Baseline section, below). The precise number of animals preying on salmon and steelhead throughout the lower Columbia River and Willamette River is not known.

A variety of nonindigenous fishes in the Lower Columbia River Recovery Domain affect salmon and their ecosystems. A number of studies have concluded that many established nonindigenous species (e.g., smallmouth bass, channel catfish, and American shad) pose a threat to the recovery of ESA-listed Pacific salmon, including LCR Chinook salmon. Threats are not restricted to direct predation; nonindigenous 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).

Information on Status of the Species since the 2016 Status Review. We do not have updated dam counts for this species, because most LCR Chinook salmon spawning takes place below Bonneville Dam. The best scientific and commercial data available are at the population level (Table 7) and indicate a mix of recent increases, decreases, and relatively static numbers of natural-origin and total spawners in 2014 to 2018 compared to the 2009 to 2013 period.[6] The direction of "% Change" between recent 5-year geometric means is even mixed within run types: for fall-run Chinook salmon populations, the percent change increased for the Kalama River; Lower Cowlitz River; Washougal River; Grays and Chinook Rivers; and Lower Gorge Tributaries populations and decreased for the Coweeman River; Upper Cowlitz River; White Salmon River; Clatskanie River; and Mill, Abernathy, and Germany Creek populations. Therefore the degree to which abundance has been driven by below-average ocean survival or by a variety of environmental conditions and management actions in freshwater spawning and rearing habitat, appears to vary between populations.

[6] The upcoming 2021 status review is expected to include population-level adult returns through 2019, and the 5-year periods used for calculating geomeans will shift forward (i.e., the last period will include 2015 to 2019). Because 2014 adult returns represented a peak at the ESU level for some populations, shifting 2014 to the preceding 5-year grouping is likely to increase the negative percent change.

Table 3. 5-year geometric mean of natural-origin spawner counts for LCR Chinook salmon, excluding jacks. Number in parenthesis is the 5-year geometric mean of total spawner counts. If there is only a value in parentheses, the total spawner count was the only available data for a population (i.e., there was no or only one estimate of natural spawners for the 5-year period). "% change" is a comparison between the two most recent 5-year periods (2014-2018 compared to 2009-2013). "NA" means not available. An "*" indicates that a data set begins in 2010 so the geometric mean is for 4 years (2010-2013), rather than 5 (2009-2009). Sources: Williams (2020a, b).

MPG	Population	1999-2003	2004-2008	2009-2013	2014-2018	% Change	2019
Cascade	Kalama River - spring	NA	(544)	89 (89)	44 (44)	-51 (-51)	52 (52)
	North Fork Lewis River - spring	(481)	(200)	(99)	(145)	(46)	NA
	Sandy River - spring	NA	NA	1559 (3261)	2837 (3129)	82 (-4)	NA
	Clackamas River - fall	NA	NA	NA	209 (318)	NA	NA
	Coweeman River - fall	NA	(599)	657* (830)	586 (636)	-11 (-23)	NA
	Kalama River - fall	(5742)	(5996)	494* (7198)	1740 (4567)	252 (-37)	NA
	Lewis River - late fall	(8362)	(6652)	10140* (9214)	11096 (11096)	9 (20)	NA
	Lower Cowlitz River - fall	(4311)	(2637)	2480* (3349)	3148 (4197)	27 (25)	NA
	Toutle River - fall	(3220)	(2817)	313* (1197)	299 (559)	-4 (-53)	NA
	Upper Cowlitz River - fall	(156)	(1935)	2750* (8071)	1851 (2697)	-33 (-67)	NA
	Washougal River - fall	(3448)	(3075)	541* (2794)	929 (1619)	72 (-42)	NA
Columbia Gorge	White Salmon River - spring	NA	NA	NA	10 (67)	NA	NA
	Lower Gorge Tributaries - fall	(1036)	(1159)	872* (881)	3467 (3721)	298 (322)	NA
	Upper Gorge Tributaries - fall	(551)	(846)	573* (1230)	539 (1169)	-6 (-5)	NA
	White Salmon River - fall	(1151)	(1457)	749* (948)	348 (580)	-54 (-39)	NA

MPG	Population	1999-2003	2004-2008	2009-2013	2014-2018	% Change	2019
Coast Range	Big Creek - fall	NA	NA	NA	11 (2277)	NA	NA
	Clatskanie River - fall	26 (265)	8 (84)	13 (96)	2 (32)	-85 (-67)	NA
	Elochoman River - fall	(1868)	(1059)	81* (713)	91 (293)	12 (-59)	NA
	Grays and Chinook Rivers - fall	(180)	(199)	81 (401)	218 (642)	169 (60)	NA
	Mill, Abernathy, and Germany Creeks - fall	(1593)	(1091)	79* (700)	30 (196)	-62 (-72)	NA
	Youngs Bay - fall	NA	NA	NA	140 (1757)	NA	NA

NMFS will evaluate the implications for extinction risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 3.

Status of UWR Chinook Salmon

Background. On March 24, 1999, NMFS listed the UWR Chinook salmon ESU as threatened (64 FR 14308). That status was affirmed on June 28, 2005 (70 FR 37160) and updated on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that this ESU should retain its threatened status (81 FR 33468). Critical habitat was designated on September 2, 2005 (70 FR 52630). The summary that follows describes the status of UWR Chinook salmon. More information can be found in the recovery plan (ODFW and NMFS 2011) and the most recent status review (NWFSC 2015).

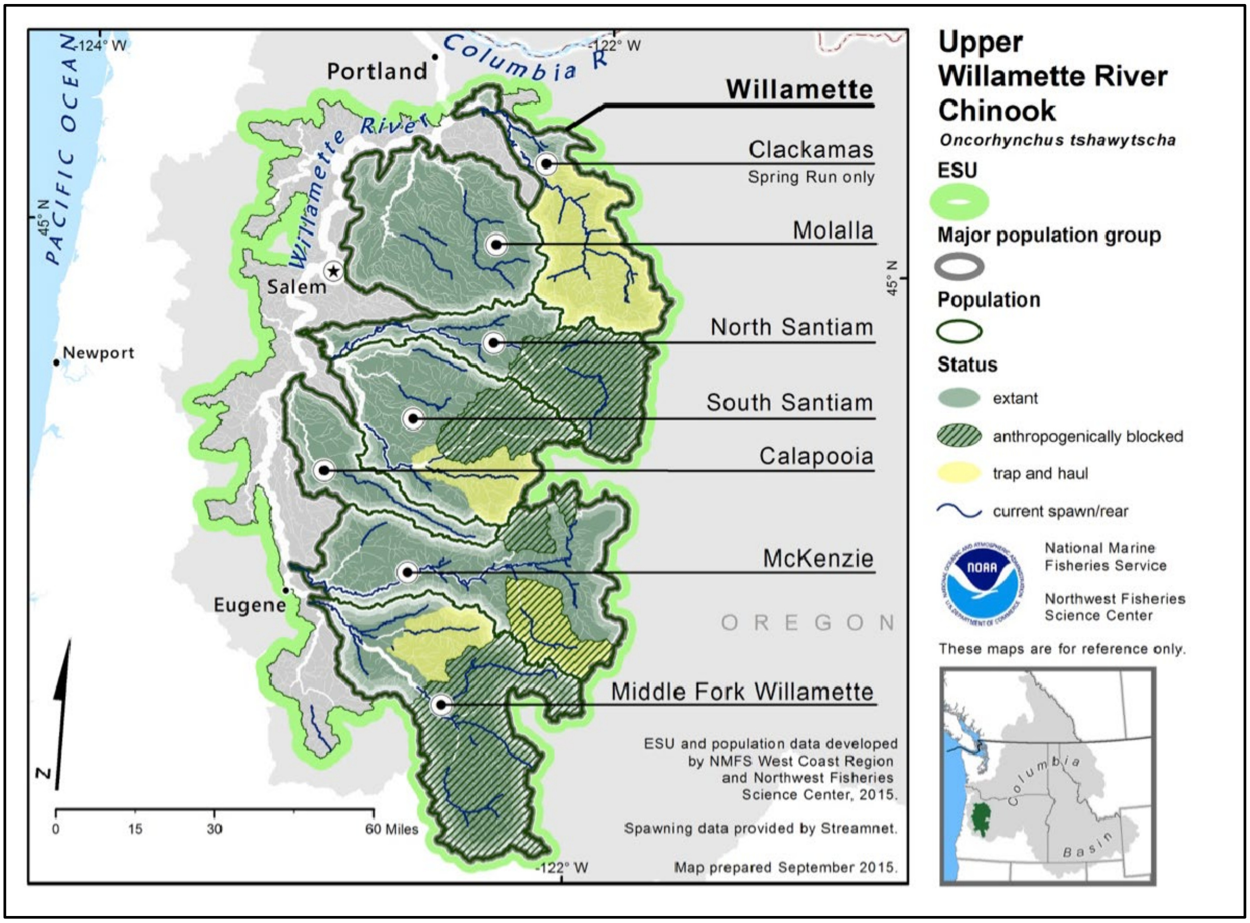

Figure 6. Map of the UWR Chinook salmon ESU's spawning and rearing areas, illustrating populations and major population groups. Source: NWFSC 2015.

The UWR Chinook salmon ESU includes all naturally spawned spring-run Chinook salmon originating from the Clackamas River subbasin and from the Willamette River subbasins upstream of Willamette Falls, as well as six artificial propagation programs (70 FR 37160).[7] The ESU contains seven independent populations within one MPG (Figure 6).

Life-History and Factors for Decline. UWR Chinook salmon differ from other Columbia River basin Chinook salmon according to both genetic and life-history data (Schreck et al. 1986, Utter et al. 1989, Waples et al. 1993, Myers et al. 1998). Recent research has shown that the ESU exhibits several different life-history pathways. Many juveniles from spring Chinook salmon populations reach the Willamette mainstem migration corridor as yearlings, but some juveniles found in the lower Willamette River are subyearlings (Friesen et al. 2004). These early

[7] McKenzie River Hatchery Program (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). In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species (81 FR 72759) and published final revisions in 2020 (85 FR 81822). There were no changes =for the UWR Chinook salmon ESU. For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005).

subyearling migrants can enter the Willamette mainstem (as fry) as early as May and head to the lower Columbia as early as June (Schroeder et al. 2005). Early subyearling migrants have been captured in the upper estuarine zone of the lower Columbia River, and have also been captured in nearshore ocean samples in June. Fall subyearling migrants usually remain in the Willamette subbasins through their first spring and summer; some spend their first winter in the Willamette River, while others move past Willamette Falls on the lower Willamette River before winter, and likely rear in the Columbia River or estuary before entering the ocean as early as March. Adult UWR Chinook salmon enter the Willamette River in January through April and ascend Willamette Falls in April through August (ODFW and NMFS 2011, Rose 2015).

By the time of listing, the UWR Chinook salmon ESU likely numbered less than 10,000 fish, compared to a historical abundance estimate of 300,000 (Myers et al. 2003), and significant natural production occurred only in the Clackamas and McKenzie populations (McElhany et al. 2007). Factors contributing to the decline of the ESU included early fishery exploitation (beginning in the late 19th century) and dramatic declines in water quality and extensive dredging in the lower Willamette River (ODFW and NMFS 2011). Concerns cited by NMFS at the time of listing included: 1) the introduction of fall-run Chinook salmon into the basin, 2) prolonged and extensive spring Chinook hatchery production in the basin, and high proportions of returning hatchery-origin adults, 3) habitat blockage and degradation, including habitat blocked by construction of the Willamette Project dams in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette River Basins and degradation caused by agricultural development and urbanization, and 4) the impacts of high harvest rates (ODFW and NMFS 2011; 63 FR 11482).

Recovery Plan. The ESA recovery plan for UWR Chinook salmon (ODFW and NMFS 2011) includes delisting criteria for the ESU, along with identification of factors currently limiting its recovery, and management actions necessary for recovery. The biological delisting criteria are based on recommendations by the W/LC TRT.[8] They are hierarchical in nature, with ESU-level criteria based on the status of natural-origin UWR Chinook salmon assessed at the population level. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the ESU will require sufficient improvement in its abundance, productivity, spatial structure, and diversity.

Abundance, Productivity, Spatial Structure, and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within an ESU based on parameters of abundance, productivity, spatial structure, and diversity (these parameters are referred to as the viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans and based on recommendations of the W/LC TRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each MPG to be considered at low extinction risk. The Conservation and Recovery Plan for Upper Willamette Chinook salmon and steelhead (ODFW and NMFS 2011) describes

[8] The recovery plan also includes "threats criteria" for each of the listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

the viability criteria in detail, and the parameter values needed for persistence of individual populations and recovery of the ESU.

At the time of the most recent status review (NWFSC 2015), NMFS found that while a few populations had experienced slight improvements in status, others had declined, and overall there had likely been a decline in the status of the ESU. The Clackamas and McKenzie River populations, previously viewed as strongholds within the ESU, had experienced declines in abundance. The apparent decline in the status of the McKenzie River population was a particular concern. In contrast to most of the other populations in this ESU, McKenzie River Chinook salmon have access to much of their historical spawning habitat, although access to historically high-quality habitat above Cougar Dam (on the South Fork McKenzie River) is still limited by poor downstream juvenile passage. Additionally, the installation of a temperature control structure in Cougar Dam in 2008 was thought to benefit downstream spawning and rearing success (NWFSC 2015).

The most recent status review (NWFSC 2015) noted that the Calapooia River population may have been functionally extinct, and that the Molalla River population remained at critically low abundance. The South Santiam River population had also declined in abundance since the previous status review. Abundance in the North Santiam River population had risen since the previous review, but still ranged only in the high hundreds of fish. Improvement in the status of the Middle Fork Willamette River population related solely to the return of natural adults to Fall Creek; however, the capacity of the Fall Creek basin alone would be insufficient to achieve the recovery goals for the Middle Fork Willamette River population (NWFSC 2015).

In terms of spatial structure, the most recent status review noted that access to historical spawning and rearing areas remained restricted by large dams in the four populations that were historically the most productive, and thus spawning and rearing was confined in these populations to more lowland reaches where land development, water temperatures, and water quality may be limiting. Pre-spawning mortality levels were generally high in the lower tributary reaches, where water temperatures and fish densities are generally the highest. Areas immediately downstream of high-head dams may also be subject to high levels of TDG. Hatchery production had remained relatively stable since earlier status reviews, although a number of operational changes had been made at hatcheries that could reduce hatchery impacts eventually (NWFSC 2015)

Given the prospect of long-term climate change, the most recent status review noted that the inability of many populations to access historical headwater spawning and rearing areas may put this ESU at greater risk (NWFSC 2015).

Limiting Factors. Understanding the limiting factors and threats that affect the UWR Chinook salmon ESU provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed. The recovery plan for UWR Chinook salmon (ODFW and NMFS 2011) identifies key and secondary limiting factors and threats for each population by area and life stage. These include:

- Restricted access to historical spawning and rearing habitat by the Willamette Project flood control/hydropower dams. Willamette Project dams block or delay adult fish passage to major portions of the historical holding and spawning habitat for UWR Chinook salmon in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette subbasins. In addition, most Willamette Project dams have limited facilities or operational provisions for safely passing juvenile Chinook salmon downstream of the facilities. In the absence of effective passage programs, UWR Chinook salmon will continue to be confined to lowland reaches, where land development, water temperatures, and water quality are limiting, and where pre-spawning mortality levels are generally high. In addition to the Federal Willamette Project dams, several municipal hydropower or flood control facilities in tributaries also cause adverse effects.
- Hydropower-related limiting factors extend to the Columbia River estuary, where adverse effects on estuarine habitat quality and quantity are related to the cumulative effects of Columbia River basin dams. Effects include an altered seasonal flow regime and Columbia River plume due to flow management (ODFW and NMFS 2011).
- Land use practices including agriculture, timber harvest, mining and grazing activities, diking, damming, development of transportation, and urbanization, which have reduced access to historically productive habitats and reduced the quality of remaining habitat by weakening important watershed processes and functions (ODFW and NMFS 2011).
- Predation by birds, native and non-native fish, and marine mammals, including increasing marine mammal predation at Willamette Falls.
- High proportions of hatchery spawners, although recent improvements offer the potential for collecting more hatchery origin adults and removing them from the natural-spawning component of the North and South Santiam populations.
- Harvest, although overall harvest rates on UWR spring Chinook have dropped from the 50-60 percent range in the 1980s and early 1990s to around 30 percent since 2000.
- Climate change effects, including increased stream temperatures, changes in precipitation/streamflow, and years of low ocean productivity.

<u>Information on Status of the Species since the 2016 Status Review</u>. Abundance data for UWR Chinook salmon are available from counts at the Willamette Falls fishway. In 2015, there was a relatively large run of UWR Chinook salmon, with 51,046 total adults (9,954 natural-origin adults) counted at Willamette Falls. However, the most recent 5-year geometric mean for returning adults at Willamette Falls (2015 to 2019) indicates a decline in both natural-origin and total numbers of adults from the previous 5-year geometric mean, for 2010 to 2014 (Table 4).

Table 4. UWR Chinook salmon adult abundance at Willamette Falls. The 5-year geometric mean of Willamette Falls counts from 2010 to 2014 was calculated at the time of the most recent status review (NWFSC 2015). The geomean for 2015 to 2019 is based on data reported in NMFS (2019) and in the ODFW Willamette Falls Fish Counts database (ODFW 2020).

5-Year Geometric Mean	Natural-Origin Adults	Total Adults
2010-2014	9,269	38,630
2015-2019	6,690	30,081

NMFS will evaluate the implications for viability risk of these more recent returns, and additional data at the population level, in the upcoming 5-year status review, expected in 2022 The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 8.

Since 2016, observations of coastal ocean conditions indicate that recent outmigrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects, which led researchers to predict the drop in adult Chinook salmon returns observed through 2019 (Werner et al. 2017). Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-m surface layer) had not returned to normal (Harvey et al. 2019). Expectations for marine survival are relatively mixed for juveniles that reached the ocean in 2019 (Zabel et al. 2020), suggesting that adult returns could increase somewhat in 2021. However, continued low jack returns as of June 1, 2020, suggest that adult numbers could remain low in 2021.

Status of UCR Spring-run Chinook Salmon

Background. On March 24, 1999, NMFS listed the UCR spring-run Chinook salmon ESU as endangered under the ESA (64 FR 14308), and the status was reaffirmed on June 28, 2005 (70 FR 37160). Critical habitat for the ESU was designated on September 2, 2005 (70 FR 52630). The most recent status review, in 2016, concluded that the ESU should retain its endangered status (81 FR 33468). The summary that follows describes the rangewide status of UCR spring-run Chinook salmon. More information can be found in the recovery plan (UCSRB 2007) and most recent status review for this species (NMFS 2016a) [9].

The UCR spring-run Chinook salmon ESU includes all naturally spawned spring-run Chinook salmon originating from Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam (excluding the Okanogan River). The ESU comprises three extant independent populations, which are grouped into one MPG (historically, a population also spawned in the Okanogan and would also have been part of this MPG, but it is extirpated and not

[9] In addition, a technical memo prepared for the status review contains detailed information on the biological status of the species (NWFSC 2015).

required to achieve the ESA recovery goals) [10]. It also includes spring-run Chinook salmon from six artificial propagation programs (Table 5) (70 FR 37160) [11]. Historically, UCR spring-run Chinook salmon likely included two additional MPGs (Figure 7). These were extirpated by the completion of Grand Coulee and Chief Joseph Dams, and reintroduction of these extirpated MPGs is not required for recovery as defined in the ESA recovery plan (UCSRB 2007).

Table 5. UCR spring-run Chinook salmon major population group and component populations, and hatchery programs (UCSRB 2007, 70 FR 37160).

Major Population Group	***Populations***
North Cascades MPG	Wenatchee River Entiat River Methow River
Hatchery Programs	
Hatchery programs included in ESU	Twisp River Methow River Winthrop National Fish Hatchery Chiwawa River White River Chewuch River

[10] On July 11, 2014, NMFS designated the Okanogan River population as a "nonessential experimental population" of UCR spring-run Chinook salmon (79 FR 40004).

[11] For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005). In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including UCR spring-run Chinook (81 FR 72759). The proposed changes for hatchery program inclusion in this ESU were to add the Nason Creek Program and the Chief Joseph spring Chinook Hatchery Program and remove the Chewuch River Program (as it is considered to be part of the Methow Composite Program). We expect to publish the final revisions in 2020.

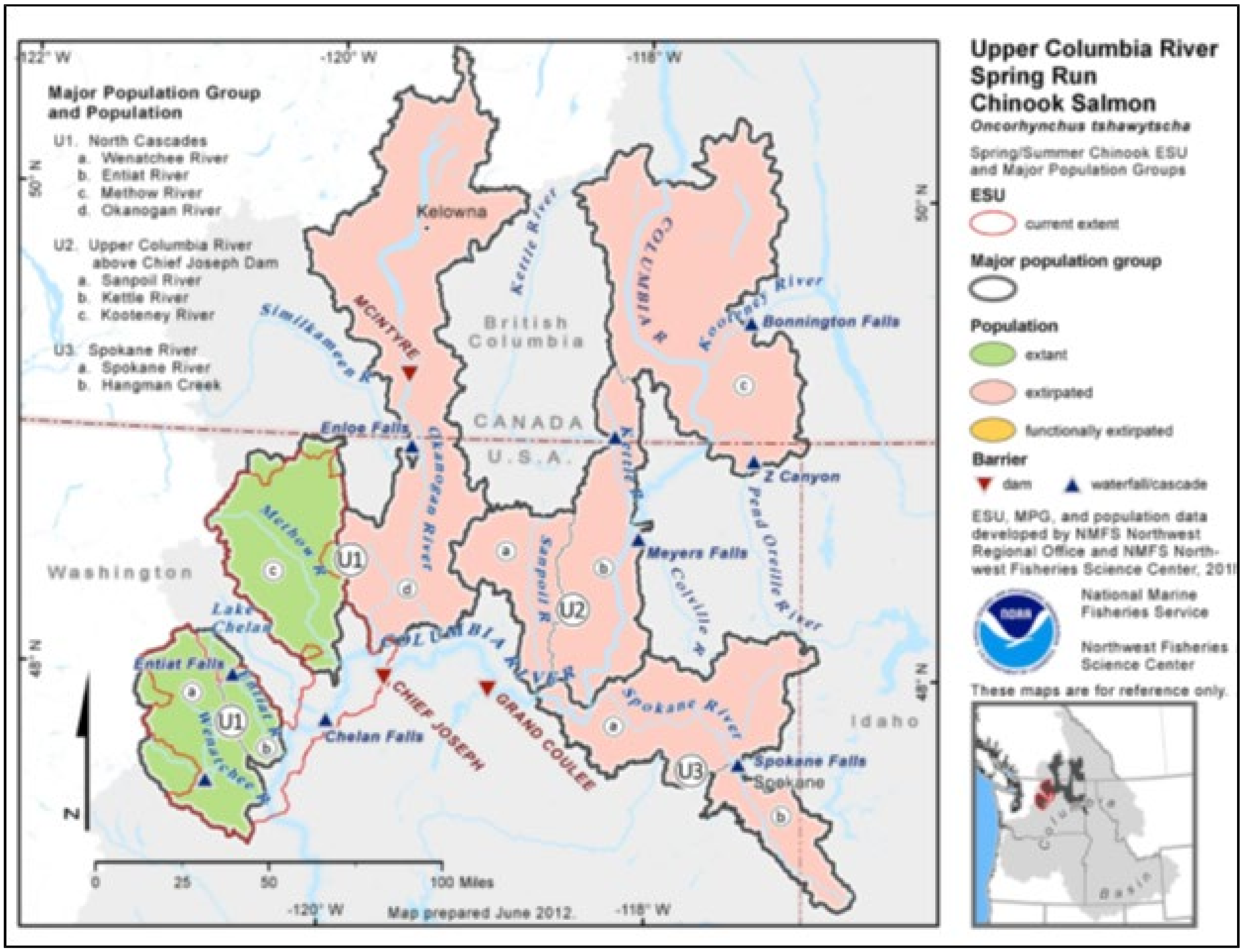

Figure 7. Map illustrating UCR spring-run Chinook salmon ESU's populations and major population groups (NWFSC 2015).

Life History and Factors for Decline. Adult UCR spring-run Chinook salmon begin returning from the ocean in April and May, with the run into the Columbia River peaking in mid-May. They enter the upper Columbia River tributaries from April through July. After migration, they hold in freshwater tributaries until spawning occurs in the late summer, peaking in mid-to-late August. Juvenile spring Chinook salmon spend a year in freshwater before migrating to saltwater in the spring of their second year of life. Most UCR spring-run Chinook salmon return as adults after 2 or 3 years in the ocean. Some precocious males, or jacks, return after one winter at sea. A few other males mature sexually in freshwater without migrating to the sea. The run, however, is dominated by 4- and 5-year-old fish that have spent 2 and 3 years at sea, respectively. Fecundity ranges from 4,200 to 5,900 eggs, depending on the age and size of the female (UCSRB 2007).

Factors contributing to the decline of UCR spring-run Chinook salmon included the intensive commercial fisheries in the lower Columbia River. These fisheries began in the latter half of the 1800s, continued into the 1900s, and nearly eliminated many salmon and steelhead stocks. With time, the construction of dams and diversions, some without passage, blocked or impeded salmon and steelhead migrations. Early hatcheries, operated to mitigate the impacts of dams on fish passage and spawning and rearing habitat, employed practices such as transferring fish among basins without regard to their origin. While these practices increased the abundance of stocks, they also decreased the diversity and productivity of populations they intended to supplement. Concurrent with these activities, human population growth within the basin was increasing and land uses were adversely affecting salmon spawning and rearing habitat. In addition, non-native species were introduced by both public and private interests that directly or indirectly affected salmon (UCSRB 2007).

Annual spawning escapements for all three of the extant UCR spring-run Chinook salmon populations showed steep declines beginning in the late 1980s, leading to extremely low abundance levels in the mid-1990s.

All three extant populations spawn in tributaries to the Columbia River upstream of the confluence of the Snake River with the Columbia River. They pass the four lower Columbia River dams (Bonneville, The Dalles, John Day, and McNary), operation of which is part of the proposed action. In addition, all three populations also spawn upstream of the PUD-operated Priest Rapids, Wanapum, and Rock Island Dams on the upper Columbia River. The Entiat River population must pass one additional PUD dam (Rocky Reach) and the Methow population must pass two additional PUD dams (Rocky Reach and Wells Dams). The operation of these PUD dams is not part of the proposed action.

Recovery Plan. The ESA recovery plan for UCR spring-run Chinook salmon (UCSRB 2007) includes delisting criteria for the ESU, along with identification of factors currently limiting its recovery, and management actions necessary to achieve the goals[12]. The biological delisting criteria are based on recommendations by the ICTRT[13]. They are hierarchical in nature, with ESU-level criteria based on the status of natural-origin UCR spring-run Chinook salmon assessed at the population level. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the ESU will require improvement in the abundance, productivity, spatial structure, and diversity of all three extant populations to the point that all three are considered viable (i.e., at low risk of extinction) (UCSRB 2007).

Abundance, Productivity, Spatial Structure and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within the ESU based on parameters of abundance, productivity, spatial structure, and diversity (these parameters are referred to as the viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans and based on recommendations of the ICTRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each

[12] This plan was developed by the Upper Columbia Salmon Recovery Board and then reviewed and adopted by NMFS (72 FR 57303).
[13] The recovery plan also includes "threats criteria" for each of the relevant listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

MPG to be considered at low risk. Generally, each MPG must achieve low risk for the ESU as a whole to be considered no longer threatened or endangered. For the single UCR spring-run Chinook salmon MPG to achieve low risk, all three of its extant populations must achieve viable status (i.e., low extinction risk) (UCSRB 2007).

As of the most recent status review (NMFS 2016a), the 5-year geometric mean abundance of adult natural-origin spawners had increased for each population relative to the levels reported in the 2011 status review, but natural-origin escapements remained well below the corresponding ICTRT thresholds for viability (i.e., low extinction risk). The short-term (e.g., 15-year) trend in natural-origin spawners was neutral for the Wenatchee River population and positive for the Entiat and Methow River populations. Time series of smolt production data from several locations within the Wenatchee subbasin showed some indication of density-dependent effects at higher spawning levels. The evaluation of overall abundance and productivity resulted in all three extant populations continuing to be rated at high risk (NWFSC 2015, NMFS 2016a).

In the most recent status review (NMFS 2016a), all three populations continued to be rated at low risk for spatial structure and at high risk for diversity. The high-risk diversity rating was driven primarily by continued high proportions of hatchery-origin spawners in natural spawning areas and a lack of genetic diversity among the natural-origin spawners. Direct hatchery supplementation in the Entiat subbasin was discontinued in 2007, and an upward trend in the proportion of natural-origin spawners in that population was attributed to that closure. Large-scale hatchery supplementation programs continued in the Methow and Wenatchee Rivers. These programs are intended to counter short-term demographic risks given current average survival levels and the associated year-to-year variability. The composite spatial structure/diversity risks for all three of the extant natural populations in this ESU were also rated as high (NWFSC 2015, NMFS 2016a).

Table 6 lists the MPGs and populations in this ESU and summarizes their abundance/productivity, spatial structure, diversity, and overall population risk status, based on information in the most recent status review (NWFSC 2015, NMFS 2016a); it also summarizes their target risk status for delisting (UCSRB 2007).

Table 6. UCR spring-run Chinook salmon population-level risk for abundance/productivity (A/P), diversity, integrated spatial structure/diversity (SS/D), overall status as of the most recent status review (NWFSC 2015, NMFS 2016a), and recovery plan target status (UCSRB 2007). Risk ratings range from very low (VL) to low (L), moderate (M), high (H), very high (VH), and extirpated (E).

Population	ICTRT Minimum Abundance Threshold[1]	A/P Risk Rating	Diversity Risk Rating	Integrated SS/D Risk Rating	Overall Extinction Risk	Recovery Plan Target Extinction Risk Rating
Wenatchee River	2,000	H	H	H	H	L
Entiat River	500	H	H	H	H	L
Methow River	2,000	H	H	H	H	L

[1]Minimum abundance thresholds represent the number of spawners needed for a population of a given size category to achieve low risk (viability) at a given productivity (ICTRT 2007).

Limiting Factors. Understanding the limiting factors and threats that affect UCR spring-run Chinook salmon provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting the species is to ensure that the underlying limiting factors and threats have been addressed. Limiting factors identified in the recovery plan (UCSRB 2007) for this ESU include (in no particular order):

- Habitat degradation: Human activities have altered and/or curtailed habitat-forming processes and limited the habitat suitable for UCR spring-run Chinook salmon in the upper Columbia River tributaries. Storage dams, diversions, roads and railways, agriculture, residential development, and forest management continue to cause changes in water flow, water temperature, sedimentation, floodplain dynamics, riparian function, and other aspects of the ecosystem, that are deleterious to UCR spring-run Chinook salmon and their habitat.
- Hydropower systems: Conditions for UCR spring-run Chinook salmon have been fundamentally altered by the construction and operation of mainstem dams for power generation, navigation, and flood control. UCR spring-run Chinook salmon are adversely affected by hydrosystem-related flow and water quality effects, obstructed and/or delayed passage, and ecological changes caused by impoundments. Effects occur at the four Federal dams on the lower Columbia River and at FERC-licensed dams on the Upper Columbia River[14].

[14] All three populations spawn upstream of the PUD-operated Priest Rapids, Wanapum, and Rock Island Dams on the upper Columbia River. The Entiat River population must pass one additional PUD dam (Rocky Reach) and the Methow population must pass two additional PUD dams (Rocky Reach and Wells Dams).

- Harvest: Historical harvest rates have been reduced from their peak as a result of international treaties, fisheries conservation acts, the advent of weak-stock management, regional conservation goals, and the ESA listing of many salmon ESUs and steelhead DPSs. While fisheries do not target weak stocks of listed salmon or steelhead, listed fish are incidentally caught in fisheries directed at hatchery and unlisted natural-origin stocks.
- Hatcheries: In the upper Columbia River region, hatcheries producing spring-run Chinook salmon are operated to mitigate the impacts of habitat loss resulting from the construction of Grand Coulee Dam and passage and habitat impacts of the mid-Columbia PUD dams. While these hatcheries provide valuable mitigation and/or conservation benefits, they can also cause adverse impacts, including genetic effects that reduce fitness and survival, ecological effects such as competition and predation, facility effects on passage and water quality, incidental handling and mortality due to harvest, and masking of the true status of natural-origin populations.
- Additional factors include changes in estuarine habitat, climate change, inadequacy of regulatory mechanisms, fluctuating ocean cycles, and predation.

In its most recent status review NMFS (2016d) noted that:

- Despite efforts to improve tributary habitat conditions, considerable improvement is still needed to restore habitat to levels that will support viable populations.
- Direct survival of juvenile salmonids outmigrating from upper Columbia River populations has increased as a result of juvenile passage improvements at Federal and PUD dams.
- Harvest exploitation rates[15] have remained relatively low, generally below 10 percent, though they had been increasing in recent years. The recent increases have resulted from increased allowable harvest rates under the abundance-driven sliding-scale harvest rate strategy that guides annual management.
- Natural-origin contributions to spawning in the Wenatchee and Methow River populations have trended downwards since 1990. NMFS (2016d) said that this reflected increased hatchery supplementation in those populations to boost abundance. Spring-run Chinook salmon hatchery releases into the Entiat River were discontinued in 2007, and the numbers of hatchery-origin spawners have decreased in response.
- Avian and pinniped predation on UCR spring-run Chinook salmon have increased since the previous status review in 2011, and non-indigenous fish species remain a threat.
- Some regulatory mechanisms have improved since the previous status review, but, particularly for land-use regulatory mechanisms, there was lack of documentation or analysis of their effectiveness.
- Climate change was a concern, particularly the future effects of continued warming in marine and freshwater systems.

Information on Status of the Species since the 2016 Status Review. The best scientific and commercial data available with respect to the adult abundance of UCR spring-run Chinook salmon indicates a substantial downward trend in the abundance of natural-origin spawners at the

[15] Exploitation rate is the proportion of the total number of fish from a given natural-origin population(s) or hatchery stock(s) that die from the result of fishing activity in a given year.

ESU level from 2015 to 2019 (Figure 8). This recent downturn is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity (see discussion below) because hydropower operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices have been relatively constant or improving over the past 10 years[16]. Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.

Population-level abundance estimates of natural-origin and total (natural- plus hatchery-origin) spawners through 2018 are shown in Table 7. These data also show recent and substantial downward trends in abundance for all three populations of UCR spring-run Chinook salmon when compared to the 2009 to 2013 period[17]. All populations remain considerably below the minimum abundance thresholds established by the ICTRT (shown in Table 7) and include substantial numbers of hatchery-origin adults.

[16] Many factors (e.g., higher summer temperatures, lower late summer flows, low spring flows, etc.) affect the ability of tributary habitat to produce juvenile migrants (capacity) each year. Recent drought and temperature patterns may have had a negative effect on tributary habitat productivity, and as a result, lower than average juvenile production may have contributed in some years to downturns in adult abundance.

[17] The upcoming status review, expected in 2022, will include population-level adult returns through 2019, and will add a new rolling 5-year geomean, for 2015 to 2019. Because the 2015 adult returns represented a peak at the ESU level (Figure 8), the negative percent change between the 2015–2019 and 2014–2018 geomeans will not necessarily be greater than that shown in Table 2.6-3 between the 2014–2018 and 2009–2013 geomeans, at least for some populations.

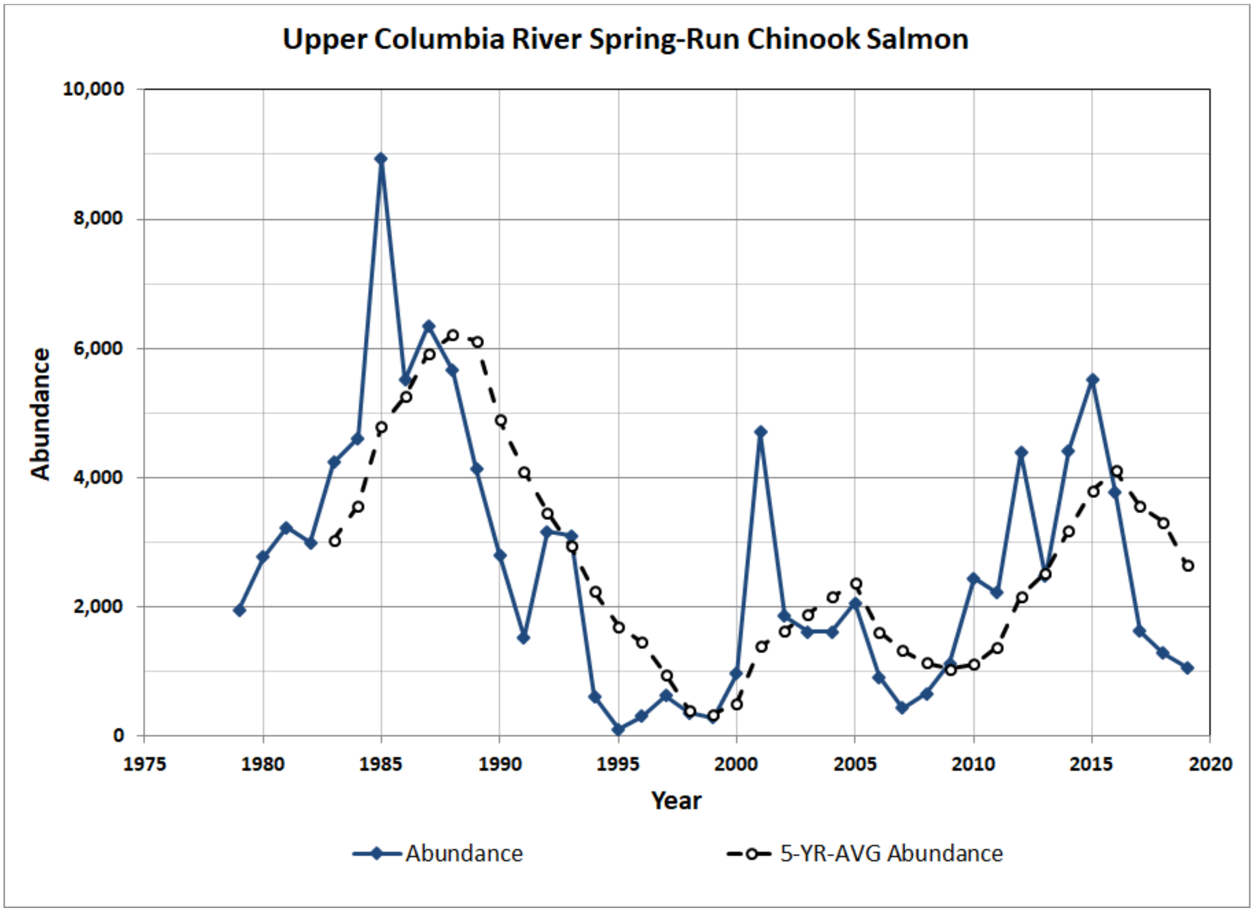

Figure 8. Annual abundance and 5-year average abundance estimates for the UCR spring-run Chinook salmon ESU (natural-origin fish only) at Rock Island Dam based on passage counts from 1979 to 2019. Data are from the 2020 Joint Staff Report on Stock Status and Fisheries (ODFW and WDFW 2020).

Table 7. 5-year geometric mean of natural-origin spawner counts for UCR spring-run Chinook salmon, excluding jacks. Number in parenthesis is the 5-year geometric mean of total spawner counts. "% change" is a comparison between the two most recent 5-year periods (2014-2018 compared to 2009-2013). "NA" means not available. At the time of drafting this opinion, 2019 data were not available for any of the populations in this ESU. Source: (Williams 2020c).

MPG	Population	1989–1993	1994–1998	1999–2003	2004–2008	2009–2013	2014–2018	% Change
North Cascades	Entiat River	NA	44 (55)	104 (190)	121 (284)	228 (336)	134 (186)	-41 (-45)
	Methow River	NA	60 (89)	159 (1158)	351 (1256)	428 (1785)	295 (803)	-31 (-55)
	Wenatchee River	NA	102 (208)	423 (971)	371 (1372)	664 (1987)	517 (1230)	-22 (-38)

NMFS will evaluate the implications for viability risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 7.

Since 2016, observations of coastal ocean conditions indicate that recent outmigrant year classes have experienced below average ocean survival during a marine heatwave and its lingering effects, which led researchers to predict the drop in adult returns observed through 2019 (Werner et al. 2017). Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-meter surface layer) had not returned to normal (Harvey et al. 2019). Expectations for marine survival are relatively mixed for juvenile Chinook salmon that reached the ocean in 2019 (Zabel et al. 2020). Based on mainstem dam counts, overall returns of spring Chinook salmon in 2020 also appear to be low, similar to 2019 counts.

Status of Snake River Spring/Summer-run Chinook Salmon

Background. On June 3, 1992, NMFS listed the SR spring/summer-run Chinook salmon ESU as a threatened species (57 FR 23458). The threatened status was reaffirmed on June 28, 2005 (70 FR 37160), and again on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that the ESU should retain its threatened status (81 FR 33468). Critical habitat was originally designated on December 28, 1993 (58 FR 68543), then updated on October 25, 1999 (65 FR 57399). The summary that follows describes the rangewide status of SR spring/summer Chinook salmon. Additional information can be found in the recovery plan (NMFS 2017a) and most recent status review (NMFS 2016b) for this species[18].

[18] In addition, a technical memo prepared for the status review contains more detailed information on the biological status of the species (NWFSC 2015).

The SR spring/summer-run Chinook salmon ESU includes all naturally spawned populations of spring/summer-run Chinook salmon originating from the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins. The ESU includes 28 extant natural populations (plus three functionally extirpated populations and one extirpated population), which are aggregated into five MPGs based on genetic, environmental, and life-history characteristics. Eleven artificial propagation programs are also included in the ESU (NMFS 2017a, 70 FR 37160) [19]. Figure 9 shows a map of the ESU and its component MPGs; Table 8 lists the populations within each MPG and the hatchery programs that are part of the ESU. Historically, SR spring/summer Chinook salmon also spawned and reared in several areas that are no longer accessible in the Clearwater River basin and in the area above Hells Canyon Dam.

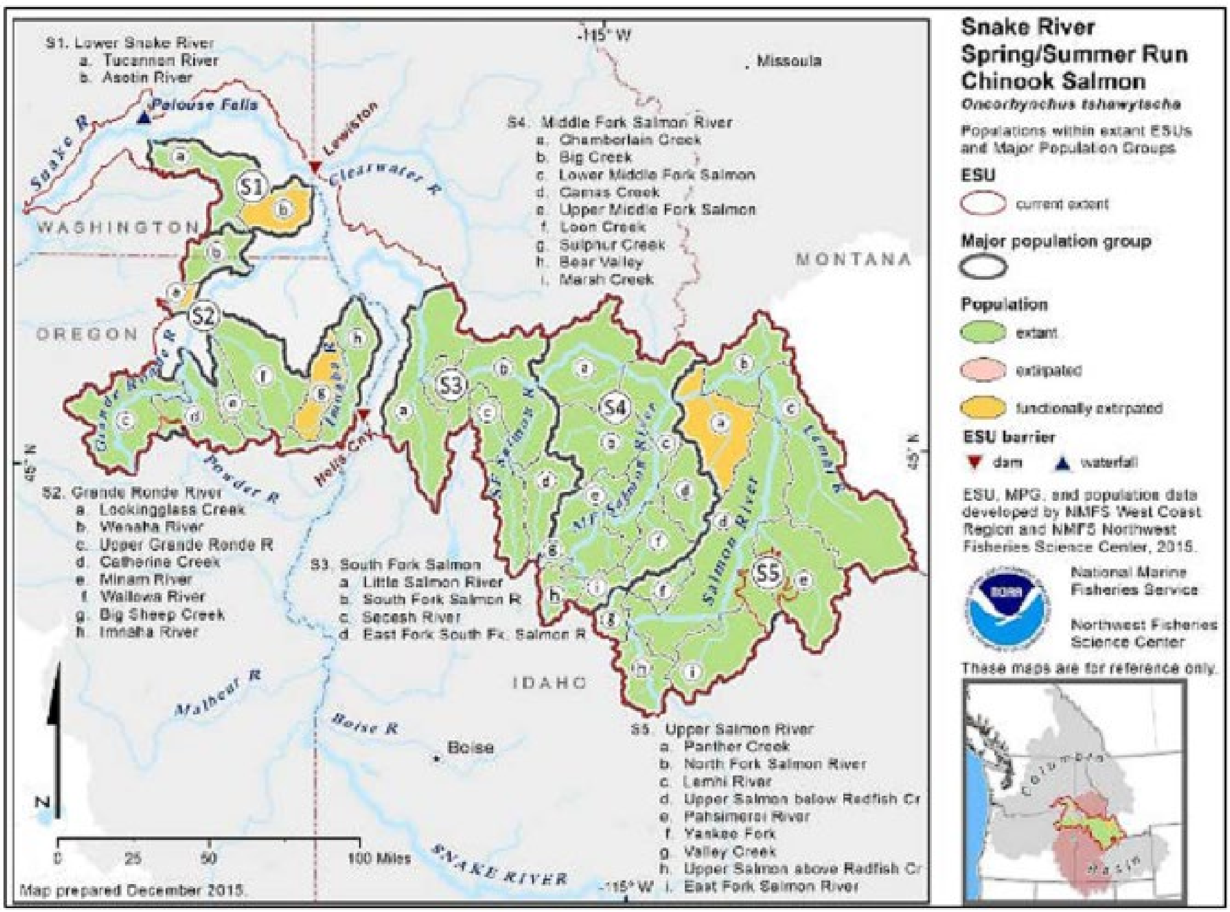

Figure 9. Map illustrating SR spring/summer Chinook salmon ESU's populations and major population groups (NWFSC 2015).

[19] For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005). In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including SR spring/summer Chinook salmon (81 FR 72759). The proposed changes for hatchery program inclusion in this ESU were to add the Yankee Fork Program, the Dollar Creek Program, and the Panther Creek Program. We expect to publish the final revisions in 2020.

Table 8. SR spring/summer Chinook salmon ESU major population groups and component populations, and hatchery programs (NMFS 2017a, 70 FR 37160).

Major Population Group	***Populations***
Lower Snake River	Tucannon River Asotin Creek (functionally extirpated)
Grande Ronde/Imnaha River	Wenaha River Lostine/Wallowa Rivers Minam River Catherine Creek Upper Grande Ronde River Imnaha River Lookingglass Creek (functionally extirpated) Big Sheep Creek (functionally extirpated)
South Fork Salmon River	Secesh River East Fork South Fork Salmon River South Fork Salmon River Mainstem Little Salmon River
Middle Fork Salmon River	Bear Valley Marsh Creek Sulphur Creek Loon Creek Camas Creek Big Creek Chamberlain Creek Lower Middle Fork Salmon Upper Middle Fork Salmon
Upper Salmon	Lower Salmon River Lemhi River Pahsimeroi River Upper Salmon River East Fork Salmon River Valley Creek Yankee Fork North Fork Salmon River Panther Creek (extirpated)
Hatchery Programs	
Hatchery programs included in ESU	Tucannon River Lostine River Catherine Creek Lookingglass Hatchery Reintroduction Upper Grande Ronde Imnaha River Big Sheep Creek McCall Hatchery Johnson Creek Artificial Propagation Enhancement Pahsimeroi Hatchery Sawtooth Hatchery

Life-History and Factors for Decline. SR spring/summer Chinook salmon generally exhibit a stream-type life-history, meaning that they reside in freshwater for a year or more before migrating toward the ocean, although some populations exhibit variations from this pattern (e.g., Salmon River basin juveniles may spend less than 1 year in freshwater) (Copeland and Venditti 2009). Juvenile outmigrants generally pass downstream of Bonneville Dam from late April through early June. Yearling outmigrants are thought to spend relatively little time in the estuary compared to sub-yearling ocean-type fish, often travelling from Bonneville Dam (river mile [RM] 146) to a sampling site at RM 43 in 1 to 2 days. Adult SR spring-run Chinook salmon return to the Columbia River in early spring and pass Bonneville Dam beginning in early March through late May. Adult SR summer-run Chinook salmon return to the Columbia River from June through July. Adults from both runs hold in deep pools in the mainstem Columbia and Snake Rivers and the lower ends of the spawning tributaries until late summer, when they migrate into the higher elevation spawning reaches (NMFS 2017a).

Historically, the entire Snake River basin is thought to have produced more than 1 million adult spring/summer Chinook salmon in some years (ISAB 2015, NMFS 2017a). By the 1950s, abundance of SR spring/summer Chinook salmon had declined to an estimated annual average of 125,000 adults (Matthews and Waples 1991). Declines continued, reaching a low of only about 2,200 adults (hatchery and natural-origin combined) in 1995, shortly after the ESA listing. Over the long term, abundance has been affected by a variety of factors, including ocean conditions, harvest, increased predation, construction and continued operation of Snake and Columbia River dams, adverse impacts of hatchery fish, and widespread alteration of spawning and rearing habitats (NMFS 2017a).

Harvest rates soared in the late 1800s and remained high until the 1970s. At the same time, increased European-American settlement resulted in the deterioration of habitat conditions due to logging, mining, grazing, farming, irrigation, development, and other land use practices that cumulatively reduced access to and productivity of spawning and rearing habitat, increased sediment contributions to streams, reduced instream flows, and increased stream temperatures (NMFS 2017a).

Large portions of historical habitat were blocked in 1901 by the construction of Swan Falls Dam, on the Snake River, and later by construction of the three-dam Hells Canyon Complex from 1955 to 1967. Dam construction also blocked and/or hindered fish access to historical habitat in the Clearwater River basin as a result of the construction of Lewiston Dam (removed in 1973 but believed to have caused the extirpation of native Chinook salmon in that subbasin). The loss of this historical habitat substantially reduced the spatial structure of this species. The production of SR spring/summer Chinook salmon was further affected by the development of the eight Federal dams and reservoirs in the mainstem lower Columbia/Snake River migration corridor between the late 1930s and early 1970s; four on the lower Columbia River (Bonneville, The Dalles, John Day, and McNary Dams) and four on the lower Snake River (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams) (Figure 10) (NMFS 2017a).

Figure 10. All populations of SR spring/summer Chinook salmon migrate through four lower Columbia River mainstem dams (Bonneville, The Dalles, John Day and McNary Dams), and all except one population (the Tucannon) migrate through four additional dams on the lower Snake River (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams). The Tucannon population migrates through six dams (the four lower Columbia River mainstem dams and two lower Snake River dams. (Modified from a map obtained at //www.nwcouncil.org/.)

Recovery Plan. The ESA recovery plan for SR spring/summer Chinook salmon (NMFS 2017a) includes delisting criteria for the ESU, along with identification of factors currently limiting the recovery of the ESU, and management actions necessary for recovery. The biological delisting criteria are based on recommendations by the Interior Columbia Basin Technical Recovery Team (ICTRT) [20]. They are hierarchical in nature, with ESU-level criteria based on the status of natural-origin Chinook salmon assessed at the population level. The plan identifies ESU- and MPG-level biological criteria, and within each MPG, it provides guidance on a target risk status for each population, consistent with the MPG-level criteria. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the ESU will require sufficient improvement in its abundance, productivity, spatial structure, and diversity. Table 9 summarizes the recovery plan

[20] The recovery plan also includes "threats criteria" for each of the relevant listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

goals and population status (as of the most recent status review) for SR spring/summer Chinook salmon.

Table 9. Population status as of the most recent status review (NWFSC 2015, NMFS 2016b) and recovery plan target status for SR spring/summer Chinook salmon populations (NMFS 2017a).

MPG	Population	Population Status (as of 2016 status review)	Recovery Plan Proposed Target Status	ICTRT Viability Criteria Recommendations Regarding Target Status
Lower Snake	Tucannon River	high risk	highly viable	The basic ICTRT criteria would call for both populations to be restored to viable status, with one achieving highly viable status. The ICTRT recommended that recovery efforts prioritize restoring the Tucannon River to highly viable status and evaluate the potential for reintroducing production in Asotin Creek as recovery efforts progress.
	Asotin Creek	functionally extirpated	consider reintroduction	
Grande Ronde/ Imnaha	Catherine Creek	high risk	viable or highly viable	The basic ICTRT criteria call for a minimum of four populations at viable status, with at least one highly viable, and the rest meeting maintained status. The potential scenario identified by the ICTRT would include viable populations in the Imnaha River (representing important run-timing diversity), the Lostine/Wallowa River (representing a large-size population), and at least one from each of the following pairs: Catherine Creek or Upper Grande Ronde River (representing large-size populations), and Minam River or Wenaha River.
	Upper Grande Ronde River	high risk	maintained	
	Minam River	high risk	viable or highly viable	
	Wenaha River	high risk	viable or highly viable	
	Lostine/Wallowa Rivers	high risk	viable or highly viable	
	Imnaha River	high risk	viable or highly viable	
	Big Sheep Creek	functionally extirpated	consider reintroduction	
	Lookingglass Creek	functionally extirpated	consider reintroduction	
South Fork Salmon	South Fork Salmon River Mainstem	high risk	viable	The basic ICTRT criteria call for two of the populations in this MPG to be restored to viable status, with at least one of these highly viable, and the rest meeting maintained status. The ICTRT recommended that the populations in the South Fork Salmon River drainages be given priority due to the relatively small size and the high level of potential
	Secesh River	high risk	highly viable	
	East Fork South Fork Salmon River	high risk	maintained	

MPG	Population	Population Status (as of 2016 status review)	Recovery Plan Proposed Target Status	ICTRT Viability Criteria Recommendations Regarding Target Status
	Little Salmon River	high risk	maintained	hatchery integration for the Little Salmon River population.
Middle Fork Salmon	Big Creek	high risk	highly viable	The basic ICTRT criteria call for at least five of the nine populations in this MPG to be restored to viable status, with at least one demonstrating highly viable status. The remaining populations should achieve maintained status. The ICTRT example recovery scenario recommended that Chamberlain Creek (geographic position), Big Creek (large-size category), Bear Valley Creek, Marsh Creek, and either Loon Creek or Camas Creek achieve viable status.
	Bear Valley	high risk	viable	
	Marsh Creek	high risk	viable	
	Sulphur Creek	high risk	maintained	
	Camas Creek	high risk	maintained	
	Loon Creek	high risk	viable	
	Chamberlain Creek	maintained	viable	
	Lower Middle Fork Salmon River	high risk	maintained	
	Upper Middle Fork Salmon River	high risk	maintained	
Upper Salmon	Lemhi River	high risk	viable	The basic ICTRT criteria for this MPG call for at least five populations to meet viability criteria, with at least one highly viable; the rest should be maintained. The ICTRT recommendation includes restoring the Pahsimeroi River (summer Chinook life-history), the Lemhi River and Upper Salmon Mainstem River (very large-size category), the East Fork Salmon River (large-size category), and the Valley Creek populations to viable status.
	Valley Creek	high risk	viable	
	Yankee Fork	high risk	maintained	
	Upper Salmon River	high risk	highly viable	
	North Fork Salmon River	high risk	maintained	
	Lower Salmon River	high risk	maintained	
	East Fork Salmon River	high risk	viable	
	Pahsimeroi River	high risk	viable	
	Panther Creek	extirpated	reintroduction	

<u>Abundance, Productivity, Spatial Structure, and Diversity</u>. NMFS evaluates species status by evaluating the status of the independent populations within the ESU based on parameters of

abundance, productivity, spatial structure, and diversity (these parameters are referred to as the viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans, and based on recommendations of the ICTRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each MPG to be considered at low risk. Generally, each MPG must achieve low risk for the ESU as a whole to be considered no longer threatened or endangered.

NMFS' most recent status review (NMFS 2016b) indicated that the SR spring/summer Chinook salmon ESU remained at high overall risk, and that all but one population in the ESU remained at high risk (the Chamberlain Creek population, in the Middle Fork Salmon River MPG, was determined in the most recent status review to have improved to an overall status of "maintained" due to an increase in abundance) [21]. In the most recent status review, natural-origin abundance for most populations in the ESU had increased over the levels reported in the previous status review, although the increases were not substantial enough to change viability ratings (NWFSC 2015, NMFS 2016b). Relatively high ocean survival immediately before 2015 was a major factor in those abundance patterns.

The most recent status review found that, since the previous status review, some populations had increased in both abundance and productivity[22], others had increased in abundance while their productivity decreased[23], two populations had decreased in abundance and increased in productivity[24], and one population (Loon Creek in the Middle Fork Salmon River MPG) had decreased in both abundance and productivity. There was no consistent pattern of response across populations or across MPGs (NWFSC 2015, NMFS 2016b).

Evaluation of population spatial structure in the most recent status review indicated that most populations remained at low or moderate risk for that parameter. Four populations (Catherine Creek and Upper Grande Ronde, in the Grande Ronde/Imnaha River MPG; Lemhi River, in the Upper Salmon River MPG; and the Lower Middle Fork Salmon River population, in the Middle Fork Salmon River MPG) remained at high risk for this parameter (NWFSC 2015, NMFS 2016b).

Evaluation of diversity for this ESU indicated that three MPGs have populations that are being supplemented with local broodstock hatchery programs. In most cases, those programs evolved from mitigation efforts and include some form of sliding-scale management guidelines that limit hatchery contribution to natural spawning based on the abundance of natural-origin fish returning to spawn—the more natural-origin fish that return, the fewer hatchery fish are needed to spawn naturally. Sliding-scale management is designed to maximize hatchery benefits in low abundance years and reduce hatchery risks at higher spawning levels. Most populations in the ESU were rated at low to moderate risk for diversity except for the Yankee Fork, East Fork Salmon River,

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[21] "Maintained" population status indicates that the population does not meet the criteria for a viable population but does support ecological functions and preserve options for recovery of the ESU.
[22] Catherine Creek, Upper Grande Ronde River, Minam River, Lostine/Wallowa River, Imnaha River, Sulphur Creek, Lemhi River, Valley Creek, Upper Salmon River, East Fork Salmon River, and Pahsimeroi River.
[23] Tucannon, South Fork Salmon, East Fork South Fork Salmon, Big Creek, Bear Valley Creek, March Creek, Camas Creek, and Yankee Fork.
[24] Wenaha and Lower Salmon River populations.

and Pahsimeroi River populations, which were rated at high risk for this parameter (NWFSC 2015, NMFS 2016b).

Overall, while the most recent status review found improvements in the abundance/productivity in multiple populations (as of 2014 adult returns) relative to prior reviews, those changes were not sufficient to warrant a change in ESU status. All extant populations (except Chamberlain Creek) still faced a high risk of extinction (NWFSC 2015, NMFS 2016b). There is a considerable range in the relative improvements in life-cycle survivals or limiting life-stage capacities required to attain viable status for the populations in the ESU. In general, populations within the South Fork Salmon River MPG are the closest to viability among the MPGs. The other multiple-population MPGs each have a range of viability (NWFSC 2015, NMFS 2016b).

Table 10 lists the MPGs and populations in this ESU and summarizes their abundance/ productivity, spatial structure, diversity, and overall population risk status, based on information in the most recent status review (NWFSC 2015, NMFS 2016b).

Table 10. SR spring/summer Chinook salmon population-level risk for abundance/productivity (A/P), diversity, and integrated spatial structure/diversity (SS/D) and overall status as of the most recent status review (NWFSC 2015, NMFS 2016b). Risk ratings ranged from very low (VL), to low (L), moderate (M), high (H), very high (VH), functionally extirpated (FE), and extirpated (E). Shaded populations are the most likely combinations within each MPG to be improved to viable status. "Maintained" (MT) population status indicates that the population does not meet the criteria for a viable (low risk) population but does support ecological functions and preserve options for recovery of the ESU.

Major Population Group	Population	ICTRT Minimum Abundance Threshold[1]	A/P Risk Rating	Diversity Risk Rating	Integrated SS/D Risk Rating	Overall Extinction Risk Rating
Lower Snake	Tucannon River	750	H	M	M	H
	Asotin Creek	500	FE	FE	FE	FE
Grande Ronde/ Imnaha	Catherine Creek	1,000	H	M	M	H
	Upper Grande Ronde River	1,000	H	M	H	H
	Minam River	750	H (M)	M	M	H
	Wenaha River	750	H	M	M	H
	Lostine/Wallowa Rivers	1,000	H	M	M	H
	Imnaha River	750	H (M)	M	M	H
	Big Sheep Creek	500	FE	FE	FE	FE

Major Population Group	Population	ICTRT Minimum Abundance Threshold[1]	A/P Risk Rating	Diversity Risk Rating	Integrated SS/D Risk Rating	Overall Extinction Risk Rating
	Lookingglass Creek	500	FE	FE	FE	FE
South Fork Salmon	South Fork Salmon River	1,000	H (M)	M	M	H
	Secesh River	750	H (M)	L	L	H
	E Fork S Fork Salmon River	1,000	H	L	L	H
	Little Salmon River	750	Insufficient data	L	L	H
Middle Fork Salmon	Big Creek	1,000	H	M	M	H
	Bear Valley Creek	750	H (M)	L	L	H
	Marsh Creek	500	H	L	L	H
	Sulphur Creek	500	H	M	M	H
	Camas Creek	500	H	M	M	H
	Loon Creek	500	H	M	M	H
	Chamberlain Creek	750	M	L	L	MT
	Lower Mainstem Middle Fork Salmon River	500	Insufficient data	M	M	H
	Upper Mainstem Middle Fork Salmon River	750	H	M	M	H
Upper Salmon	Lemhi River	2,000	H	H	H	H
	Valley Creek	500	H	M	M	H
	Yankee Fork	500	H	H	H	H
	Upper Salmon River	1,000	H (M)	L	L	H
	North Fork Salmon River	500	Insufficient data	L	L	H
	Lower Salmon River	2,000	H	L	L	H

Major Population Group	Population	ICTRT Minimum Abundance Threshold[1]	A/P Risk Rating	Diversity Risk Rating	Integrated SS/D Risk Rating	Overall Extinction Risk Rating
	East Fork Salmon River	1,000	H	H	H	H
	Pahsimeroi River	1,000	H (M)	H	H	H
	Panther Creek	750	E	E	E	E

[1]Minimum abundance thresholds represent the number of spawners needed for a population of a given size category to achieve low risk (viability) at a given productivity (ICTRT 2007).

Limiting Factors. Understanding the limiting factors and threats that affect the SR spring/summer Chinook salmon ESU provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed. Limiting factors identified in the recovery plan (NMFS 2017a) for this ESU include (in no particular order):

- Tributary habitat degradation: Past and/or present land use hinders SR spring/summer Chinook salmon productivity through the following limiting factors: impaired fish passage (e.g., culverts, water diversions, and weirs at hatchery facilities); reduced stream complexity and channel structure; excess fine sediment; elevated summer water temperatures; diminished streamflow during critical periods; reduced floodplain connectivity and function; and degraded riparian conditions.
- Estuarine habitat degradation: Past and current land use (including dredging, filling, diking, and channelizing of lower Columbia River tributaries) and alterations to Columbia River flow regimes by reservoir storage and release operations have reduced the quality and quantity of estuarine habitat.
- Hydropower: Federal hydropower projects in the lower Snake and Columbia River mainstem affect juvenile and adult SR spring/summer Chinook salmon, which must pass up to eight mainstem dams. The fish are also affected to a lesser degree by the management of water released from the Hells Canyon Complex on the middle Snake River, Dworshak Dam on the North Fork Clearwater River, and other projects, including upper basin storage reservoirs in the U.S. and Canada. Limiting factors include those related to dam passage mortality; loss of habitat due to conversion of riverine habitat to slower moving reservoirs with modified shorelines; and changes in temperature regimes due to flow modifications in all mainstem reaches.
- Harvest: Direct and indirect effects associated with past and present fisheries continue to affect the abundance, productivity, and diversity of SR spring/summer Chinook salmon. However, while harvest-related mortality contributed significantly to the species' decline, harvest impacts have been reduced substantially and have remained relatively constant in recent years.

- Hatchery programs: Hatchery programs can improve the abundance of salmon populations with low abundance and support reintroduction into areas where they have been blocked or extirpated. However, hatchery propagation also poses risks to natural-origin salmon. These risks include genetic risks, reduced fitness, altered life-history traits, increased competition for food and habitat, amplified predation, and transferring of diseases.
- Predation: Anthropogenic changes have altered the relationships between salmonids and other fish, bird, and pinniped species. Predation by pinnipeds, birds, and piscivorous fish in the mainstem Columbia and Snake Rivers and some tributaries has increased to the point that it is a factor limiting the viability of SR spring/summer Chinook salmon.
- Additional factors include exposure to toxic contaminants, and the effects of climate change and ocean cycles.

In its most recent status review, NMFS (2016b) noted that:

- Improvements had been made in tributary and estuary habitat conditions due to restoration and protection efforts, but habitat concerns remain throughout the Snake River basin, particularly in regard to streamflow, floodplain management, and water temperature.
- Changes to hydropower operations and passage had increased juvenile survival rates.
- Hot summer temperatures and impaired migration conditions in 2013 resulted in approximately 15 percent of the migrating adult summer Chinook salmon failing to pass Lower Granite Dam. Hot summer temperatures in 2015 again led to substantial adult losses, primarily in the lower Columbia River but also in the lower Snake River.
- The adoption of the 2008 to 2017 U.S. v. Oregon Management Agreement had, on average, reduced impacts of freshwater fisheries to all Snake River ESUs and DPSs.
- SR spring/summer Chinook salmon hatchery production levels had remained stable since the previous review. Many captive broodstock programs initiated in the 1990s had been terminated after the status of the targeted populations improved.
- New information indicated that avian and pinniped predation on SR spring/summer Chinook salmon had increased since the previous status review.
- Regulatory mechanisms had generally improved since the previous status review.
- Uncertainty regarding the long-term impacts of climate change and the ability of SR spring/summer Chinook salmon to adapt added additional risks to species recovery.
- Key protective measures included continued releases of cool water from Dworshak Dam during late summer, continued flow augmentation to enhance flows in the lower Snake River in July and August, and continued efforts to improve adult passage at Lower Granite Dam.

<u>Information on Status of the Species since the 2016 Status Review</u>. The best scientific and commercial data available with respect to the adult abundance of SR spring/summer Chinook salmon indicate a substantial downward trend in the abundance of natural-origin spawners at the ESU level from 2014 to 2019 (Figure 11). The past 3 years (2017 through 2019) have shown the lowest returns since 1999. This recent downturn in adult abundance is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity (see discussion below), because hydropower operations, the overall availability and quality of

tributary and estuary habitat, and hatchery practices have been relatively constant or improving over the past 10 years[25]. Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.

Population-level estimates of natural-origin and total (natural- plus hatchery-origin) spawners through 2018 are shown in Table 11. These data also show recent and substantial downward trends in abundance of natural-origin and total spawners for most of the MPGs and populations (exceptions are the Lemhi River, Camas Creek, and Upper Grande Ronde Mainstem) when compared to the 2009 to 2013 period (Table 11) [26]. All populations except Chamberlain Creek remain considerably below the minimum abundance thresholds established by the ICTRT (shown in Table 11). For many populations, the total spawner counts include substantial numbers of hatchery-origin adults. Exceptions are the entirety of the Middle Fork MPG and several populations in the Upper Salmon MPG, where there are no hatchery fish included in the spawner counts.

[25] Many factors (e.g., higher summer temperatures, lower late summer flows, low spring flows, etc.) affect the ability of tributary habitat to produce juvenile migrants (capacity) each year. Recent drought and temperature patterns may have had a negative effect on tributary habitat productivity, and as a result, lower than average juvenile production may have contributed in some years to downturns in adult abundance.

[26] The upcoming status review, expected in 2022, will include population-level adult returns through 2019, and will add a new rolling 5-year geomean, for 2015 to 2019. Because the 2014 adult returns represented a peak at the ESU level, the negative percent change between the 2015–2019 and 2014–2018 geomeans will likely be greater than that shown in Table 2.2-4 between the 2014–2018 and 2009–2013 geomeans, at least for some populations.

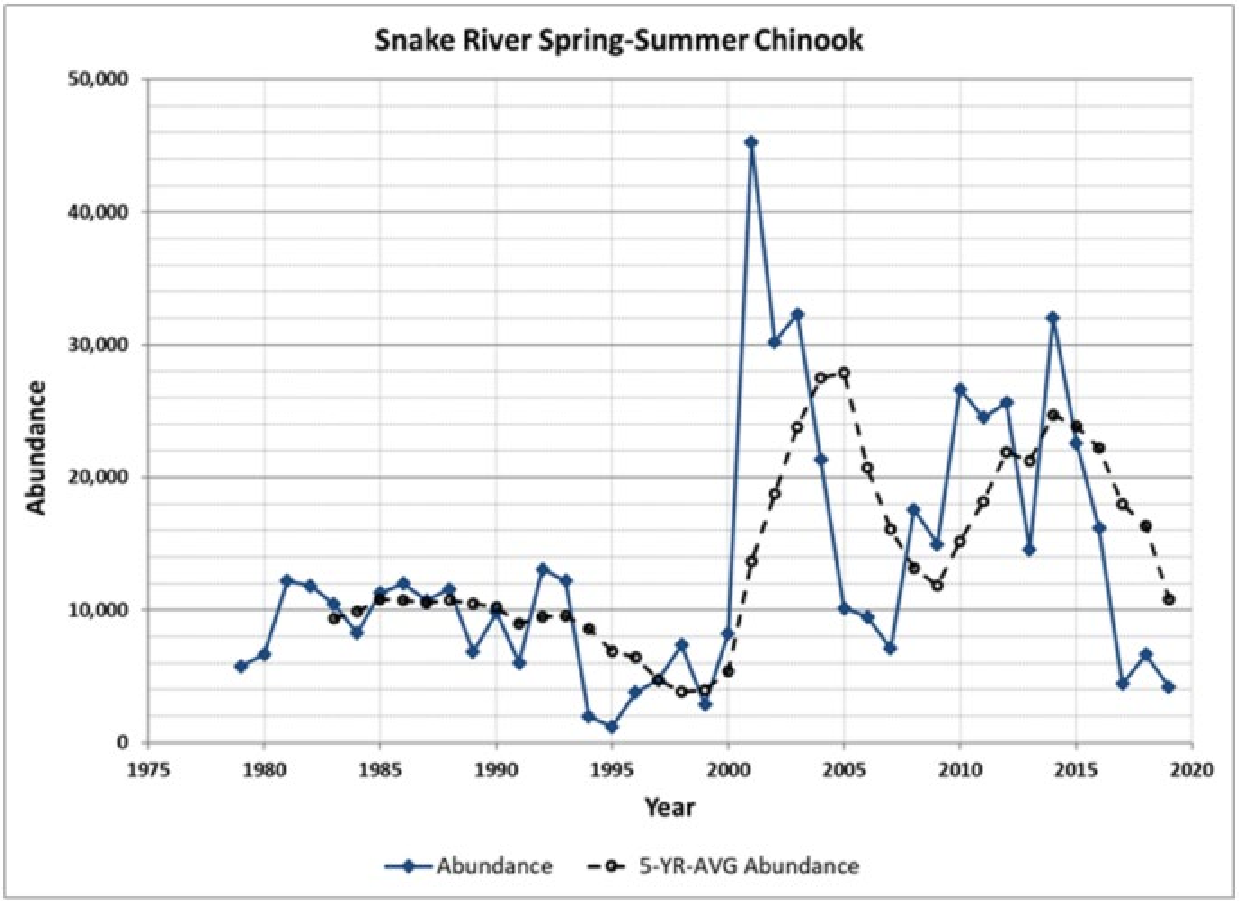

Figure 11. Annual abundance and 5-year average abundance estimates for the SR spring/summer Chinook ESU (natural-origin fish only and excluding jacks), including Lower Granite Dam passage and Tucannon River escapement estimates from 1979 to 2019. Data are from the 2020 Joint Staff Report on Stock Status and Fisheries (ODFW and WDFW 2020).

Table 11. 5-year geometric mean of natural-origin spawner counts for SR spring/summer Chinook salmon, excluding jacks. Number in parenthesis is the 5-year geometric mean of total spawner counts. "% Change" is a comparison between the two most recent 5-year periods (2014–2018 compared to 2009–2013). "NA" means not available. At the time of drafting this opinion, 2019 data were not available for any of the populations in this ESU. Source: (Williams 2020d).

Population	MPG	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	% Change
Grande Ronde/Imnaha River	Catherine Creek	NA	40 (46)	138 (186)	51 (185)	264 (549)	112 (298)	-58 (-46)
	Upper Grande Ronde River Mainstem	NA	31 (39)	36 (37)	22 (101)	70 (459)	77 (292)	10 (-36)
	Imnaha River Mainstem	218 (468)	193 (354)	792 (1579)	227 (905)	462 (1408)	354 (840)	-23 (-40)
	Lostine/Wallowa Rivers	86 (206)	86 (92)	292 (374)	243 (648)	705 (1650)	427 (821)	-39 (-50)
	Minam River	172 (391)	115 (131)	413 (423)	393 (400)	572 (618)	440 (475)	-23 (-23)
	Wenaha River	77 (244)	132 (198)	384 (409)	386 (396)	409 (486)	389 (555)	-5 (14)
South Fork Salmon River	South Fork Salmon River	683 (1020)	313 (561)	829 (1308)	634 (1093)	759 (1058)	241 (615)	-68 (-42)
	East Fork South Fork Salmon River	295 (305)	136 (140)	251 (315)	119 (254)	338 (646)	317 (556)	-6 (-14)
	Secesh River	383 (392)	210 (221)	623 (644)	387 (409)	781 (798)	481 (501)	-38 (-37)
	Little Salmon River	NA	NA	NA	NA	NA	NA	NA
Middle Fork Salmon River	Bear Valley Creek	215 (215)	77 (77)	482 (482)	278 (291)	618 (618)	373 (373)	-40 (-40)
	Big Creek	119 (119)	20 (20)	207 (207)	104 (104)	257 (257)	129 (129)	-50 (-50)
	Camas Creek	33 (33)	NA	72 (72)	45 (45)	31 (31)	53 (53)	71 (71)
	Chamberlain Creek	412 (412)	69 (69)	787 (787)	468 (468)	748 (748)	693 (693)	-7 (-7)

Population	MPG	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	% Change
	Loon Creek	61 (61)	NA	136 (136)	60 (60)	58 (58)	42 (42)	-28 (-28)
	Marsh Creek	156 (156)	NA	NA	110 (110)	374 (374)	311 (311)	-17 (-17)
	Upper Middle Fork Salmon River Mainstem	NA	NA	81 (81)	63 (63)	76 (76)	75 (75)	-1 (-1)
	Lower Middle Fork Salmon River Mainstem	NA	NA	NA	NA	NA	4 (4)	NA
	Sulphur Creek	46 (46)	NA	NA	37 (37)	71 (71)	52 (52)	-27 (-27)
Upper Salmon	East Fork Salmon River	118 (178)	22 (35)	304 (304)	238 (238)	451 (451)	285 (285)	-37 (-37)
	Lemhi River	68 (68)	35 (35)	194 (194)	68 (68)	195 (195)	273 (273)	40 (40)
	North Fork Salmon River	29 (29)	7 (7)	52 (52)	57 (57)	106 (106)	52 (52)	-51 (-51)
	Pahsimeroi River	NA	25 (34)	127 (257)	186 (290)	297 (311)	192 (382)	-35 (23)
	Lower Salmon River Mainstem	82 (82)	28 (28)	157 (157)	114 (114)	102 (102)	63 (63)	-38 (-38)
	Upper Salmon River Mainstem	308 (366)	61 (72)	443 (711)	322 (572)	517 (736)	219 (657)	-58 (-11)
	Valley Creek	34 (34)	NA	77 (77)	76 (76)	144 (144)	132 (132)	-8 (-8)
	Yankee Fork	25 (25)	NA	30 (30)	NA	117 (728)	47 (59)	-60 (-92)
Lower Snake	Tucannon River	278 (381)	60 (74)	92 (325)	225 (300)	321 (510)	84 (291)	-74 (-43)

NMFS will evaluate the implications for viability risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 11.

Since 2016, observations of coastal ocean conditions indicate that recent outmigrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects, which led researchers to predict the drop in adult Chinook salmon returns observed through 2019 (Werner et al. 2017). Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-meter surface layer) had not returned to normal (Harvey et al. 2019). Based on mainstem dam counts as of June 1, overall returns of spring Chinook salmon in 2020 also appear to be low, similar to 2019 counts. Expectations for marine survival are relatively mixed for juveniles that reached the ocean in 2019 (Zabel et al. 2020), suggesting that adult returns could increase somewhat in 2021. However, continued low jack returns as of June 1, 2020, suggest that adult numbers could remain low in 2021.

Status of Snake River Fall-Run Chinook Salmon

Background. On April 22, 1992, NMFS listed the SR fall Chinook salmon ESU as a threatened species (57 FR 14653). The threatened status was reaffirmed on June 28, 2005 (70 FR 37160) and again on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that this ESU should retain its threatened status (81 FR 33468). Critical habitat was originally designated on December 28, 1993 (58 FR 68543). The summary that follows describes the status of SR fall Chinook salmon. Additional information can be found in the recovery plan (NMFS 2017b) and the most recent status review for this species (NMFS 2016b) [27].

The SR fall-run Chinook salmon ESU includes one MPG with one extant population: Lower Mainstem Snake River population, which includes all natural-origin fall-run Chinook salmon originating from the mainstem Snake River below Hells Canyon Dam and from the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River subbasins (NMFS 2017b). Fall-run Chinook salmon from four artificial propagation programs are also included in this ESU—the Lyons Ferry Hatchery Program, the Fall Chinook Acclimation Ponds Program, the Nez Perce Tribal Hatchery Program, and the Oxbow Hatchery Program (now referred to as the Idaho Power Program (NMFS 2017b, 70 FR 37160) [28].

Historically, another large population of fall-run Chinook salmon also spawned above the Hells Canyon Dam Complex (NMFS 2016b, 2017h). This population was extirpated in the early 1960s after the construction of the Hells Canyon Dams (Figure 12). The extant, ESA-listed population occupies a geographically large and complex area with five major spawning groups: 1) Upper Hells Canyon, 2) Lower Hells Canyon, 3) Clearwater River, 4) Grande Ronde River, and 5) Tucannon River.

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[27] In addition, a technical memo prepared for the status review contains more detailed information on the biological status of the species (NWFSC 2015).

[28] For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005). In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including SR fall Chinook salmon (81 FR 72759). The proposed changes for hatchery programs in this ESU were to change the name of the Oxbow Hatchery Program to the Idaho Power Program. We expect to publish the final revisions in 2020.

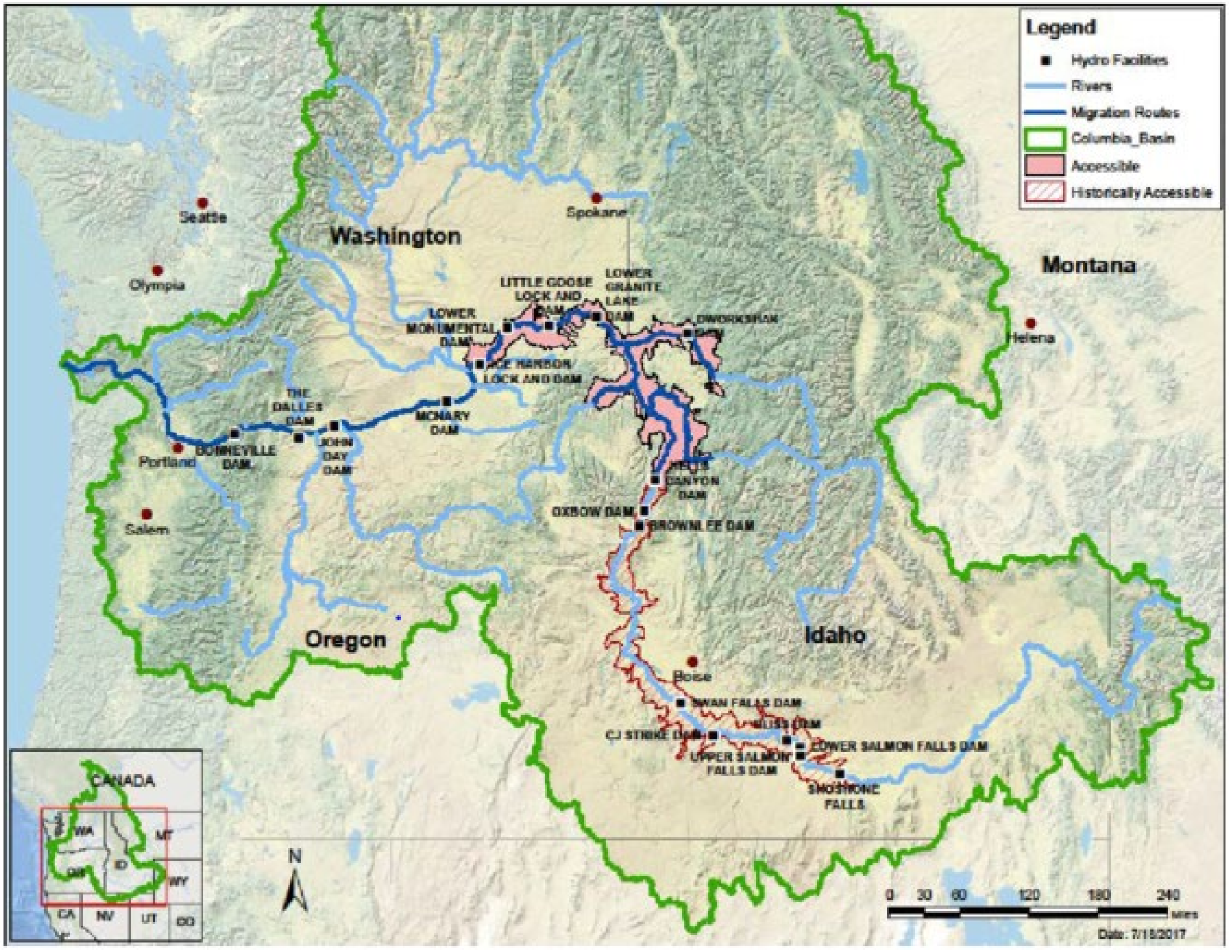

Figure 12. Map of the SR fall Chinook salmon current and historical spawning range. The areas shaded pink denote habitat that is currently occupied; the red hatched areas denote habitat that was accessible historically, but is now blocked by the Hells Canyon Project and other dams on the mainstem Snake River. Source: NMFS 2017b.

Life History and Factors for Decline. Most SR fall Chinook salmon production historically came from large mainstem reaches that supported a subyearling, or "ocean-type," life history strategy. Adults migrated up the Columbia and Snake Rivers from July to August through November and spawned from late September to early October through November. Eggs developed rapidly in the relatively warm lower mainstem reaches of several tributary rivers, which facilitated emergence during late winter and early spring and accelerated growth such that juveniles could become smolts and migrate to the ocean in May and June (NMFS 2017b). This life history strategy allowed fall Chinook salmon to avoid high summer temperatures and losses associated with over-summering and over-wintering that affect other Chinook salmon ESUs with a yearling, or "stream-type," life history strategy.

At present, the subyearling life history strategy contributes most of the natural-origin adult returns to the ESU, and the timing of adult migration and spawning plus egg incubation, fry emergence, and juvenile emigration is similar to historical patterns. However, a yearling life history strategy is also supported, mostly for juveniles from the cooler Clearwater River subbasin[29], which overwinter in the lower Snake River reservoirs or other cool-water refuge areas and migrate downstream the following spring (NMFS 2017b).

Multiple factors were responsible for the decline of SR fall Chinook salmon. First, they were harvested at very high rates starting in the 1880s, and continuing through the 1980s. Second, the development of mainstem dams in the middle Snake River from the 1900s to the 1960s (Swan Falls Dam, the Hells Canyon Complex of dams, and others) inundated and blocked access to the most productive spawning and rearing habitat, eliminated one of the two large populations that existed historically, and affected water quality. The construction of Lewiston Dam on the Clearwater River blocked access to upstream habitat there starting in 1927, and extirpated fall Chinook salmon within that subbasin. Third, the development of mainstem dams in the lower Snake and Columbia Rivers (1938 to 1975) greatly altered mainstem migration and rearing habitat, affected the survival of juvenile and adult migrants, and affected water quality (increased TDG levels, altered thermal regime, decreased sediment transport, etc.). Fourth, the construction and operation of dams and water conveyance systems for irrigation and other purposes (starting in the late 1800s) substantially affected seasonal flows in the mainstem Snake and Columbia Rivers and the Columbia River estuary and plume. Fifth, land use practices (agriculture, grazing, mining, timber harvest, etc.) negatively affected important water-quality parameters (nutrients, fine sediments, toxic contaminants) and channel complexity, especially in the middle Snake River[30] and the lower reaches of the five Snake River tributaries used for spawning and rearing.

Lastly, strays from non-Snake-River-origin hatcheries on the spawning grounds posed a serious threat to the genetic integrity of the species (Waples et al. 1993; NMFS 2016b, 2017b).

These factors substantially reduced the amount and quality of available spawning, rearing, and migration corridor habitat; reduced the productivity of SR fall-run Chinook salmon in all freshwater life history stages; and resulted in extremely low abundance by 1990, when only 78 naturally produced adults were counted passing Lower Granite Dam[31].

While some of the threats that contributed to the original listing of SR fall Chinook salmon continue, many actions have been taken to reduce threats and improve SR fall Chinook salmon survival and the conservation value of the habitat upon which they depend. While still substantial, overall harvest rates have been reduced from around 60 to 80 percent as recently as the 1980s to 40 to 50 percent since the mid-1990s as a result of reduced ocean harvest and the use of abundance-based “sliding scales” to manage fisheries in the mainstem Columbia River. These actions have improved the productivity and abundance of the single population by

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[29] Cool water has been released from Dworshak Dam since the mid-1990s to reduce summer temperatures that can impair passage conditions for migrating adult salmon and steelhead. This action retards the growth and delays the migration of juveniles rearing in the Clearwater River in July and August, but maintains thermal conditions, especially in Lower Granite, Little Goose, and Lower Monumental Reservoirs that allow juvenile Chinook to survive the summer and early-fall periods, overwinter, and migrate the following spring.

[30] Currently, water quality in the middle Snake River is highly degraded (excessive nutrients, excessive algal growth, anoxic or hypoxic conditions in spawning gravels, and increased sediment loads) and not sufficient to support fall Chinook salmon production.

[31] This compares to an estimated historical average of about 500,000 returning adults (NMFS 2017b).

increasing the number of adult fall-run Chinook salmon returning to the spawning areas (NMFS 2016b, 2017b).

Starting in the late 1990s, large numbers of hatchery-produced fish—up to 5.5 million annually—began to be released. These programs have substantially improved the abundance of SR fall Chinook salmon in spawning areas upstream of Lower Granite Dam. The progeny of hatchery fish spawning in the wild are considered natural-origin when they return to spawn, so these fish contributed to the rapid rebuilding of the ESU. However, NMFS (2016b) noted concerns that continued high levels of hatchery-origin fish on the spawning grounds could pose a risk to long term population diversity and productivity.

Since 1992, Idaho Power Company has operated the Hells Canyon Complex of dams to provide stable spawning and incubation flows in the upper Hells Canyon reach of the Snake River for SR fall Chinook salmon. These flows ensure that redds are not dewatered during winter load-following operations (i.e., daily and hourly flow fluctuations). This voluntary action has likely improved egg-to-fry survival, although some negative effects on habitat quality. The Action Agencies have also taken many structural and operational measures at CRS projects to improve conditions for SR fall Chinook salmon since the ESA listing in 1992 (NMFS 2017b).

Recovery Plan. The ESA recovery plan for SR fall Chinook salmon (NMFS 2017b) includes delisting criteria for the ESU, along with identification of factors currently limiting its recovery, and management actions necessary to achieve the goals. Biological delisting criteria are based on recommendations by the ICTRT[32]. They are hierarchical in nature, with ESU-level criteria based on the status of natural-origin SR fall Chinook salmon assessed at the population level. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the ESU will require sufficient improvement in its abundance, productivity, spatial structure, and diversity.

The recovery plan considered three potential recovery scenarios (including two single-population scenarios and one that would require recovering the extirpated population above the Hells Canyon Dam complex). It identified the single-population scenario aimed at achieving highly viable status (50 percent probability of a less than 1 percent risk of extinction in 100 years) for the extant population and evaluating the status of the population based on natural productivity in one or two "natural production emphasis areas" as the most likely scenario to achieve recovery. The relatively low hatchery contributions targeted in the natural production emphasis area(s) would provide "an opportunity to gain more direct information on intrinsic productivity without the masking effect common when high levels of hatchery-origin spawners are present" (NMFS 2017b).

Abundance, Productivity, Spatial Structure, and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within the ESU based on parameters of abundance, productivity, spatial structure, and diversity (these parameters are referred to as the

[32] The recovery plan also includes "threats criteria" for each of the listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans and based on recommendations of the ICTRT. Delisting criteria define parameters for individual population status as well as for how many and which populations must achieve a particular status for each MPG to be considered at low risk. Generally, each MPG must achieve low risk for the ESU as a whole to be considered no longer threatened or endangered.

As of the most recent status review (NWFSC 2015, NMFS 2016b), the extant Lower Mainstem SR fall Chinook salmon population was considered viable (i.e., at low risk of extinction), an improvement from its moderate risk rating in the previous status review but below the recovery plan goal of high certainty of highly viable status (i.e., very low extinction risk). This risk rating was based on a low risk rating for abundance/productivity and a moderate risk rating for spatial structure/diversity (NWFSC 2015).

The 10-year geometric mean in natural-origin abundance for spawner escapement for the years 2005 to 2014 was 6,418. This geometric mean exceeded the buffer for statistical uncertainty in estimated abundance in the recovery plan. The associated productivity estimates, however, were below the recovery plan requirements, and reflected uncertainty due to the high numbers of hatchery-origin fish on the spawning grounds. The status review also noted uncertainty about whether the recent increases in abundance (which were driven largely by relatively high escapements in the last 3 years of that review period) could be sustained over the long run (NWFSC 2015, NMFS 2016b).

The moderate risk rating for spatial structure/diversity was driven by changes in major life history patterns, shifts in phenotypic traits, and high levels of genetic homogeneity in samples from natural-origin returns. The rating also reflected risk associated with the high levels of hatchery-origin spawners in natural spawning areas and the potential for selective pressure imposed by current hydropower operations and cumulative harvest impacts. To achieve delisting goals, the spatial structure/diversity rating needs to be at low risk (NWFSC 2015).

The most recent status review (NWFSC 2015, NMFS 2016b) noted that to achieve the abundance/productivity risk rating consistent with the proposed delisting criteria, an increase in estimated productivity (or a decrease in the year-to-year variability associated with the estimate) would be required, and natural-origin abundance of the extant population would need to remain relatively high. An increase in productivity could occur with a further reduction in mortalities across life stages. It is also possible that survival improvements resulting from actions in recent years (e.g., more consistent flow-related conditions affecting spawning and rearing, and increased passage survivals resulting from expanded spill programs) have increased productivity, but that due to sustained recent high abundances, we have not been able to measure the intrinsic productivity of the population (which measures productivity at low abundances and is the metric recommended by the ICTRT). A third general possibility is that productivity may be decreasing over time as a result of negative impacts of chronically high hatchery proportions across natural spawning areas. Such a decrease would also be largely masked by the high annual spawning levels (NWFSC 2015, NMFS 2016b).

Limiting Factors. Understanding the limiting factors and threats that affect SR fall Chinook salmon provides important information and perspective regarding the status of the species. One of the necessary steps in achieving species' recovery and delisting is to ensure that the underlying limiting factors and threats have been addressed. Limiting factors and threats identified in the recovery plan (NMFS 2017b) for this ESU include (in no particular order):

- Blocked habitat: The Hells Canyon Complex of dams (and five additional upstream Snake River dams) blocks access to 80 percent of the historical spawning habitat for SR fall Chinook salmon, including the habitat that was historically the most productive[33].
- Hydropower: Operation of the Hells Canyon Complex dams has altered flows, sediment transport, and the thermal regime of the Lower Snake River, resulting in altered migration patterns, juvenile fish stranding, and entrapment. Idaho Power Company reduces these effects by providing stable flow from Hells Canyon Dam during the fall Chinook salmon spawning season to support incubating eggs and emerging fry. In addition, eight CRS projects (four on the lower Snake River and four on the Columbia River) adversely affect passage for juveniles and adults.
- Tributary habitat: Although SR fall Chinook salmon spawn primarily in the mainstem Snake River, they also spawn in lower reaches of tributaries to the Snake River, where lack of habitat complexity, excess fine sediment, degraded riparian conditions, low summer flows, and water quality (high summer water temperatures, low dissolved oxygen, and nutrients) are of some concern.
- Estuary: SR fall Chinook salmon subyearling migrants that access and use shallow, nearshore areas and other floodplain habitats are affected by reduced estuarine habitat as a result of changes in sediment/nutrient levels and flow, reduced floodplain connectivity, increased water temperature, changes in food sources, altered predator/prey relationships, and exposure to toxic contaminants.
- Harvest: SR fall Chinook salmon encounter fisheries in the ocean, in the mainstem Columbia River, and in some tributaries. Fisheries do not directly target ESA-listed natural-origin fall Chinook salmon. Instead they target marked hatchery fish (fall Chinook salmon and other species) and non-listed natural fish (fall Chinook salmon and other species). While the recovery plan noted that the total exploitation rate on SR fall Chinook salmon had declined significantly since ESA listing, it also noted the direct and indirect effects of harvest as a concern.
- Hatcheries: At one time, out-of-ESU hatchery programs were a major concern because the returning adult fish strayed into the Snake River and spawned naturally. Strays from out-of-ESU programs have since been reduced substantially. Within-ESU hatchery programs have reduced short-term risk to SR fall Chinook salmon by increasing abundance and spatial structure, but the size of the programs relative to the level of natural-origin production and consequent high proportion of hatchery-origin fish on the spawning grounds raises concerns about natural-origin productivity and diversity.
- Predation: In general, rates of predation by birds on SR fall Chinook salmon are relatively low. California sea lions that gather at Bonneville Dam have generally left the area by the time of the fall Chinook salmon migration. However, the number of Steller

[33] Currently, however, the mainstem habitat in the blocked area is too degraded to support significant fall Chinook salmon production.

sea lions in the area has increased since 2011, and they are assumed to prey on adult SR fall Chinook salmon, although the level of predation is not known. Both native and non-native fish prey on fall Chinook salmon.
- Additional factors include exposure to toxic contaminants, and the effects of climate change and ocean cycles.

In its most recent status review, NMFS (2016b) noted that:

- Abundance in the extant SR fall Chinook salmon population had increased substantially since listing. This increase was attributed to a combination of actions that enhanced spawning and incubation conditions below Hells Canyon Dam, improved survival through the hydropower system, reduced harvest, and increased natural production through hatchery supplementation.
- Improvements had been made in tributary and estuary habitat conditions due to restoration and protection efforts, but habitat concerns remain throughout the Snake River basin, particularly in regard to streamflow, floodplain management, and water temperature.
- Changes to hydropower operations and passage had increased juvenile survival rates.
- The adoption of the 2008 to 2017 *U.S. v. Oregon* Management Agreement had, on average, reduced impacts of freshwater fisheries to all Snake River ESUs/DPSs.
- SR fall Chinook salmon hatchery production levels had increased since the previous review. Considerable uncertainty existed about the effect of SR fall Chinook salmon hatchery programs on the extant population.
- New information indicated that avian and pinniped predation had increased since the previous status review, although it was not possible to quantify the change or impact on SR fall Chinook salmon.
- Regulatory mechanisms had in general improved since the previous status review.
- Uncertainty regarding the long-term impacts of climate change and the ability of SR fall Chinook salmon to adapt added additional risks to species recovery.

Information on Status of the Species since the 2016 Status Review. The best available scientific and commercial data available with respect to the adult abundance of SR fall Chinook salmon indicates a substantial downward trend in the abundance of natural-origin spawners at the ESU level from 2013 to 2019 (Figure 13). The recent downturn is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity (see discussion below), because hydropower operations and hatchery practices have been relatively constant or improving over the past 10 years. Even with this decline, overall abundance has remained higher than before 2005.

The SR fall Chinook salmon ESU is composed of a single demographically independent population. Five-year geometric means in the numbers of natural-origin and total (natural- plus hatchery-origin) spawners through 2018 are shown in Table 12. These indicate very small negative changes in abundance between the two most recent 5-year periods[34]. This ESU appears to be less negatively affected by ocean conditions than SR spring/summer Chinook salmon.

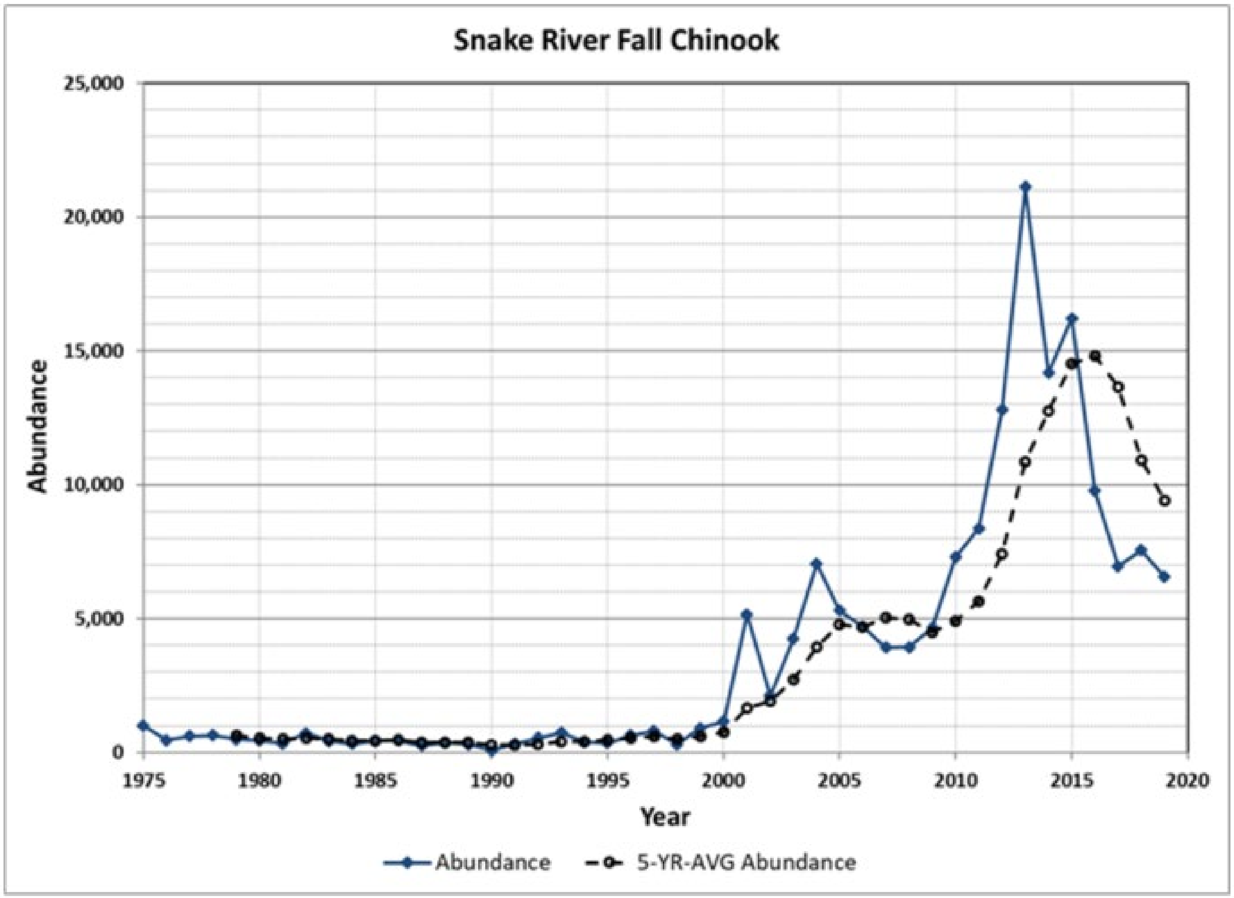

Figure 13. Annual abundance and 5-year average abundance estimates for the SR fall Chinook salmon ESU (natural-origin fish only) at Lower Granite Dam from 1975 to 2019. Data from 1975 to 2018 are from the 2019 Joint Staff Report on Stock Status and Fisheries (WDFW and ODFW 2019). The 2019 estimate is from the Nez Perce Tribe (Hesse 2020).

[34] The upcoming status review, expected in 2022, will include population-level adult returns through 2019, and will add a new rolling 5-year geomean, for 2015-2019. Because the adult return in 2014 was higher than in subsequent years, the negative percent change between the 2015-2019 and 2014-2018 geomeans will likely be greater than that shown in Table 2.5-1 between the 2014-2018 and 2009-2013 geomeans.

Table 12. 5-year geometric mean of natural-origin spawner counts for SR fall Chinook salmon. Number in parenthesis is the 5-year geometric mean of total spawner counts. "% change" is between the two most recent 5-year periods (2014-2018 compared to 2009-2013). At the time of drafting this opinion, 2019 data were not available for this ESU. Source: Williams (2020a).

Population	MPG	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	% Change
Snake River Mainstem	Lower Mainstem Snake River	313 (597)	467 (785)	2083 (5513)	3930 (10002)	8985 (31327)	8809 (30364)	-2 (-3)

NMFS will evaluate the implications for viability risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 12.

Since the status review in 2016, observations of coastal ocean conditions suggested that recent outmigrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects, which led researchers to predict the drop in adult Chinook salmon returns observed through 2019 (Werner et al. 2017). Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ocean ecosystem (e.g., temperatures below the 50-meter surface layer) had not returned to normal (Harvey et al. 2019). Expectations for marine survival are relatively mixed for juveniles that reached the ocean in 2019 (Zabel et al. 2020).

Status of Columbia River Chum Salmon

Background. On March 25, 1999, NMFS listed the CR chum salmon ESU as a threatened species (64 FR 14508). The threatened status was reaffirmed on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that this ESU should retain its threatened status (81 FR 33468). Critical habitat was designated on September 2, 2005 (70 FR 52630). The summary that follows describes the status of CR chum salmon. More information can be found in the recovery plan (NMFS 2013b) and most recent status review for this species (NMFS 2016c) [35].

The CR chum salmon ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Oregon and Washington (Figure 14) [36]. The ESU consists of 17 historical populations in three distinct ecological regions: Coast, Cascade, and Gorge. Each

[35] In addition, a technical memo prepared for the status review contains detailed information on the biological status of the species (NWFSC 2015).
[36] The historical upstream boundary for chum salmon is generally considered to have been Celilo Falls, which historically was located approximately where The Dalles Dam is now located (NMFS 2013b).

of these three ecological regions is considered an MPG[37]. The ESU also includes two artificial propagation programs (70 FR 37160) [38].

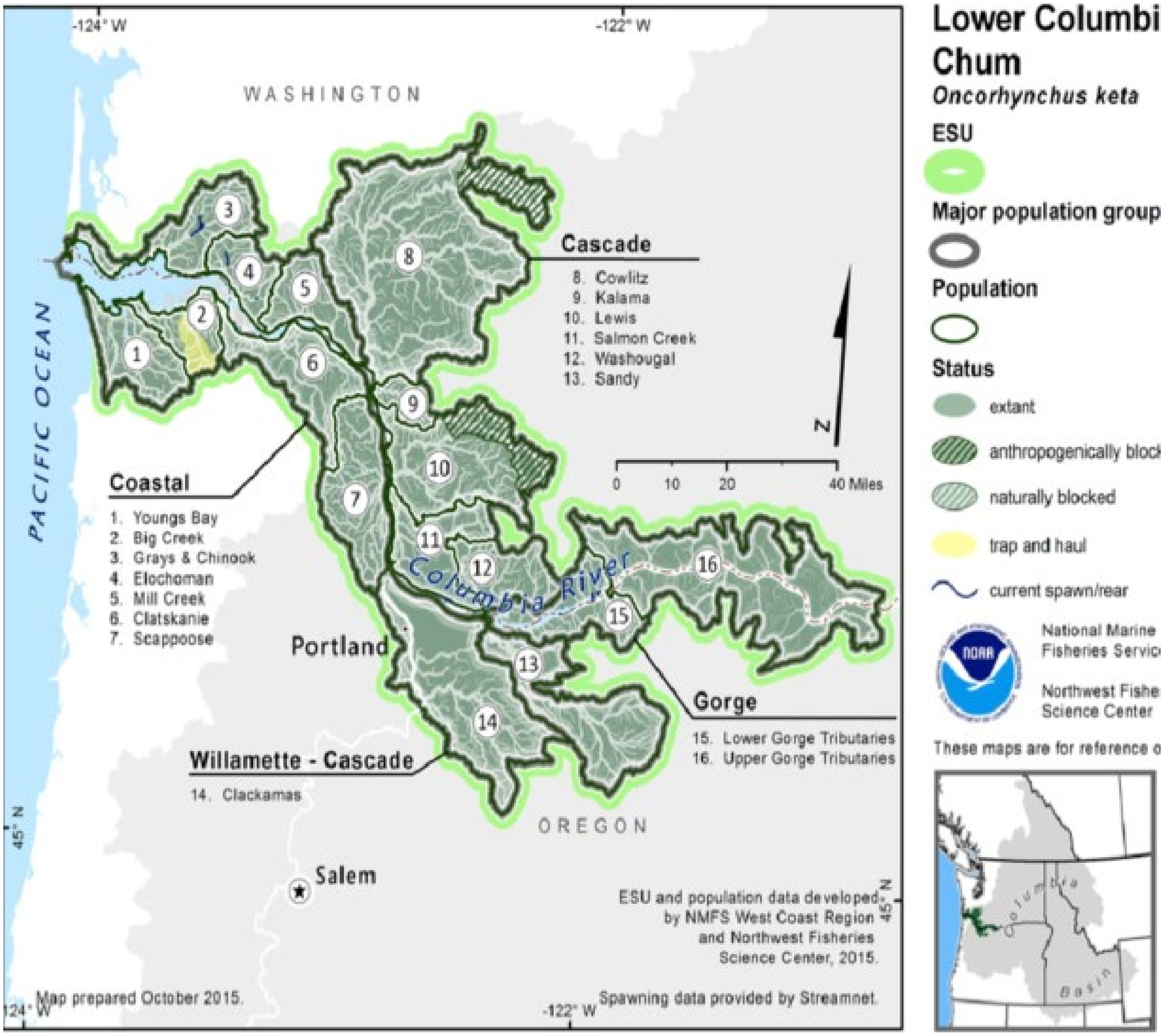

Figure 14. Map illustrating CR chum salmon ESU's populations and major population groups.

[37] The W/LC TRT used the term "strata" to refer to these population groupings, which are significant in identifying delisting criteria. The strata are analogous to the "major population groups" defined by the ICTRT. For consistency, we use the term "major population group" throughout this opinion.

[38] The Grays River Program and the Washougal River Hatchery/Duncan Creek Program in Washington. In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including CR Chum salmon (81 FR 72759). The proposed change for hatchery program inclusion in this ESU was to add the Big Creek Hatchery Program (Oregon). We expect to publish the final revisions in 2020. For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005).

Life History and Factors for Decline. Historically, CR chum salmon were abundant and widely distributed. They spawned in the mainstem Columbia River and the lower reaches of most lower Columbia River tributaries. The historical upstream boundary for chum salmon is generally considered to have been Celilo Falls, which was located approximately where The Dalles Dam is now located, although there are some reports of chum salmon spawning as far up as the Walla Walla and Umatilla Rivers (NMFS 2013b). Chum salmon spawn in the mainstem and in low-gradient, low-elevation reaches and side channels (LCFRB 2010, ODFW 2010). They enter freshwater close to the time of spawning, and their spawning sites are typically associated with areas of upwelling water. Adult chum salmon are virtually all fall-run fish, entering freshwater from mid-October through November and spawning from early November to late December (LCFRB 2010). There is evidence that a summer-run chum salmon population returned historically to the Cowlitz River, and fish displaying this life history are occasionally observed there (Myers et al. 2006, Ford 2011).

Chum salmon fry are capable of adapting to seawater soon after emergence from gravel (LCFRB 2010) and usually spend weeks or months in estuaries (NMFS 2011, 2013b). Their small size at emigration is thought to make them susceptible to predation from both birds and fish during this life stage, and shallow, protected habitats such as salt marshes, tidal creeks, and intertidal flats serve as significant rearing areas for juvenile chum salmon during estuarine residency (LCFRB 2010). Access to these habitats has been impaired by agricultural and residential land use, particularly modification via dikes, levees, bank stabilization, and tide gates, but also by flow alterations caused by mainstem dams.

CR chum salmon runs once numbered in the hundreds of thousands (in some years more than 500,000 chum salmon were harvested in commercial fisheries), but had begun to decline by the early 1950s (Johnson et al. 2012), primarily as a result of habitat degradation and high harvest rates. While harvest rates were drastically curtailed in the 1950s, the ESU continues to be affected by loss and degradation of spawning and rearing habitat and perhaps by the legacy effects of historical harvest. In addition, mainstem hydropower dams have impaired access and inundated historical spawning habitat for one population, and had downstream flow effects on habitat in the estuary. Together, these factors contributed to declines such that at the time of listing, total natural-origin abundance for the ESU was probably a few thousand fish per year, and most historical populations were either at very high extinction risk or extirpated, or nearly so (NMFS 2013b, 64 FR 14508).

Recovery Plan. The ESA recovery plan for CR chum salmon (NMFS 2013b) includes delisting criteria for the ESU, along with identification of factors currently limiting its recovery, and management actions necessary for recovery. The biological delisting criteria are based on recommendations by the Willamette-Lower Columbia Technical Recovery Team (W/LC TRT) [39]. They are hierarchical in nature, with ESU-level criteria based on the status of natural-origin CR chum salmon assessed at the population level. Population-level assessments are based on an evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of

[39] The recovery plan also includes "threats criteria" for each of the listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

the ESU will require sufficient improvement in its abundance, productivity, spatial structure, and diversity.

Abundance, Productivity, Spatial Structure, and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within an ESU based on parameters of abundance, productivity, spatial structure, and diversity (these parameters are referred to as the viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans and based on recommendations of the W/LC TRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each MPG to be considered at low extinction risk. For CR chum salmon, recovery requires improving all three MPGs to a high probability of persistence or a probability of persistence consistent with their historical condition.

NMFS' most recent status review found that the CR chum ESU was relatively unchanged in status from previous reviews (NMFS 2016c). While improvements in the status of some populations were observed, most remained at high to very high extinction risk, with very low abundances, and the ESU overall remained at moderate to high extinction risk. Most populations will require very large improvements to reach their recovery goals (NWFSC 2015, NMFS 2016c).

In the most recent status review, the Grays River population, in the Coast MPG, was considered to be on an improving trend and at moderate, if not lower, extinction risk. The other six populations in this MPG were considered to be at very high extinction risk, and some perhaps functionally extirpated. In the Cascade MPG, two spawning aggregates discovered in the early 2000s in the mainstem Columbia River just upstream of the I-205 Bridge are considered part of the Washougal population, and the abundance trend for this spawning aggregation was found to be stable and potentially slightly positive in the most recent status review. The other five populations in the Cascade MPG were considered at very high extinction risk, with critically low abundances. In the Gorge MPG, the Lower Gorge population was considered viable, and its abundance as of the most recent status review was, on average, somewhat improved since the previous status review; however, ocean conditions were likely responsible for this increase, and the overall trend since 2000 was found to be negative (NWFSC 2015). Spawning in the Upper Gorge population (above Bonneville) was thought to be very limited due to the inundation of historical spawning areas by Bonneville Reservoir; however, small numbers of chum salmon do migrate past Bonneville Dam in most years, and chum fry are observed at the Bonneville Dam juvenile sampling facility (NWFSC 2015).

Table 12 lists the MPGs and populations in this ESU and summarizes their abundance/productivity, spatial structure, diversity, and overall population risk status at the time of the most recent status review; it also summarizes their target risk status for delisting (NMFS 2013b, 2016i; NWFSC 2015).

Table 13. CR chum salmon population-level risk for abundance/productivity (A/P), spatial structure, diversity, overall extinction risk as of the most recent status review (NWFSC 2015, NMFS 2016c), and recovery plan target status (NMFS 2013b). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH). The populations that spawn upstream of Bonneville Dam are highlighted in gray. * = no data.

MPG		Population	A/P Risk Rating	Spatial Structure Risk Rating	Diversity Risk Rating	Overall Extinction Risk Rating	Recovery Plan Target Extinction Risk Rating
Ecological Subregion	Run Timing						
Coast Range	Fall	Youngs Bay (OR)	*	*	*	VH	VH
		Grays/Chinook Rivers (WA)	VL	M	L	M	VL
		Big Creek (OR)	*	*	*	VH	VH
		Elochoman/Skamokawa creeks (WA)	VH	L	H	VH	L
		Clatskanie River (OR)	*	*	*	VH	L
		Mill, Germany, and Abernathy creeks (WA)	VH	L	H	VH	L
		Scappoose River (OR)	*	*	*	VH	L
Cascade Range	Summer	Cowlitz River (WA)	VH	H	H	VH	M
	Fall	Cowlitz (WA)	VH	L	H	VH	M
		Kalama River (WA)	VH	L	H	VH	M
		Lewis River (WA)	VH	L	H	VH	L
		Salmon Creek (WA)	VH	H	H	VH	VH
		Clackamas (OR)	*	*	*	VH	M
		Sandy (OR)	*	*	*	VH	L
		Washougal (WA)	VH	L	H	VH	VL
Columbia Gorge	Fall	Lower Gorge (WA, OR)	VL	L	VL	L	VL
		Upper Gorge (WA, OR)	VH	H	H	VH	M

Limiting Factors. Understanding the limiting factors and threats that affect the CR chum salmon ESU provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed.

For CR chum salmon, the pervasive loss of spawning, incubation, and rearing habitat is a primary limiting factor. Chum spawning habitats (upwelling areas of clean gravel beds in mainstem and side-channel portions of low-gradient reaches above tidewater) have been practically eliminated in most systems as a result of past and current land uses. Similarly, access to the estuary habitats in which juvenile chum salmon spend considerable time rearing has been impaired by agricultural and residential land use, particularly modification via dikes, levees, bank stabilization, and tide gates, but also by flow alterations caused by mainstem dams. These alterations impair sediment routing, influence habitat-forming processes, reduce access to peripheral habitats, and change the dynamics of the Columbia River estuarine food web (NMFS 2013b).

For the Upper Gorge population, which spawns above Bonneville Dam, the dam has impeded passage and inundated historical spawning habitat. For the Lower Gorge population, hydrosystem operations have the potential to limit access to spawning and incubation habitat in the Bonneville tailrace by dewatering redds before emergence. To avoid this, the Action Agencies provide flows at Bonneville Dam to support chum spawning, incubation, and migration (NMFS 2013b). In almost all years since such flows have been implemented, the Action Agencies have been able to fully support chum spawning, incubation, and migration below Bonneville Dam; however, in 2 years out of the last 21, other objectives have impaired the ability to fully support chum spawning, incubation, and migration (see below for more detail).

While high historical harvest rates of chum salmon contributed to their decline, harvest rates have been drastically reduced and harvest mortality is no longer considered a limiting factor for CR chum salmon. Land development, especially in the low gradient reaches that chum salmon prefer, will continue to be a threat to most populations due to projected increases in the population of the greater Vancouver/Portland area and the lower Columbia River overall (Metro 2014). This continued habitat degradation, in combination with the potential effects of climate change, will present a continuing strong negative influence.

The recovery plan for CR chum salmon identifies ESU- and MPG-level biological recovery criteria[40], and within each MPG, it also identifies specific population-level goals consistent with the MPG-level criteria (NMFS 2013b). Achieving recovery will require improving tributary and estuarine habitat conditions, reducing or mitigating hydropower impacts (see discussion below), and reestablishing chum salmon populations where they may have been extirpated.

Information on Status of the Species since the 2016 Status Review. We do not have updated dam counts for this species comparable to those discussed in prior sections for interior basin salmon and steelhead, because almost all CR chum salmon spawning takes place below Bonneville Dam. The best scientific and commercial data available indicate recent increasing trends in the abundance of both natural-origin and total spawners when compared to the 2009 to 2013 period (Table 14), with the exception of the Upper Gorge Tributaries population, which decreased in abundance[41].

[40] The ESU-level criterion is that each MPG that historically existed must have a high probability of persistence or have a probability of persistence consistent with its historical condition. The recovery plan also contains criteria for determining whether an MPG has met that standard, based on the status of the individual populations in the MPG (NMFS 2013b).

[41] The upcoming 2021 status review is expected to include population-level adult returns through 2019, and the 5-year periods used for calculating geomeans will shift forward (i.e., the last period will include 2015 to 2019). Shifting 2014 to the preceding 5-year grouping could reduce the magnitude of the positive percent change for some populations.

Table 14. 5-year geometric mean of natural-origin spawner counts for CR chum salmon. Number in parenthesis is the 5-year geometric mean of total spawner counts. "% change" is a comparison between the two most recent 5-year periods (2014-2018 compared to 2009-2013). "NA" means not available. An "*" indicates that, at the time of drafting this opinion, data for the Upper Gorge Tributaries population only were available through 2017. No data for chum salmon were available for 2019. Source: Williams (2020c).

MPG	Population	1999-2003	2004-2008	2009-2013	2014-2018	% Change
Coast	Grays and Chinook Rivers	NA	4898 (5246)	5767 (6058)	8884 (9525)	54 (57)
Cascade	Washougal River	NA	925 (931)	2084 (2097)	2641 (2658)	27 (27)
Columbia Gorge	Lower Gorge Tributaries	NA	978 (995)	1707 (1722)	3540 (3563)	107 (107)
	Upper Gorge Tributaries	48	141	80	68*	-15

Since 2016, observations of coastal ocean conditions indicate that recent outmigrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects (Werner et al. 2017). The relationship between ocean conditions and chum salmon survival is an area of active investigation. A preliminary model suggested increased adult returns in response to the same environmental indicators that predict higher Chinook and coho salmon returns, but failed to predict the substantial adult returns in 2016 and significantly under-predicted returns in 2017 and 2018 (Hillson 2020, Homel 2020). The ocean survival of chum salmon was above average in 2016 through 2018, potentially due to their unique consumption of the types of gelatinous organisms (jellies, salps, larvaceans) that were abundant during the recent warm ocean conditions (Brodeur et al. 2019, Morgan et al. 2019).

NMFS will evaluate the implications for extinction risk of more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 14.

Status of LCR Coho Salmon

Background. On June 28, 2005, NMFS listed the LCR coho salmon ESU as a threatened species (70 FR 37160). The threatened status was reaffirmed on April 14, 2014. The most recent status review, in 2016, concluded that this ESU should retain its threatened status (81 FR 33468). Critical habitat was designated on January 24, 2016 (81 FR 9252). The summary that follows describes the status of LCR coho salmon. More information can be found in the recovery plan (NMFS 2013a) and the most recent status review (NWFSC 2015) for this species.[42]

The LCR coho salmon ESU includes naturally spawned coho salmon originating from the Columbia River and its tributaries downstream from the White Salmon and Hood Rivers (inclusive) and any such fish originating from the Willamette River and its tributaries below Willamette Falls (Figure 15). The ESU also includes coho salmon from 21 artificial propagation programs (70 FR 37160).43 The ESU contains 24 independent populations in three ecological regions (Coast, Cascade, and Gorge); each of these three ecological regions is considered an MPG.[44]

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[42] In addition, a technical memo prepared for the status review contains detailed information on the biological status of the species (NWFSC 2015).

[43] Grays River Program; Peterson Coho Project; Big Creek Hatchery Program (ODFW Stock #13); Astoria High School Salmon-Trout Enhancement Program (STEP) Coho Program; Warrenton High School STEP Coho Program; Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers; Cowlitz Game and Anglers Coho Program; Friends of the Cowlitz Coho Program; North Fork Toutle River Hatchery Program; Kalama River Type-N Coho Program; Kalama River Type-S Coho Program; Lewis River Type-N Coho Program; Lewis River Type-S Coho Program; Fish First Wild Coho Program; Fish First Type-N Coho Program; Syverson Project Type-N Coho Program; Washougal River Type-N Coho Program; Eagle Creek National Fish Hatchery Program; Sandy Hatchery Program (ODFW Stock #11); and the Bonneville/Cascade/Oxbow Complex (ODFW Stock #14) Hatchery Program. In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including LCR coho salmon (81 FR 72759) and final revisions in 2020 (85 FR 81822). The final changes for hatchery program inclusion in this ESU were to remove the Kalama River Type-S Coho Program and add the Clatsop County Fisheries/Klaskanine Hatchery and Clatsop County Fisheries Net Pen Programs. For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005).

[44] The W/LC TRT used the term "strata" to refer to these population groupings, which are significant in identifying delisting criteria. The strata are analogous to the "major population groups" defined by the ICTRT. For consistency, we use the term "major population group" throughout this opinion.

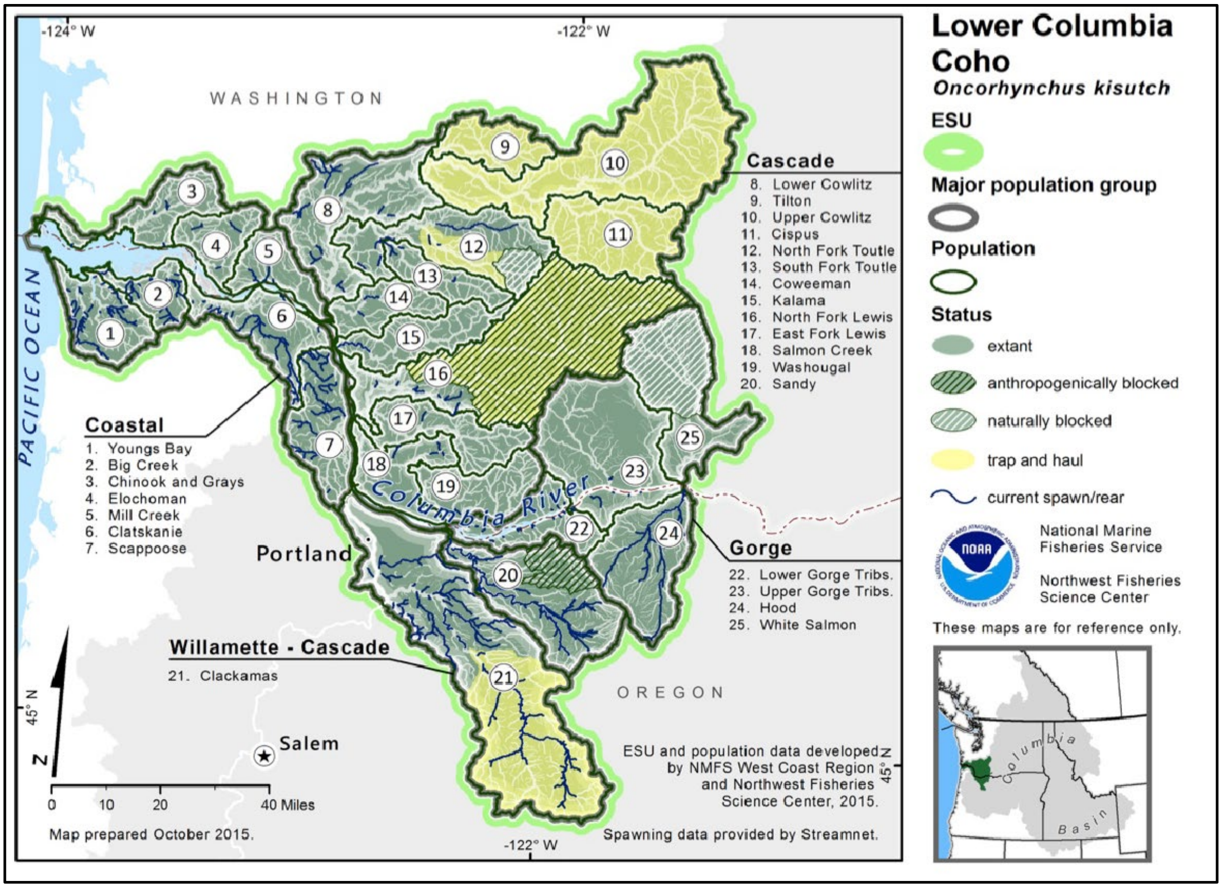

Figure 15. Map of the LCR coho salmon ESU's spawning and rearing areas, illustrating populations and major population groups.

Life-History and Factors for Decline. LCR coho salmon are typically categorized as either early- or late-returning stocks. Early-returning adult coho salmon enter the Columbia River in mid-August and begin entering tributaries in early September, with peak spawning from mid-October to early November. Late-returning coho salmon pass through the lower Columbia from late September through December and enter tributaries from October through January. Most spawning occurs from November to January (LCFRB 2010). Coho salmon generally spawn in intermediate positions in tributaries, typically further upstream than chum or fall-run Chinook, but often downstream of steelhead or spring-run Chinook (ODFW 2010). They particularly favor small, rain-driven, lower elevation streams characterized by relatively low flows during late summer and early fall, and increased river flows and decreased water temperatures in winter (LCFRB 2010). On their return, adult fish often mill near river mouths or in lower river pools until the first fall freshets occur (LCFRB 2010). Juveniles typically rear in freshwater for more than a year. After emergence, coho salmon fry move to shallow, low-velocity rearing areas, primarily along stream edges and inside channels. Juvenile coho salmon favor pool habitat and often congregate in quiet backwaters, side channels, and small creeks with riparian cover and woody debris. Side-channel rearing areas are particularly critical for overwinter survival, which is a key regulator of freshwater productivity (LCFRB 2010).

It is impossible to accurately estimate the decline in LCR stocks of coho salmon, but a NMFS review estimated that the runs may have been reduced to less than 5 percent of historical levels by the late 1950s (Johnson et al. 1991). The drastic decline in coho salmon abundance initiated a widespread hatchery enhancement program after 1960. This program increased coho salmon abundance in the Columbia River to near historical levels, but the causes of the original decline were not addressed by this extensive hatchery production. Overharvest, habitat blockage and destruction, and other activities detrimental to natural production continued. The result was a continued decline in naturally spawning runs while harvest exploitation of hatchery fish continued at increased levels (Johnson et al. 1991).

In the early 1980s, it was estimated that less than 25,000 coho salmon were spawning naturally in the Columbia River basin, and these fish were thought to be mainly feral hatchery fish and returns from hatchery outplants in streams away from hatcheries, although some were naturally produced. The NMFS review found no data to suggest that these numbers had changed significantly by the time of their review, and noted that ODFW estimated that there might be less than 195 coho salmon in Oregon, existing in small, isolated populations in the Lewis and Clark and Sandy River systems (Johnson et al. 1991).

Recovery Plan. The ESA recovery plan for LCR coho salmon (NMFS 2013a) includes delisting criteria for the ESU, along with identification of factors currently limiting its recovery, and management actions necessary for recovery. The biological delisting criteria are based on recommendations by the W/LC TRT.[45] They are hierarchical in nature, with ESU-level criteria based on the status of natural-origin LCR coho salmon assessed at the population level. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the ESU will require sufficient improvement in its abundance, productivity, spatial structure, and diversity.

Abundance, Productivity, Spatial Structure, and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within an ESU based on parameters of abundance, productivity, spatial structure, and diversity (these parameters are referred to as the viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans, and based on recommendations of the W/LC TRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each MPG to be considered at low extinction risk. For LCR coho salmon, recovery requires improving all three MPGs to a high probability of persistence or a probability of persistence consistent with their historical condition.

Earlier status reviews of LCR coho salmon raised concerns that most of the historical populations in the ESU appeared to be either extirpated or nearly so, and that the two populations with any significant production (Sandy and Clackamas Rivers) were at appreciable risk because of low abundance, declining trends, and failure to respond after a dramatic reduction in harvest.

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[45] The recovery plan also includes "threats criteria" for each of the listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

The large number of hatchery coho salmon in the ESU was also considered an important risk factor (Good et al. 2005, McElhany et al. 2007). The extreme loss of naturally spawning populations, low abundance of extant populations, diminished diversity, and fragmentation and isolation of the remaining naturally produced fish conferred considerable risks to LCR coho salmon.

These previous status reviews, however, lacked adequate quantitative data on abundance and hatchery contribution for a number of populations. Anecdotal information provided during these reviews suggested that hatchery-origin fish dominated many of the populations and that natural productivity was very low. More recent surveys provide a more accurate understanding of the status of these populations; however, with only 2 or 3 years of data, it is not possible to determine whether there has been a true improvement in status. It is, however, certain that the contribution of naturally produced fish is much higher than previously thought. Overall, the estimated changes in status for coho salmon populations noted in the most recent status review reflect improvements in abundance, diversity, and spatial structure, as well as monitoring (NWFSC 2015).

NMFS' most recent status review (NMFS 2013a) found that long-term abundances were generally stable or improving. In the Coast MPG, the Scappoose Creek population exhibited a positive abundance trend and contained few hatchery-origin fish. Similarly, the Clatskanie River population had moderate numbers of naturally produced spawners, with proportionately few hatchery-origin spawners. The initiation of spawner surveys in Washington tributaries also indicated the presence of moderate numbers of coho salmon, with total abundances in the hundreds to low thousands of fish, a substantial proportion of which were naturally produced.[46] Oregon tributaries in this MPG had abundances in the hundreds of fish, the majority of which were naturally produced. In the Cascade MPG, abundance trends for the Sandy and Clackamas populations remained stable and positive, respectively. There were also substantial returns of natural-origin coho salmon to the Tilton and Upper Cowlitz/Cispus Rivers in 2014. Where it was possible to calculate trends for populations in this MPG, they were generally stable. In the Gorge MPG, natural-origin abundances were low, with hatchery-origin fish contributing a large proportion of the total number of spawners, most notably in the Hood River (NWFSC 2015).
In terms of diversity effects, the most recent status review (NMFS 2013a) noted that hatchery releases had remained relatively steady since 2005, and that for most populations, the proportion of hatchery-origin fish spawning naturally exceeded the criteria set in the recovery plan. Efforts to shift production into localized areas (e.g., Youngs Bay and Big Creek) to reduce the influence of hatchery fish on other nearby populations (e.g., Scappoose and Clatskanie) were considered in transition. Reductions were also noted in the number of hatchery-origin juvenile coho salmon released into the Sandy River, and integrated hatchery programs had been developed in a number of basins to limit the loss of genetic diversity (NWFSC 2015).

The most recent status review (NMFS 2013a) also described a number of large-scale efforts to improve access to habitat, one of the primary metrics for spatial structure. On the Hood River, Powerdale Dam was removed in 2010. Condit Dam, on the White Salmon River, was removed in 2011 (although current monitoring efforts did not include coho salmon surveys, so the most

[46] These new data series for Washington tributaries were too short to calculate meaningful population trends.

recent status review noted that the extent of recolonization was unknown). Trap and haul fish passage operations were begun on the Lewis River in 2012, although juvenile passage efficiencies were still considered relatively poor. In addition, efforts to provide downstream juvenile passage at the Cowlitz Dam complex began in the 1990s, and the most recent status review noted that there had been a gradual increase in the numbers of naturally produced coho salmon adults. A trap and haul program was also in use to maintain access to the North Toutle River above the sediment retention structure. The most recent status review noted that many of these actions had occurred too recently to be fully evaluated, and where data were available they were not able to be assessed (NWFSC 2015, NMFS 2013a). The most recent status review also noted that while recent dam removals and the initiation of trap-and-haul programs had eliminated most major spatial structure limitations, smaller migrational barriers such as culverts may still limit spatial structure.

The most recent status review (NWFSC 2015) concluded that the status of a number of coho salmon populations had changed since earlier reviews. Changes in abundance and productivity, diversity, and spatial structure were generally positive; however, it remained unclear whether this was due to the improved level of monitoring, or the effects of recent recovery efforts, or both. Despite the improved information and recent improvements, the LCR coho salmon ESU most likely remained at moderate risk of extinction (NMFS 2013a). Furthermore, at the time of the most recent status review, none of the MPGs had met their recovery goals, and most populations still required substantial improvements to reach their recovery goals (Table 9). Abundances were still relatively low, and most populations remained at moderate or high risk of extinction. For the lower Columbia River region, land development and increasing human population pressures are likely to continue to degrade habitat, especially in lowland areas.

Table 15 lists the MPGs and populations in this ESU and summarizes their abundance/productivity, spatial structure, diversity, and overall population risk status at the time of the most recent status review (NWFSC 2015); it also summarizes their target risk status for delisting (NMFS 2013a).

Table 15. LCR coho salmon population-level risk for abundance/productivity (A/P), spatial structure, diversity, overall extinction risk as of the most recent status review (NWFSC 2015, NMFS 2013a), and recovery plan target status (NMFS 2013a). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH). The populations that spawn upstream of Bonneville Dam are highlighted in gray.

Ecological Subregion	Population	A/P Risk Rating	Spatial Structure Risk Rating	Diversity Risk Rating	Overall Extinction Risk Rating	Recovery Plan Target Status
Coast Range	**Youngs Bay (OR)**	VH	VL	VH	VH	VH
	Grays/Chinook Rivers (WA)	VH	L	VH	VH	L
	Big Creek (OR)	VH	L	H	VH	VH
	Elochoman/Skamokawa creeks (WA)	VH	L	VH	VH	L
	Clatskanie River (OR)	H	VL	M	H	VL
	Mill, Germany, and Abernathy creeks (WA)	VH	L	H	VH	M
	Scappoose River (OR)	M	L	M	M	VL
Cascade Range	**Lower Cowlitz (WA)**	VH	M	M	VH	L
	Upper Cowlitz (WA)	VH	M	H	VH	L
	Cispus (WA)	VH	M	H	VH	L
	Tilton River (WA)	VH	M	H	VH	VH
	South Fork Toutle River (WA)	VH	L	M	VH	L
	North Fork Toutle River (WA)	VH	M	H	VH	L
	Coweeman River (WA)	VH	L	M	VH	L
	Kalama River (WA)	VH	L	LH	VH	H
	North Fork Lewis River (WA)	VH	LH	H	VH	H
	East Fork Lewis River (WA)	VH	L	M	VH	L
	Salmon Creek (WA)	VH	M	VH	VH	VH
	Clackamas (OR)	M	VL	L	M	VL
	Sandy (OR)	VH	L	M	VH	L
	Washougal (WA)	VH	L	H	VH	M
Columbia Gorge	**Lower Gorge (WA, OR)**	VH	M	VH	VH	L
	Upper Gorge/White Salmon (WA)	VH	M	VH	VH	L
	Upper Gorge /Hood (OR)	VH	VL	H	VH	L

Limiting Factors. Understanding the limiting factors and threats that affect the LCR coho salmon ESU provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed. LCR coho salmon have been—and continue to be—affected by habitat degradation, hydropower impacts, harvest, and hatchery production (NMFS 2013a).

Impaired side channel and wetland conditions and degraded floodplain habitat have significant negative impacts on juvenile coho salmon throughout the ESU, while degraded riparian conditions and channel structure and form have negative impacts on both juveniles and adults of all populations. Extensive channelization, diking, wetland conversion, stream clearing, and, in some subbasins, gravel extraction have severed access to historically productive habitats, simplified remaining tributary habitats, and weakened the watershed processes that once created healthy ecosystems (NMFS 2013a).

Dam-related impacts vary throughout the ESU. Mainstem flow management alters flow volume and timing in the estuary, reducing access to peripheral habitat and changing the dynamics of the estuarine food web. As stream-type fish, juvenile coho salmon spend less time in the estuary than do ocean-type salmon, yet estuary habitat conditions do play a role in their survival, particularly those displaying less dominant life-history strategies. In addition, Bonneville Dam creates passage issues for the Upper Gorge/Hood and Upper Gorge/White Salmon populations, and the reservoir may have inundated historical spawning habitat. Tributary dams are a limiting factor in some subbasins, particularly the Cowlitz and Lewis subbasins (NMFS 2013a).
Harvest-related mortality was identified as a primary limiting factor for the ESU. For the period from 1970 to 1993, harvest rates averaged 82 percent, but since 2005, harvest impacts have been drastically reduced through measures such as mark-selective fisheries and time and area closures in both ocean and in-river fisheries (NMFS 2013a). Hatchery-related effects were also identified as a primary limiting factor for the ESU. Although production is reduced from the peak in the late 1980s, legacy effects of hatchery fish and current hatchery production continue to pose a threat to LCR coho salmon. It is likely that most coho salmon spawning naturally in the lower Columbia River are of hatchery origin (NMFS 2013a).

Birds, fish, and marine mammals also prey on LCR coho salmon in the lower Columbia River and, for those spawning above Bonneville Dam, in the reservoir (NMFS 2013a).

Information on Status of the Species since the 2016 Status Review. We do not have dam counts for this species, because most LCR coho salmon spawning takes place below Bonneville Dam. The best scientific and commercial data available are at the population level (Table 16) and indicate a mix of recent increases, decreases, and relatively static numbers of natural-origin and total spawners in 2014 to 2018 compared to the 2009 to 2013 period.[47] Therefore, the degree which abundance has been driven by below average ocean survival or by a variety of environmental conditions and management actions in freshwater spawning and rearing habitat, appears to vary between populations.

[47] The upcoming status review is expected to include population-level adult returns through 2019, and the 5-year periods used for calculating geomeans will shift forward (i.e., the last period will include 2015 to 2019). Because 2014 adult returns represented a peak at the ESU level for some populations, shifting 2014 to the preceding 5-year grouping is likely to increase the negative percent change.

Table 16. 5-year geometric mean of natural-origin spawner counts for LCR coho salmon. Number in parenthesis is the 5-year geometric mean of total spawner counts. "% change" is a comparison between the two most recent 5-year periods (i.e., 2014-2018 compared to 2009-2013). "NA" means not available. At the time of drafting this opinion, 2019 data were not available for any of the populations in this ESU. Source: Williams (2020b).

MPG	Population	1999-2003	2004-2008	2009-2013	2014-2018	% Change
Cascade	Kalama River	NA	NA	10 (278)	45 (232)	350 (-17)
	North Fork Lewis River	NA	NA	1196 (2133)	1409 (7373)	18 (246)
	Sandy River	NA	966 (1025)	1296 (1427)	1259 (1308)	-3 (-8)
	Clackamas River	1625 (2654)	2379 (4013)	3494 (4075)	3752 (4226)	7 (4)
	Coweeman River	NA	NA	2874 (3106)	2308 (2697)	-20 (-13)
	South Fork Toutle River	NA	NA	1580 (1878)	1554 (2068)	-2 (10)
	East Fork Lewis River	NA	NA	1822 (2080)	821 (1222)	-55 (-41)
	Lower Cowlitz River	NA	NA	3717 (4400)	3754 (4486)	1 (2)
	North Fork Toutle River	NA	NA	1092 (1628)	1133 (2038)	4 (25)
	Upper Cowlitz River	4095 (36296)	4881 (22031)	1122 (13084)	1011 (6403)	-10 (-51)
	Washougal River	NA	NA	527 (702)	192 (756)	-64 (8)
	Salmon Creek	NA	NA	1428 (1530)	1623 (1755)	14 (15)
	Tilton River	1099 (11802)	883 (4438)	1603 (5378)	2632 (5321)	64 (-1)
Columbia Gorge	Lower Gorge Tributaries	NA	NA	458 (559)	439 (541)	-4 (-3)
	Upper Gorge Tributaries	NA	NA	43 (59)	40 (53)	-7 (-10)
	Scappoose Creek	NA	461 (474)	622 (622)	577 (583)	-7 (-6)

MPG	Population	1999-2003	2004-2008	2009-2013	2014-2018	% Change
Coast Range	**Clatskanie River**	NA	598 (617)	1033 (1091)	348 (469)	-6 (-57)
	Elochoman River	NA	NA	531 (1158)	744 (1180)	40 (2)
	Grays and Chinook Rivers	NA	NA	252 (1288)	357 (1172)	42 (-9)
	Mill, Abernathy, and Germany Creeks	NA	NA	526 (587)	843 (948)	60 (61)

Since 2016, observations of coastal ocean conditions indicate that recent outmigrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects, which led researchers to predict the drop in adult coho salmon returns observed through 2019 (Werner et al. 2017). Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-m surface layer) had not returned to normal (Harvey et al. 2019). Expectations for marine survival are relatively mixed for juveniles that reached the ocean in 2019 (Zabel et al. 2020).

NMFS will evaluate the implications for extinction risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 16.

Status of Snake River Sockeye Salmon

Background. On November 20, 1991, NMFS listed the SR sockeye salmon ESU as an endangered species (56 FR 58619). The endangered status was reaffirmed on June 28, 2005 (70 FR 37160) and again on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that this ESU should retain its endangered status (81 FR 33468). Critical habitat was designated on December 28, 1993 (58 FR 68543). The summary that follows describes the status of SR sockeye salmon. Additional information can be found in the recovery plan (NMFS 2015a) and the most recent status review for this species (NMFS 2016b) [48].

The ESU includes all anadromous and residual sockeye salmon from the Snake River basin, and artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program (NMFS 2015a, 70 FR 37160) [49]. The ICTRT defined Sawtooth Valley sockeye salmon as the

[48] In addition, a technical memo prepared for the status review contains more detailed information on the biological status of the species (NWFSC 2015).

[49] For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005). In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including SR sockeye salmon (81 FR 72759). The proposed change for

single MPG within the SR sockeye salmon ESU. The MPG contains one extant population (Redfish Lake) and two to four extirpated, historical populations (Alturas, Petit, Stanley, and Yellowbelly Lakes). At the time of listing in 1991, the only extant population (the Redfish Lake population) had about 10 fish returning per year (NMFS 2015a). Table 17 lists the populations and hatchery programs that are part of the ESU.

Table 17. SR sockeye major population group, component populations, and hatchery (NMFS 2015a, 70 FR 37160).

Major Population Group	***Populations***
Sawtooth Valley	Redfish Lake Alturas Lake (extirpated) Pettit Lake (extirpated) Stanley Lake (extirpated) Yellowbelly Lakes (extirpated)
Hatchery Programs	
Hatchery programs included in ESU	Redfish Lake Captive Broodstock Program

Life History and Factors for Decline. Historically, adult SR sockeye salmon entered the Columbia River in June and July, migrated upstream through the Snake and Salmon Rivers, and arrived at the Sawtooth Valley lakes in August and September (Bjornn et al. 1968). Spawning in lakeshore gravels peaked in October. Fry emerged in late April and May and moved immediately to the open waters of the lake, where they fed on plankton for 1 to 3 years before migrating to the ocean. Juvenile sockeye salmon generally left the Sawtooth Valley lakes from late April through May and migrated nearly 900 miles to the Pacific Ocean. While pre-dam reports indicate that sockeye salmon smolts passed through the lower Snake River in May and June, PIT-tagged smolts from Redfish Lake passed Lower Granite Dam from mid-May to mid-July. SR sockeye salmon enter the estuary at a large size as a result of the long time they spend in the natal lakes before emigrating as juveniles to the ocean. They generally return as 4-year-old or older fish to their natal Sawtooth Valley Lake to spawn (NMFS 2015a).

SR sockeye salmon populations declined through the early- and mid-1900s, leading to an ESA-listing of the species as endangered in 1991. By the time of listing, all populations but one, the Redfish Lake population in the Sawtooth Valley, were extirpated, and that population had dwindled to fewer than 10 fish per year. In some years before 1998, no anadromous sockeye salmon returned to the Snake River basin. Many human activities contributed to the near extinction of SR sockeye salmon. The NMFS status review that led to the original listing decision attributed the decline to overfishing; irrigation diversions; obstacles to migrating fish, including dams; and eradication through poisoning. NMFS' 1991 listing decision for SR sockeye

hatchery program inclusion in this ESU was to add the Snake River Sockeye Salmon Hatchery Program. We expect to publish the final revisions in 2020.

salmon noted that such factors as hydropower development, water withdrawal and irrigation diversions, water storage, commercial harvest, and inadequate regulatory mechanisms represented a continued threat to the species' existence. Since that time, our understanding of key threats has expanded to include factors affecting survival at different points in the SR sockeye salmon life cycle. Sources of mortality for adults include predation, exposure to elevated water temperatures and elevated TDG, fallback over dams, straying to non-natal streams, harvest, and disease. Sources of mortality for juveniles include hatchery effects (e.g., disease, water quality, and mechanical failure), stress of release from the hatchery, food supply (productivity) and water quality in lakes, losses during downstream passage to and through the CRS or during transport, predation, and ocean conditions (NMFS 2015a).

Before the turn of the 20th century, large runs of sockeye salmon returned annually to the Snake River basin (Evermann 1895, Selbie et al. 2007). Sockeye salmon ascended the Snake River to the Wallowa River basin in northeastern Oregon and the Payette and Salmon River basins in Idaho to spawn in natural lakes[50]. Today, the last remaining SR sockeye salmon are in the Sawtooth Valley of Idaho, and of the five lakes that formerly supported sockeye populations, only the Redfish Lake population remains (Figure 16). This population is supported by a captive broodstock program and conventional hatchery programs; reintroduction of captive broodstock progeny has included incorporating multiple releases into Redfish, Pettit, and Alturas Lakes. The Redfish Lake population migrates 900 miles downstream from the Sawtooth Valley through the Salmon, Snake, and Columbia Rivers and passes through eight major Federal dams to reach the ocean. After 1 to 3 years in the ocean, the fish return to the Sawtooth Valley as adults, passing once again through the eight dams. Anadromous sockeye salmon returning to Redfish Lake travel a greater distance from the sea (900 miles) and to a higher elevation (6,500 feet) than any other sockeye salmon population (NMFS 2013c, 2015c).

[50] The historical relationships between the different SR sockeye salmon populations are not known. Because of the large geographic separation between the Wallowa, Payette, and Salmon River lakes, it is possible that each drainage supported a separate ESU (ICTRT 2005).

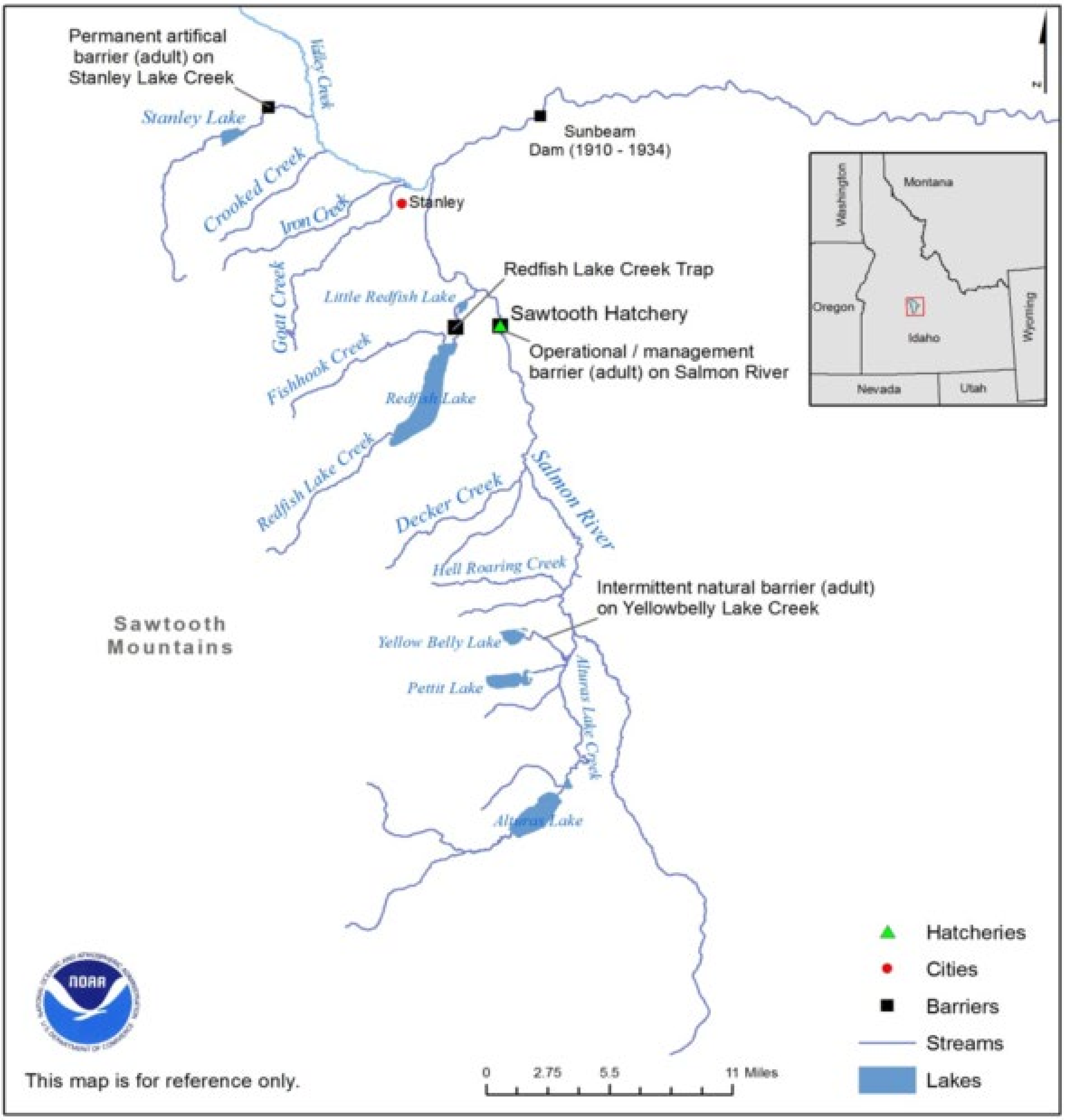

Figure 16. Map of SR sockeye salmon spawning areas and barriers in the Stanley Basin and Sawtooth Valley, Idaho.

Recovery Plan. The ESA recovery plan for SR sockeye salmon (NMFS 2015a) includes delisting criteria for the ESU, along with identification of factors currently limiting the recovery of the ESU, and management actions necessary for recovery. Biological delisting criteria are based on recommendations by the ICTRT[51]. They are hierarchical in nature, with ESU-level

[51] The recovery plan also includes "threats criteria" for each of the listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

criteria based on the status of natural-origin SR sockeye salmon assessed at the population level. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the ESU will require sufficient improvement in its abundance, productivity, spatial structure, and diversity.

The ICTRT recommended that the long-term recovery scenario for SR sockeye salmon should include restoring at least two of the three historical lake populations in the ESU to highly viable, and one to viable status, using Redfish Lake, Alturas Lake, and Pettit Lake. As recovery efforts progress over time, the ICTRT recommended considering expansion of reintroductions into Yellowbelly Lake and Stanley Lake (NMFS 2015a).

The SR sockeye salmon ESU is at a high risk of extinction. The recovery strategy aims to reintroduce and support adaptation of naturally self-sustaining sockeye salmon populations in the Sawtooth Valley lakes. The recovery strategy has three phases: 1) preservation with the captive broodstock program, 2) reintroduction, and 3) a program emphasizing natural adaptation and viability. At this time, we are still working on the first two phases; reintroduction efforts using Redfish Lake stock have been ongoing in Redfish Lake since 1993, Pettit Lake since 1995, and Alturas Lake since 1997 (Figures 16 and 17).

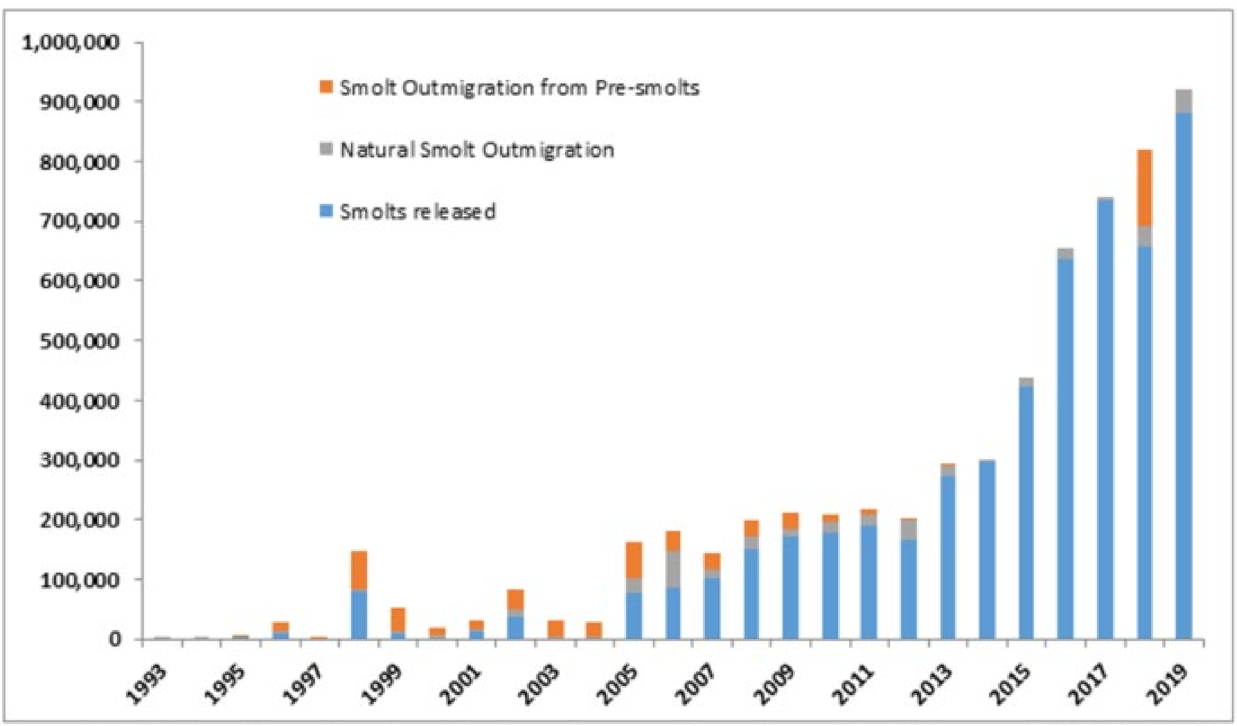

Figure 17. Estimated annual numbers of sockeye salmon smolt outmigrants from the Sawtooth Valley basin. This includes all hatchery smolt releases, known outmigrants originating from hatchery presmolts, and estimates of unmarked juveniles from Redfish, Alturas, and Pettit Lakes (Bellerud 2020).

Abundance, Productivity, Spatial Structure, and Diversity. In its recovery plan and most recent status review, NMFS noted that approximately two-thirds of the returning adults each year were captured at the Redfish Lake Creek weir, with the remaining adults captured at the Sawtooth Hatchery weir on the mainstem Salmon River upstream of the Redfish Lake Creek confluence. Although total SR sockeye salmon returns to the Sawtooth Basin were high enough to allow for some level of spawning in Redfish Lake, the hatchery program's priority remained genetic conservation and building sufficient returns to support sustained outplanting and recolonization of the species' historical range (NMFS 2015a, 2016b).

Adult returns of sockeye salmon to the Sawtooth Basin showed a general pattern of increase through 2014 (Table 18) (Johnson et al. 2020). In the 7 years before 2015, adult returns varied from a low of 242 in 2012 (including 52 natural-origin fish) to a high of 1,516 in 2014 (including 453 natural-origin fish). The large increases in returning adults in those years reflected improved survival during downstream migration through the mainstem Salmon, lower Snake, and Columbia Rivers and in the ocean, as well as increases in juvenile production since the early 1990s (NMFS 2016b).

Table 18. Hatchery- and natural-origin sockeye salmon returns to Sawtooth Valley, 1999 to 2019 (NMFS 2015a, Johnson et al. 2020).

Return Year	Total Return	Natural Return	Hatchery Return	Alturas Returns[1]	Observed Not Trapped
1999	7	0	7	0	0
2000	243	10	233	0	14
2001	23	4	19	0	3
2002	15	6	9	1	7
2003	2	0	2	0	1
2004	24	4	20	0	3
2005	6	2	4	0	0
2006	3	1	2	0	0
2007	4	3	1	0	0
2008	598	140	458	1	51
2009	817	86	731	2	16
2010	1,322	178	1,144	14	33
2011	1,099	145	954	2	18
2012	242	52	190	0	15
2013	270	79	191	0	2
2014	1,516	453	1,062	0	63
2015[2]	91	28	63	0	0
2016	572	33	539	0	23
2017	162	11	151	0	24
2018	113	13	100	0	3
2019	17	14	3	0	0

[1] These fish were assigned as sockeye salmon returns to Alturas Lake and are included in the natural-return numbers.

[2] In 2015, 56 sockeye returned to the Sawtooth Valley and 35 Snake River basin-origin sockeye were transported from Lower Granite Dam.

In 2015, the trend of adult returns was interrupted. Although the largest estimated number of SR sockeye salmon adults in recent history (4,093) arrived at Bonneville Dam that year, elevated water temperatures resulted in only 1 percent survival from Bonneville to Lower Granite Dam. Agencies and stakeholders quickly implemented a transportation program in which sockeye salmon were captured at Lower Granite Dam and trucked to the Sawtooth Valley to avoid the high temperatures. Fortunately, the “safety net” captive broodstock program was able to provide adults to maintain the SR sockeye salmon hatchery program (NMFS 2013c). In addition to the high temperature issue, the hatcheries had operational issues during 2015 to 2017 that resulted in high mortalities. It now appears that the operational issues are resolved or close to resolution. The low return of adults to the Sawtooth Valley in 2015 and the hatchery juvenile production issues in 2015 to 2017 likely contributed, along with recent poor ocean conditions, to the lower 2017 to 2019 SR sockeye salmon returns compared to previous years. There is also increasing evidence that competition with extremely large numbers of hatchery produced pink salmon, combined with a warm ocean, are substantially reducing the productivity (and abundance) of southerly populations of west coast sockeye salmon—especially in odd years, when adult pinks are far most abundant (Connors et al. 2020).

Long-term recovery objectives for this ESU are framed in terms of natural production. Substantial progress has been made with the captive broodstock hatchery program, but natural production levels of anadromous returns remain extremely low for this ESU.

<u>Limiting Factors</u>. Understanding the limiting factors and threats that affect SR sockeye salmon provides important information and perspective regarding the status of the species. One of the necessary steps in achieving species’ recovery and delisting is to ensure that the underlying limiting factors and threats have been addressed. Limiting factors and threats identified in the recovery plan (NMFS 2015a) for this ESU include (in no particular order):

- Natal lake habitat: In the Sawtooth Valley natal lakes, limiting factors include blocked access; low zooplankton density (which can restrict sockeye salmon growth and fitness); current and legacy effects of land use and other human activities such as mining, grazing, recreational use, lakeshore development, and irrigation diversions; lake poisoning[52]; and introduction and continued stocking of non-native species (such as brook trout, rainbow trout, lake trout, and kokanee).
- Mainstem Salmon River habitat: In the mainstem Salmon River migration corridor, irrigation withdrawals have contributed to reduced baseflows, altered hydrologic regimes, elevated water temperatures, and reduced availability of thermal refugia; the presence of toxic compounds has the potential to impair fitness; historical and current land uses have led to degraded riparian, floodplain, and instream habitat, elevated water temperatures, elevated sediment levels, and barriers to migration; and emigrating juveniles are subject to predation by smallmouth bass, hatchery steelhead, hatchery rainbow trout, and brook trout.

[52] In the 1950s, based on very low levels of adult sockeye salmon returns to Stanley, Pettit, and Yellowbelly Lakes, the IDFG made the decision to develop these lakes for resident species sport fisheries. Yellowbelly, Pettit, and Stanley Lakes were chemically treated with Toxaphene, Rotenone, and Fish-Tox, but the larger Alturas and Redfish Lakes were not.

- Lower Snake River habitat upstream of Lower Granite Reservoir: Operation of the Hells Canyon Complex dams has altered flows, riparian function, and food webs, and land use adjacent to the Snake River and its tributaries has degraded water quality and altered the thermal regime.
- Mainstem CRS migration corridor: Federal hydropower dams have created passage barriers and conversion of riverine habitat to reservoirs, and water withdrawals have degraded habitat conditions.
- Estuary habitat: Dikes, levees, and hydrosystem flow operations have disconnected the river from much of its historical floodplain, eliminating shallow-water habitat and altering the food web; water temperatures in the estuary during summer months are also higher than they were historically.
- Hatcheries: The Redfish Lake Sockeye Captive Broodstock Program has been vital to conserving genetic resources and helping SR sockeye salmon avoid extinction. As the program transitions to a larger scale supplementation program, the potential exists for loss of genetic diversity due to hatchery fish spawning with natural-origin fish (NMFS 2013c).
- Harvest: There are no fisheries targeting SR sockeye salmon, and fisheries targeting other Snake River species are managed to protect SR sockeye salmon. Non-Indian fisheries in the lower Columbia River are limited to an incidental take rate of 1 percent of the SR sockeye salmon adults reaching the Columbia River mouth, and Treaty Indian fisheries are limited to an incidental take rate of 5 to 7 percent, depending on the run size of upriver sockeye salmon stocks
- Predation: The recovery plan identified potential concerns related to predation by native and non-native fishes, predation by birds, and predation by marine mammals.

In its most recent status review, NMFS (2016b) noted that:

- Improvements had been made in tributary and estuary habitat conditions due to restoration and protection efforts, but habitat concerns remain throughout the Snake River basin, particularly in regard to streamflow, floodplain management, and water temperature.
- Changes to hydropower operations and passage had increased juvenile survival rates.
- Hot summer temperatures and impaired migration conditions in 2013 resulted in approximately 30 percent of the migrating adult SR sockeye salmon failing to pass Lower Granite Dam. In 2015, in response to high water temperatures, regional fish managers collected adult SR sockeye salmon at Lower Granite Dam and transported them to the Eagle Hatchery in Idaho.
- The adoption of the 2008 to 2017 U.S. v. Oregon Management Agreement had, on average, reduced impacts of freshwater fisheries to all Snake River ESUs/DPSs.
- Extirpation and further loss of genetic diversity of SR sockeye salmon had been averted largely due to the hatchery broodstock program, and the program was adjusting to promote increases in population diversity, spatial structure, and long-term recovery of the ESU.
- New information indicated that avian and pinniped predation had increased since the previous status review, although specific information on impacts to SR sockeye salmon was not available.

- Regulatory mechanisms had in general improved since the previous status review.
- Uncertainty regarding the long-term impacts of climate change and the ability of SR sockeye salmon to adapt added additional risks to species recovery.
- Key protective measures included continued releases of cool water from Dworshak Dam during late summer, continued flow augmentation to enhance flows in the lower Snake River in July and August, and continued efforts to improve adult passage at Lower Granite Dam.

Information on Status of the Species since the 2016 Status Review. The best scientific and commercial data available indicate a substantial downward trend in the returns of hatchery-origin and natural-origin adults to the Sawtooth Valley since 2014 (Table 18). The 5-year geometric mean of total spawner counts declined 6 percent in 2014 to 2018 when compared to 2009 to 2013 (Table 19) [53].

The recent downturn in adult abundance is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity (see discussion below), because the effects of hydropower operations and the overall availability and quality of tributary and estuary habitat were relatively constant or improving over the past 10 years[54]. However, adult returns of SR sockeye salmon to the Sawtooth Valley were also significantly impacted by earlier than average warm water temperatures in the mainstem in 2015. And hatchery operations faced significant water chemistry issues in 2015 to 2017 that resulted in the very poor survival of outplanted juveniles as they made their way through the hydrosystem. Those hatchery practices have been modified significantly, and early indications are positive that water chemistry is no longer a significant source of mortality in the hydrosystem for hatchery-origin juveniles.

Table 19. 5-year geometric mean of total spawner counts for SR sockeye salmon. "% change" is between the two most recent 5-year periods. At the time of drafting this opinion, 2019 data were not available. "NA" means not available. Source: Williams (2020a).

Population	MPG	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	% Change
Sawtooth Valley	Redfish Lake	NA	NA	(244)	(395)	(977)	(923)	(-6)

[53] The upcoming status review, expected in 2022, will include population-level adult returns through 2019, and will add an updated 5-year geomean, for 2015 to 2019. Because the 2014 adult returns represented a peak (Table 2.4-2), the negative percent change between the 2015–2019 and 2014–2018 geomeans will likely be greater than that shown in Table 2.4-3 between the 2014–2018 and 2009–2013 geomeans.
[54] Many factors (e.g., higher summer temperatures, lower late summer flows, low spring flows, etc.) affect the ability of tributary habitat to produce juvenile migrants (capacity) each year. Recent drought and temperature patterns may have had a negative effect on tributary habitat productivity, and as a result, lower than average juvenile production may have contributed in some years to downturns in adult abundance.

NMFS will evaluate the implications for viability risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 18 and Table 19.

Since 2016, observations of coastal ocean conditions indicate that recent outmigrant year classes have experienced below-average ocean survival during a marine heatwave and its lingering effects, which led researchers to predict the drop in adult Chinook salmon returns observed through 2019 (Werner et al. 2017). These conditions are also likely to have affected sockeye salmon returns. Some of the negative impacts on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-meter surface layer) had not returned to normal (Harvey et al. 2019). Expectations for marine survival are relatively mixed for juveniles that reached the ocean in 2019 (Zabel et al. 2020). There is also increasing evidence that the increasing abundance of pink salmon across the North Pacific Ocean, driven in large part by extremely large and increasing hatchery releases from Alaska, Russia, and other Pacific Rim countries, are substantially depressing the abundance of odd year sockeye returns (Connors et al. 2020)

Status of LCR Steelhead

Background. On March 19, 1998, NMFS listed the LCR steelhead DPS as a threatened species (63 FR 13347). The threatened status was reaffirmed on January 5, 2006 (71 FR 834), and most recently on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that this DPS should retain its threatened status (81 FR 33468). Critical habitat for LCR steelhead was designated on September 2, 2005 (70 FR 52630). The summary that follows describes the status of LCR steelhead. More information can be found in the recovery plan (NMFS 2013a) and the most recent status review for this DPS (NWFSC 2015).

The LCR steelhead DPS includes all naturally spawned anadromous *O. mykiss* originating below natural and manmade impassable barriers from rivers between the Cowlitz and Wind Rivers (inclusive) and the Willamette and Hood Rivers (inclusive), and excludes such fish originating from the upper Willamette River basin above Willamette Falls. This DPS also includes steelhead from seven artificial propagation programs (71 FR 834).[55]

The DPS consists of 23 independent populations, which are grouped into four MPGs based on combinations of ecoregion (Cascade, and Gorge) and life-history type (winter-run and summer-

[55] Cowlitz Trout Hatchery Late Winter-run Program; Kalama River Wild Winter-run and Summer-run Programs; Clackamas Hatchery Late Winter-run Program; Sandy Hatchery Late Winter-run Program; Hood River Winter-run Program; and Lewis River Wild Late-run Winter Steelhead Program. In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including LCR steelhead (81 FR 72759) and in 2020, NMFS published final revisions (85 FR 81822). The final changes for hatchery program inclusion in this DPS were to add the Upper Cowlitz River Wild Program and the Tilton River Wild Program. For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in a DPS, see NMFS (2005).

run): Cascade Winter (14 populations), Cascade Summer (four populations), Gorge Winter (three populations), and Gorge Summer (two populations)[56] (Figure 18).

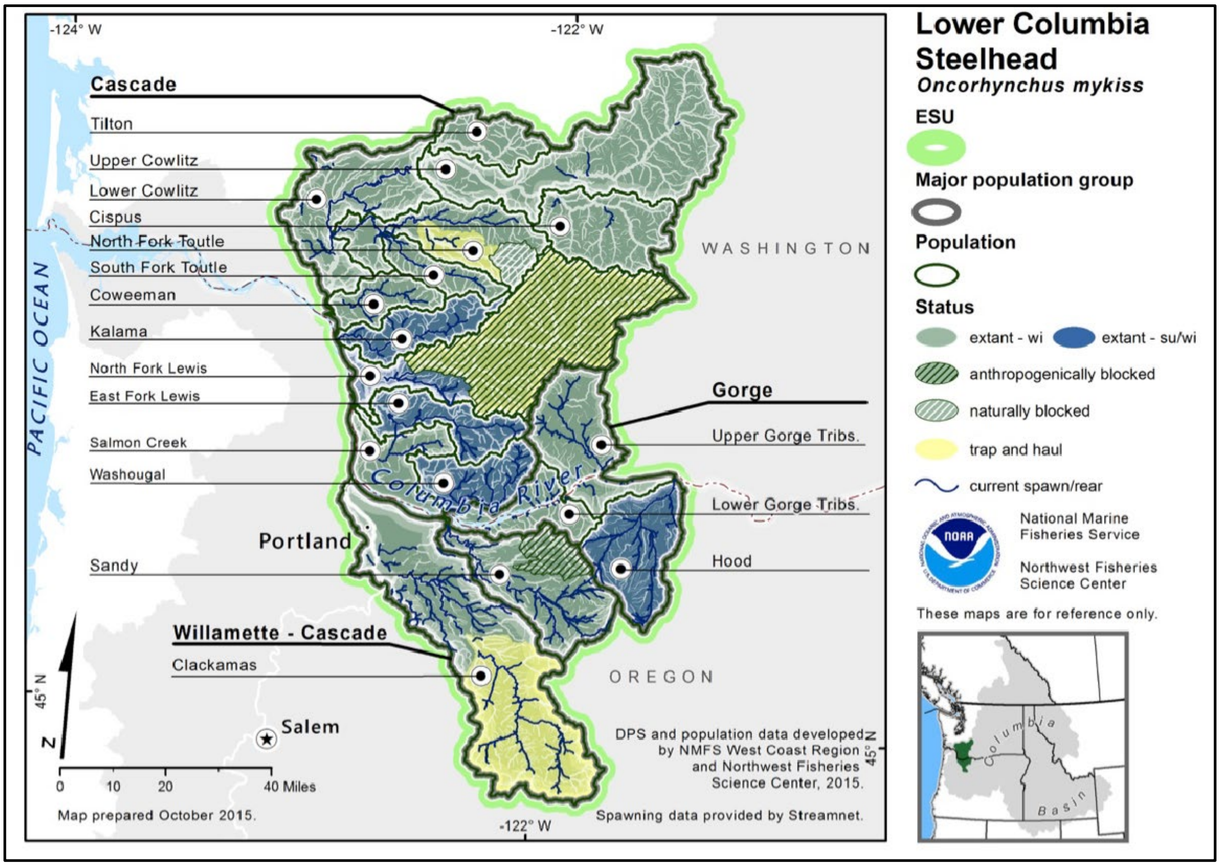

Figure 18. Map of the LCR steelhead DPS's spawning and rearing areas, illustrating populations and major population groups. Source: NWFSC 2015

Life-History and Factors for Decline. Steelhead spawn in a wide range of conditions, from large streams and rivers to small streams and side channels. Returning adult summer-run steelhead can reach headwater areas above waterfalls that are impassable to winter steelhead during high-velocity winter flows. The two life-history types (summer- and winter-run) differ in degree of sexual maturity at freshwater entry, spawning time, and frequency of repeat spawning (NMFS 2013a). Generally, summer-run steelhead enter freshwater from May to October in a sexually immature condition, and require several months in freshwater to reach sexual maturity and spawn between late February and early April. Winter-run steelhead enter freshwater from November to April in a sexually mature condition and spawn in late April and early May. Iteroparity (repeat spawning) rates for Columbia River basin steelhead have been reported as high as 2 to 6 percent for summer steelhead and 8 to 17 percent for winter steelhead (Leider et al. 1986, Busby et al. 1996, Hulett et al. 1996). The holding period for summer steelhead allows

[56] The W/LC TRT used the term "strata" to refer to these population groupings, which are significant in identifying delisting criteria. The strata are analogous to the "major population groups" defined by the ICTRT. For consistency, we use the term "major population group" throughout this opinion.

them to take advantage of periodically favorable passage conditions, but it may also result in higher pre-spawning mortality that puts summer-run steelhead at a competitive disadvantage relative to winter-run steelhead. Young steelhead typically rear in streams for 1 to 4 years before migrating to the ocean, with most migrating after 2 years in freshwater. In the lower Columbia River, outmigration of steelhead smolts (of both summer and winter life-history types) generally occurs from March to June, with peak migration usually in April or May (NMFS 2013a).

Declines in LCR steelhead have been caused by habitat degradation, harvest, hatchery production, and hydropower development that together have reduced the persistence probability of almost every population. Historically, high harvest rates contributed to population depletions, while stock transfers and straying of hatchery-origin fish reduced productivity and genetic and life-history diversity. Construction of tributary and mainstem dams has constrained the spatial structure of some steelhead populations by blocking or impairing access to historical spawning areas. Over time, population abundance and productivity have been reduced through habitat alterations. Habitat alterations in the Columbia River estuary have also contributed to increased predation on steelhead juveniles (NMFS 2013a).

Recovery Plan. The ESA recovery plan for LCR steelhead (NMFS 2013a) includes delisting criteria for the DPS, along with identification of factors currently limiting its recovery, and management actions necessary for recovery. The biological delisting criteria are based on recommendations by the W/LC TRT.[57] They are hierarchical in nature, with DPS-level criteria based on the status of natural-origin LCR steelhead assessed at the population level. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the DPS will require sufficient improvement in its abundance, productivity, spatial structure, and diversity.

The DPS-level criterion is that each MPG that historically existed must have a high probability of persistence or have a probability of persistence consistent with its historical condition. The recovery plan also contains criteria for determining whether an MPG has met that standard, based on the status of the individual populations in the MPG (NMFS 2013a). It also identifies specific population-level goals consistent with the MPG-level criteria (NMFS 2013a). The recovery strategy involves reducing threats in all categories, but crucial elements include: 1) protecting and restoring tributary habitat, especially in subbasins where large improvements in population abundance and productivity are needed to achieve recovery goals, 2) significantly reducing hatchery impacts, 3) reestablishing naturally spawning winter steelhead populations above tributary dams in the Cowlitz system (Upper Cowlitz and Cispus populations) and improving the status of the Tilton and North Fork Lewis winter steelhead populations, and 4) reducing predation.

Abundance, Productivity, Spatial Structure, and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within the DPS based on parameters of abundance, productivity, spatial structure, and diversity (these parameters are referred to as the

[57] The recovery plan also includes "threats criteria" for each of the listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans and based on recommendations of the W/LC TRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each MPG to be considered at low extinction risk. For LCR steelhead, recovery requires improving all four MPGs to a high probability of persistence or a probability of persistence consistent with their historical condition.

The most recent status review concluded that the majority of winter- and summer-run steelhead populations continued to persist at low abundances (NMFS 2013a). For winter-run populations, abundances had remained fairly stable but low (averaging in the hundreds of fish). Notable exceptions to this were the Clackamas and Sandy River winter-run populations, which showed increased natural-origin abundance and low levels of hatchery-origin spawners. For summer-run populations where abundance data were available, abundances had also been relatively stable but also low (averaging in the hundreds of fish). However, the most recent surveys available at the time (from 2014) indicated a drop in abundance, which was of concern and considered possibly a portent of changing ocean conditions (NWFSC 2015).

Historical and ongoing hatchery effects continue to affect genetic diversity and productivity in both summer- and winter-run populations, but the most recent status review found the overall situation somewhat improved compared to the previous review (NWFSC 2015). Total steelhead hatchery releases in the DPS had decreased since the previous status review, in 2011, declining from a total (summer- and winter-run) release of approximately 3.5 million to 3 million from 2008 to 2014. Some populations continued to have relatively high fractions of hatchery-origin spawners, whereas others (e.g., Wind River) have relatively few (NWFSC 2015).

For populations in this DPS that had limitations on their spatial structure (or access to historical habitats), the most recent status review noted that there had been a number of large-scale efforts to improve access (NMFS 2013a). A sample of these includes efforts to provide access to the upper Cowlitz River basin (beginning in 1996) and structural and operational changes at the dam to improve juvenile collection efficiency; removal of Powerdale Dam, on the Hood River, 2010; trap and haul operations on the Lewis River beginning in 2012; removal of Condit Dam, on the White Salmon River, in 2012; trap and haul operations at the sediment retention structure on the North Fork Toutle River, underway since 1989; removal of Marmot and Little Sandy Dams on the Sandy River in 2008, and removal of Hemlock Dam on Trout Creek, in the Wind River, in 2009. The most recent status review noted that many of these actions had occurred too recently to be fully evaluated. The review noted that, generally, where passage had been restored it remained to be demonstrated whether both adult and juvenile passage survival was sufficient to provide some level of self-sufficiency to upstream population components (NMFS 2013a, NWFSC 2015).

Overall, NMFS concluded in the most recent status review that the LCR steelhead DPS remained at moderate risk of extinction (NWFSC 2015, NMFS 2013a). Of the 23 populations, 16 were considered to be at high or very high risk of extinction, six had a moderate overall risk of extinction, and one had a low risk of extinction. None of the populations were considered fully viable. All four strata in the DPS fell short of their recovery goals, and most populations required substantial improvements to reach their recovery goals (NWFSC 2015). Table 20 lists the MPGs and populations in this DPS and summarizes their abundance/productivity, spatial structure, diversity, and overall population risk status at the time of the most recent status review; it also summarizes their target risk status for delisting (NMFS 2013a, 2016a; NWFSC 2015).

Table 20. LCR steelhead population-level risk for abundance productivity (A/P), spatial structure, diversity, overall extinction risk as of the most recent status review (NWFSC 2015, NMFS 2013a), and recovery plan target status (NMFS 2013a). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH). The populations that spawn upstream of Bonneville Dam are highlighted in gray.

MPG		Population	A/P Risk Rating	Spatial Structure Risk Rating	Diversity Risk Rating	Overall Extinction Risk Rating	Recovery Plan Target Status
Ecological Subregion	**Run Timing**						
Cascade Range	**Summer**	Kalama (WA)	L	VL	M	M	L
		North Fork Lewis River (WA)	VH	VH	VH	VH	VH
		East Fork Lewis River (WA)	VH	VL	M	VH	L
		Washougal River (WA)	M	VL	M	M	L
	Winter	Lower Cowlitz (WA)	H	M	M	H	M
		Upper Cowlitz (WA)	VH	M	M	VH	L
		Cispus (WA)	VH	M	M	VH	L
		Tilton River (WA)	VH	M	M	VH	H
		South Fork Toutle River (WA)	M	VL	L	M	VL
		North Fork Toutle River (WA)	VH	L	L	VH	L
		Coweeman River (WA)	H	VL	VL	H	L
		Kalama River (WA)	H	VL	L	H	VL
		North Fork Lewis River (WA)	VH	M	M	VH	M
		East Fork Lewis River (WA)	M	VL	M	M	L
		Salmon Creek (WA)	VH	L	M	VH	VH
		Clackamas (OR)	M	VL	M	M	M
		Sandy (OR)	H	M	M	H	VL
		Washougal (WA)	H	VL	M	H	M
Columbia Gorge	**Summer**	Wind (WA)	VL	VL	L	L	VL
		Hood River (OR)	VH	VL	H	VH	L
	Winter	Lower Gorge (WA, OR)	H	VL	M	H	L
		Upper Gorge (WA, OR)	H	M	M	H	H
		Hood (OR)	M	VL	M	M	L

Limiting Factors. Understanding the limiting factors and threats that affect the LCR steelhead DPS provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed.

Because steelhead are stream-type fish that typically rear in tributary reaches for a year or more, they depend heavily on tributary habitat conditions for their early survival (LCFRB 2010). Loss and degradation of tributary habitat is one of the main limiting factors for LCR steelhead. Impaired side channel and wetland conditions, along with degraded floodplain habitat, degraded riparian conditions, and loss of channel structure and form, have significant negative impacts on juvenile steelhead throughout the DPS. In most cases, these limiting factors have resulted from channelization, diking, wetland conversion, stream clearing, and gravel extraction, which have barred steelhead from historically productive habitats and simplified remaining habitats, weakening watershed processes that are essential to the maintenance of healthy ecosystems and reducing refugia and resting places (NMFS 2013a). As stream-type fish, steelhead spend less time in the Columbia River estuary than do ocean-type salmon such as fall Chinook, yet estuary habitat conditions nevertheless play a role in the survival of steelhead juveniles, particularly those displaying less dominant life-history strategies (NMFS 2013a).

Tributary habitat dams limit access to historical habitat for some winter steelhead populations, particularly the Upper Cowlitz, Cispus, North Fork Lewis, and Tilton populations, and the North Fork Lewis summer-run population. Four populations (Wind summer-run, Hood summer-run, Upper Gorge winter-run, and Hood winter-run) in two MPGs in this DPS are subject to CRS impacts involving passage at Bonneville Dam.

There is no direct harvest of naturally produced LCR steelhead other than a catch and release fishery in the Wind River (NWFSC 2015). They are intercepted in mainstem fisheries targeting unlisted hatchery and naturally produced Chinook salmon and unlisted steelhead, but overall impacts are low and harvest is not considered a primary limiting factor (NMFS 2013a).
High proportions of hatchery-origin spawners in some populations, combined with past stock transfers, are believed to have reduced genetic diversity within and among LCR steelhead populations. Productivity likewise has declined as a result of the influence of hatchery-origin fish. These high proportions of hatchery fish spawning naturally, along with releases of out-of DPS hatchery fish, remain a concern. We expect this factor to be greatly reduced by reforms identified in the biological opinion evaluating Mitchell Act funding (NMFS 2017c)—for example, beginning in 2019, out-of-DPS releases of hatchery steelhead inside this DPS's geographic range were terminated.

LCR steelhead populations are affected by predation by birds in the Columbia River estuary. Steelhead spawning above Bonneville Dam also are subject to predation by non-salmonid fish (primarily pikeminnow above and below the dam, but also walleye and smallmouth bass in the reservoir). Winter steelhead spawning above Bonneville Dam are also subject to predation by marine mammals (primarily sea lions) at Bonneville Dam (NMFS 2013a).

Information on Status of the Species since the 2016 Status Review. We do not have updated dam counts for this species, because most LCR steelhead spawning takes place below Bonneville Dam. The best scientific and commercial data available are at the population level (Table 21). These indicate a mix of recent increases, decreases, and relatively static numbers of natural-origin and total spawners in 2014 to 2018 compared to the 2009 to 2013 period.[58] However, in all cases where available, abundance estimates for 2019 were lower than the most recent 5-year geometric means indicating a common driver such as poor ocean conditions (e.g., temperature and salinity, coastal food webs).

Table 21. 5-year geometric mean of natural-origin spawner counts for LCR steelhead. Number in parenthesis is the 5-year geometric mean of total spawner counts. If there is only a value in parentheses, the total spawner count was the only available data for a population (i.e., there was no, or only one, estimate of natural spawners for the 5-year period). "% change" is a comparison between the two most recent 5-year periods (2014-2018 compared to 2009-2013). "NA" means not available. An "*" indicates two missing years of data from the dataset. At the time of drafting this opinion, 2019 data were available for most, but not all LCR steelhead populations. Source: Williams (2020a, b).

MPG	Population	1999-2003	2004-2008	2009-2013	2014-2018	% Change	2019
Cascade	Kalama River - summer	(318)	(380)	(493)	(567)	(15)	(377)
	Kalama River - winter	(1072)	(1440)	(883)	(891)	(1)	(153)
	Sandy River - winter	NA	NA	997 (1103)	4026 (4263)	304 (286)	1896 (2032)
	Clackamas River - winter	NA	NA	(3525)	3322 (3066)	(-13)	1500 (1702)
	Coweeman River-winter	(354)	(488)	(460)	(565)	(23)	(354)
	East Fork Lewis River - winter	(401)	(514)	(394)	(644)	(63)	(322)
	East Fork Lewis River - summer	(322)	(475)	(894)	(721)	(-19)	(367)
	Upper Cowlitz River - winter	266 (802)	429 (1056)	523 (778)	130 (396)	-75 (-49)	NA
	North Fork Toutle River - winter	NA	NA	(338)	(501)	(48)	(112)
	South Fork Toutle River - winter	(621)	(622)	(402)	(792)	(97)	(284)
	Washougal River - winter	(343)	(613)	(333)	(531)	(59)	(130)

[58] The upcoming 2021 status review is expected to include population-level adult returns through 2019, and the 5-year periods used for calculating geomeans will shift forward (i.e., the last period will include 2015 to 2019). Because 2014 adult returns represented a peak at the DPS level for some populations, shifting 2014 to the preceding 5-year grouping is likely to increase the negative percent change.

MPG	Population	1999-2003	2004-2008	2009-2013	2014-2018	% Change	2019
	Washougal River - summer	(243)	(668)	(660)*	(667)	(1)	(456)
	Tilton River - winter	190 (839)	160 (310)	231 (368)	251 (306)	9 (-17)	NA
Columbia Gorge	Upper Gorge Tributaries - winter	(35)	(17)	(21)	(9)	(-57)	(8)
	Hood River - winter	NA	NA	NA	501 (1080)	NA	NA
	Wind River - summer	483 (541)	703 (707)	845 (850)	617 (622)	-27 (-27)	(303)

NMFS will evaluate the implications for extinction risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 21.

Many LCR steelhead populations have increased in abundance since the 1990s, but even these appear to have been affected by recent poor ocean conditions. These conditions (e.g., temperature and salinity, coastal food webs), appeared to be more favorable to steelhead survival and adult returns in 2018, but were still impacted by recent warming trends.

Status of MCR Steelhead

Background. On March 25, 1999, NMFS listed the MCR steelhead DPS as a threatened species (64 FR 14517). The threatened status was reaffirmed on January 5, 2006 (71 FR 834). The most recent status review, in 2016, concluded the species should remain listed as a threatened species (81 FR 33468). Critical habitat for the DPS was designated on September 2, 2005 (70 FR 52630). The summary that follows describes the rangewide status of MCR steelhead. More information can be found in the recovery plan (NMFS 2009) and the most recent status review for this species (NWFSC 2015).

The MCR steelhead DPS includes all naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream of the Wind and Hood Rivers (exclusive) to and including the Yakima River (Figure 19). The DPS comprises 20 historical populations (three of which are extirpated) grouped into four MPGs. It also includes steelhead from seven artificial propagation programs (Table 22) (71 FR 834).[59]

[59] For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005). In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species (81 FR 72759) and final revisions in 2020 (85 FR 81822). No changes were proposed for the Mid-Columbia steelhead DPS.

This DPS does not include steelhead in the upper Deschutes River basin, which are designated as part of an experimental population (79 FR 20802, 76 FR 28715).

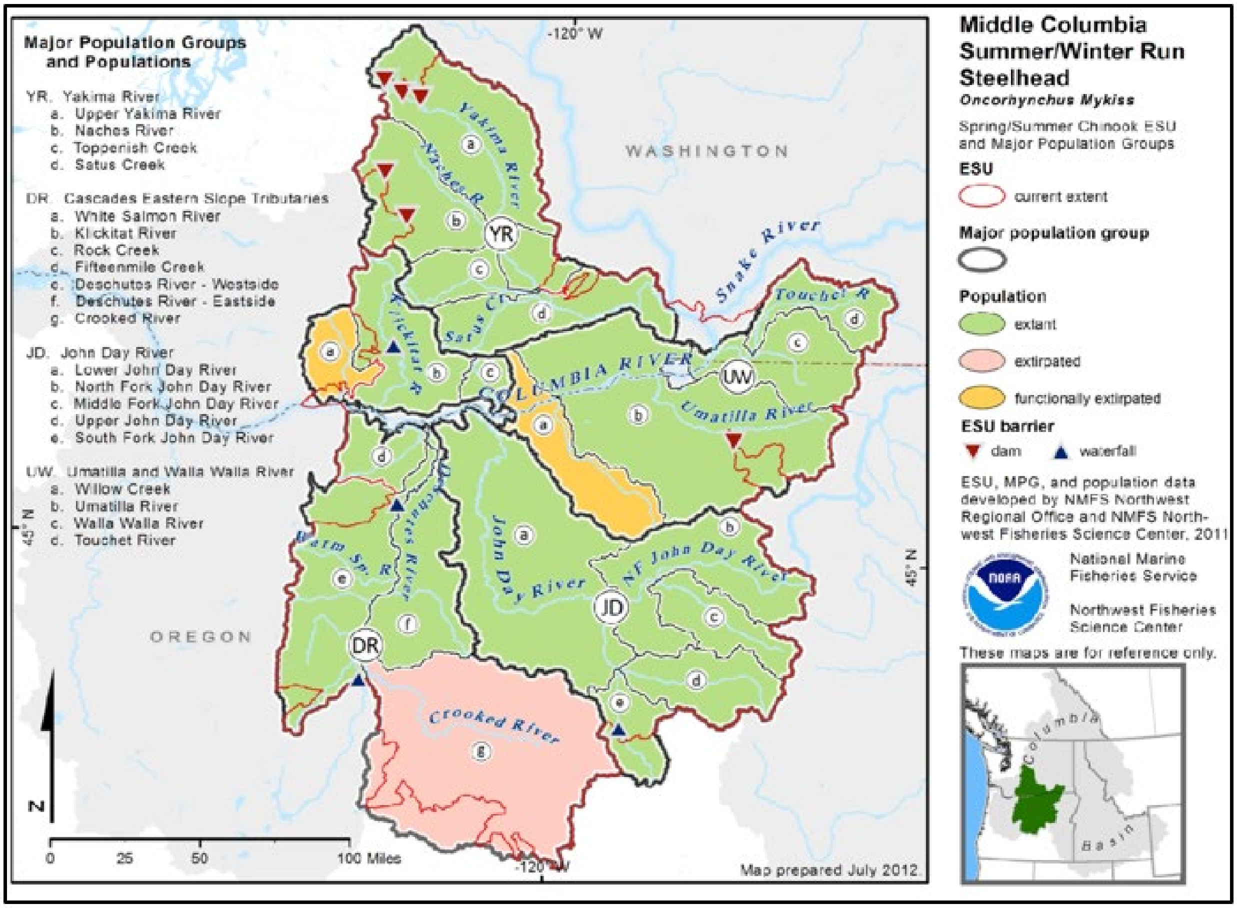

Figure 19. Map illustrating MCR steelhead DPS's populations and major population groups. Source: NWFSC 2015.

Table 22. MCR steelhead DPS major population groups and component populations, and hatchery programs (NMFS 2009, 71 FR 834). Populations with * are winter-run steelhead populations. All other populations are summer-run steelhead populations.

Major Population Group (MPG)	*Populations*
Cascades Eastern Slope Tributaries	Deschutes River Eastside Deschutes River Westside Fifteenmile Creek* Klickitat River* Rock Creek* White Salmon* (extirpated) Deschutes Crooked River (extirpated)
John Day River	John Day River Lower Mainstem Tributaries John Day River Upper Mainstem Tributaries North Fork John Day River Middle Fork John Day River South Fork John Day River
Yakima River	Naches River Satus Creek Toppenish Creek Yakima River Upstream Mainstem
Umatilla/Walla Walla Rivers	Touchet River Umatilla River Walla Walla River Willow Creek (extirpated)
Hatchery Programs	
Hatchery programs included in DPS	Touchet River Endemic Yakima River Kelt Reconditioning (four programs: Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River) Umatilla River Program Deschutes River Program

Life History and Factors for Decline. The MCR steelhead DPS includes 16 summer-run populations and four winter-run populations. Summer steelhead enter freshwater between May and October and require several months to mature before spawning; winter steelhead enter freshwater between November and April and spawn shortly thereafter. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small wood. Summer steelhead usually spawn farther upstream than winter steelhead (NMFS 2009). Steelhead may enter streams and arrive at spawning grounds weeks or months (and even up to a year) before they spawn. They are therefore vulnerable to disturbance and predation. They need cover, in the form of overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity. Once in the river, steelhead apparently rarely eat and grow little, if at all (NMFS 2009).

Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Depending on water temperature, steelhead eggs may incubate for 1.5 to 4 months before hatching. Young steelhead typically rear in streams for some time (generally 2 years) before migrating to the ocean. Some juveniles move downstream to rear in larger tributaries and mainstem rivers. Most fish in this DPS spend 1 to 2 years in saltwater before re-entering freshwater (NMFS 2009). Steelhead are iteroparous, meaning they can spawn more than once, whereas all other *Oncorhynchus* except cutthroat trout (*O. clarki*) spawn once and then die (i.e., are semelparous). Repeat spawning for Columbia River basin steelhead ranges from reported rates of 2 to 4 percent above McNary Dam (Busby et al. 1996) to 17 percent in the unimpounded tributaries below Bonneville Dam (at RM 146.1) (Leider et al. 1986).

Estimates of historical (pre-1960s) abundance indicate that the total historical run size for this DPS might have been in excess of 300,000. Total run sizes for the major steelhead stocks above Bonneville Dam were estimated in the early 1980s to be approximately 4,000 winter steelhead and 210,000 summer steelhead. Based on dam counts for this period, the MCR steelhead DPS represented the majority of this total run estimate, so the returns to this DPS were probably somewhat below 200,000 at that time. It was also estimated that 74 percent of the returns to this DPS were of hatchery origin at that time (61 FR 41541). NMFS continued to note concerns about declining abundance (including in John Day River basin, the largest producer of natural-origin steelhead) (NMFS 1996). The destruction and modification of habitat, overutilization for recreational purposes, impacts of hydropower development and operation, and high percentages of hatchery fish spawning naturally were cited as factors for decline for MCR steelhead at the time of listing (71 FR 834).

Recovery Plan. The ESA recovery plan for MCR steelhead (NMFS 2009) includes delisting criteria for the DPS, along with identification of factors currently limiting its recovery, and management actions necessary to achieve delisting. The biological delisting criteria are based on recommendations by the Interior Columbia Technical Recovery Team (ICTRT).[60] They are hierarchical in nature, with DPS-level criteria based on the status of natural-origin MCR steelhead assessed at the population level. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the DPS will require sufficient improvement in the abundance, productivity, spatial structure, and diversity of its component populations. Table 23 shows population status as of the most recent 5-year status review (NWFSC 2015) and the options for target status for each population to meet delisting criteria, based on the recovery plan (NMFS 2009) and the ICTRT recommendations.

[60] The recovery plan also includes "threats criteria" for each of the listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

Table 23. Population status as of the most recent status review (NWFSC 2015) and recovery plan target status (NMFS 2009) for MCR steelhead populations. "?" reflects uncertainty in the ratings.

MPG	Population	Population Status (Overall viability rating)	Recovery Plan Proposed Target Status
Eastern Cascades	Fifteen Mile Creek	Maintained	The Klickitat River, Fifteenmile Creek, Deschutes River Eastside, and Deschutes River Westside populations should reach at least viable status. At least one of these should be highly viable, consistent with ICTRT recommendations. MPG viability would be further bolstered if reintroduction of steelhead into the Crooked River succeeds and if the White Salmon River population successfully recolonizes its historical habitat following the removal of Condit Dam.
	Deschutes (Westside)	High Risk	
	Deschutes (Eastside)	Viable	
	Klickitat River	Maintained (?)	
	Rock Creek	High Risk (?)	
	Crooked River	Extirpated	
	White Salmon River	Extirpated	
Yakima River	Satus Creek	Viable	Two populations should achieve viable status, including at least one of the two classified as large (the Naches River and the Yakima River Upper Mainstem). The remaining two populations should, at a minimum, meet the maintained criteria. At least one population should be highly viable, consistent with ICTRT recommendations.
	Toppenish Creek	Viable	
	Naches River	Moderate	
	Upper Yakima River	High Risk	
John Day River	Lower John Day Tributaries	Maintained	The John Day River Lower Mainstem Tributaries, North Fork John Day River, and either the Middle Fork John Day River or the John Day River Upper Mainstem populations should achieve at least viable status. At least one population should be highly viable, consistent with ICTRT recommendations.
	Middle Fork John Day	Viable	
	North Fork John Day	Highly Viable	
	South Fork John Day	Viable	
	Upper John Day	Maintained	
Umatilla/Walla Walla	Umatilla River	Maintained	Two populations should meet viability criteria, and at least one population should be highly viable, consistent with ICTRT recommendations. The Umatilla River is the only large population, and therefore needs to be viable. In addition, either the Walla Walla River or Touchet River population also needs to be viable.
	Walla Walla River	Maintained	
	Touchet River	High Risk	
	Willow Creek	Extirpated	

Abundance, Productivity, Spatial Structure, and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within the DPS based on parameters of abundance, productivity, spatial structure, and diversity (these parameters are referred to as the viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans and based on recommendations of the ICTRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each MPG to be considered at low risk. Generally, each MPG must achieve low risk for the DPS as a whole to be considered no longer threatened or endangered.

The most recent status review (NWFSC 2015) found that for almost all populations in this DPS, the most recent 5-year geomean for natural-origin abundance had increased relative to the previous 5-year review.[61] Similarly, 15-year trends were positive for most populations in the DPS.[62] Populations in all four of the MCR steelhead MPGs exhibited similar temporal patterns in brood year returns per spawner: return rates for brood years 1995 to 1999 generally exceeded replacement but were generally well below replacement for brood years 2001 to 2003. Brood year return rates reflect the combined impacts of year-to-year patterns in marine life history stages, upstream and downstream passage survival, and density-dependent effects resulting from capacity or survival limitations on tributary spawning or juvenile rearing habitats. Overall, most populations showed increases in estimates of productivity. All but two populations (the Westside Deschutes River and Touchet River populations) were considered at either low or moderate risk for abundance and productivity (Table 24).

Updated information on spawner and juvenile rearing distribution for the most recent status review revealed no changes since the previous review, with all populations remaining at low or moderate risk for spatial structure. Status indicators for population diversity had changed for some populations, although in most cases the changes were not sufficient to shift composite risk ratings for a particular population, and all populations but one (the Upper Yakima River population) were rated at low or moderate risk for combined spatial structure and diversity (Table 24).

The most recent status review (NWFSC 2015) concluded that the MCR steelhead DPS was at moderate risk and remained threatened. While there had been improvements in the extinction risk for some populations, and while several populations were considered viable, the MCR steelhead DPS as a whole was not meeting delisting criteria, and most risk ratings remained unchanged from the previous review. The increases in abundance and productivity needed to achieve recovery goals for MCR steelhead were generally smaller than those needed for the other interior Columbia River basin-listed DPSs (NWFSC 2015).

Table 24 shows abundance, productivity, spatial structure, and diversity risk ratings for the 17 populations in the DPS as of the time of the most recent status review (NWFSC 2015).

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[61] For all five populations in the John Day MPG, for all four populations in the Yakima River MPG, for all three populations in the Umatilla Walla Walla MPG; and for two of the three populations for which data were available in the East Cascade MPG.

[62] For four of five populations in the John Day MPG, all four populations in the Yakima River MPG, one population in the Umatilla/Walla Walla River MPG (a second population had a slightly negative trend and data were insufficient for the third); and for one of three populations with available data in the East Cascade MPG.

Table 24. MCR steelhead population-level risk for abundance/productivity (A/P), diversity, integrated spatial structure/diversity (SS/D), and overall status as of the most recent status review (NWFSC 2015). Risk ratings ranged from very low (VL), to low (L), moderate (M), high (H), very high (VH), and extirpated (E). Maintained (MT) population status indicates that the population does not meet the criteria for a viable (low risk) population but does support ecological functions and preserve options for recovery of the DPS. "?" reflects uncertainty in the ratings.

Population	ICTRT Minimum Abundance Threshold[1]	Integrated A/P Risk Rating	Diversity Risk Rating	Integrated SS/D Risk Rating	Overall Extinction Risk Rating
Eastern Cascades MPG					
Fifteenmile Creek	500	M	L	L	MT
Westside Deschutes River	1,500	H	M	M	H
Eastside Deschutes River	1,000	L	M	M	L (Viable)
Klickitat River	1,000	M??	M	M	MT?
Rock Creek	500	NA	M	M	H?
Crooked River	2,000	E	E	E	E
White Salmon River	500	E	E	E	E
Yakima River MPG					
Satus Creek	1,000	L	M	M	L (Viable)
Toppenish Creek	500	L	M	M	L (Viable)
Naches River	1,500	M	M	M	M
Upper Yakima River	1,500	M	H	H	H
John Day River MPG					
Lower John Day tributaries	2,250	M	M	M	MT
Middle Fork John Day	1,000	L	M	M	L (Viable)

Population	ICTRT Minimum Abundance Threshold[1]	Integrated A/P Risk Rating	Diversity Risk Rating	Integrated SS/D Risk Rating	Overall Extinction Risk Rating
North Fork John Day	1,000	VL	L	L	VL (Highly viable)
South Fork John Day	500	L	M	M	L (Viable)
Upper John Day Mainstem	1,000	M	M	M	MT
Umatilla/Walla Walla MPG					
Umatilla River	1,500	M	M	M	MT
Walla Walla River	1,000	M	M	M	MT
Touchet River	1,000	H	M	M	H
Willow Creek	NA	E	E	E	E

[1] Minimum abundance thresholds represent the number of spawners needed for a population of a given size category to achieve low risk (viability) at a given productivity (ICTRT 2007). See NMFS (2009a) for additional detail relevant to specific populations.

Limiting Factors. Understanding the limiting factors and threats that affect the MCR steelhead DPS provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting the species is to ensure that the underlying limiting factors and threats have been addressed. Limiting factors identified in the recovery plan (NMFS 2009) for this ESU include (in no particular order):

- Habitat degradation: While some streams and stream reaches retain highly functional habitat conditions, nearly all historical MCR steelhead habitat lies within areas modified by human settlement and activities. These various activities have degraded streams and stream reaches across the range of the MCR steelhead DPS, leaving them with degraded floodplain connectivity and function, degraded riparian areas, insufficient large wood in channels, insufficient instream complexity and roughness, and inadequate connectivity to associated wetlands and off-channel habitats. The Columbia River estuary also provides important migratory habitat for MCR steelhead populations, and estuary habitat has been lost or significantly altered since the late 1800s, and despite recent work to restore tidal wetlands, the production of wetland macrodetritus supporting salmonid food webs is reduced both in shallow water and for larger juveniles migrating in the mainstem.

- Hydropower systems: Development and operation of the mainstem Columbia River hydropower system significantly alters travel conditions in the mainstem Columbia River, resulting in direct mortality of both upstream migrating adults and downstream migrating steelhead kelts, and direct and indirect mortality for downstream migrating juveniles. The hydropower system also changes the hydrograph, depleting historically available nutrients, changing water temperatures, and degrading rearing and food resources for both presmolts and smolts. Changes in the hydrograph leave MCR steelhead more vulnerable to bird and fish predation in the Columbia River estuary and mainstem. Several hydropower dams on Columbia River tributaries also pose threats to specific populations.
- Hatcheries: Hatchery fish that stray into middle Columbia River tributaries and spawn naturally may represent a serious threat to steelhead recovery. In particular, hatchery programs designed to return summer steelhead to upstream Columbia River tributaries result in substantial numbers of stray hatchery steelhead spawning naturally among several middle Columbia River populations. While some hatchery programs may provide conservation benefits, hatchery-induced genetic change can reduce the fitness of both hatchery and natural-origin fish in the wild, hatchery fish can compete for food and space with natural-origin fish.
- Harvest: Given current management regimes, the recovery plan did not identify harvest as a primary limiting factor for MCR steelhead.
- Predation: Anthropogenic changes in the Columbia River have altered the relationships between salmonids and other fish, bird, and pinniped species, and the recovery plan identified predation as a concern for juvenile and adult MCR steelhead. The plan noted that avian predation is a factor not only in the estuary but also farther inland, on islands in the middle Columbia River region. Predation by nonnative species was also identified as a significant factor. Predation by pinnipeds was not considered a primary limiting factor based on the relatively low numbers of MCR steelhead passing Bonneville Dam during the winter months.
- Climate change was also identified as a significant threat to MCR steelhead.

In its most recent status review NMFS (2016d) noted that:

- The many habitat restoration and protection efforts made in Columbia River tributaries and the estuary should result eventually in improved survival for the DPS, but additional improvements are needed to achieve recovery.
- Direct survival of juvenile salmonids outmigrating from MCR steelhead populations has increased as a result of juvenile passage improvements at Federal Columbia River mainstem dams. In addition, significant changes have been made at tributary hydropower projects, including passage improvements at Portland General Electric's Pelton Round Butte Project on the Deschutes River and the removal of PacifiCorp's Condit Dam on the White Salmon River. These actions are expected to benefit the DPS.
- Harvest rates remained relatively stable, with an overall exploitation rate of less than 10 percent for all fisheries combined.

- Hatchery programs continued to release hatchery steelhead and salmon within the DPS, and hatchery practices and impacts on the natural-origin populations had not changed significantly since the last review.
- Avian and pinniped predation on MCR steelhead had increased since the previous status review.
- Some regulatory mechanisms had improved since the previous status review, but, particularly for land-use regulatory mechanisms, there was lack of documentation or analysis of their effectiveness.
- Climate change was a concern, particularly the future effects of continued warming in marine and freshwater systems.

Information on Status of the Species since the 2016 Status Review. The best scientific and commercial data available with respect to the adult abundance of MCR steelhead indicates a substantial downward trend in the abundance of natural-origin spawners at the DPS level from 2014 to 2019 (Figure 20). This recent downturn in adult abundance is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity predicted by climate change scenarios (i.e., higher temperatures, increasing acidity, etc.), Hydropower operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices have been relatively constant or improving over the past 10 years.[63] Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.

Population level estimates of natural-origin and total (natural- plus hatchery-origin) spawners through 2018 or 2019 are shown in Table 25. These data also show recent and substantial downward trends in abundance for most of the MPGs and populations (exceptions are the Klickitat and Yakima River populations) when compared to the 2009 to 2013 period (Table 25).[64] In many cases, the most recent 5-year geometric mean in natural-origin abundance is considerably below the minimum abundance thresholds established by the ICTRT (shown in Table 25). The 2019 abundance level for the Tucannon River population was lower than the most recent 5-year geomean. However, the Klickitat, Middle Fork John Day, and Umatilla River populations are well above these thresholds. A relatively limited number of hatchery fish is present on the spawning grounds within this DPS, so that the 5-year geometric means are the same or very close for both natural-origin and total estimates of adults. The 2019 natural-origin abundance level for the South Fork John Day River population was higher than the geometric mean for 2013 to 2018, but the abundance levels for the Lower John Day River Tributaries, Middle Fork John Day River, Walla Walla River, and Touchet River were lower than their respective recent geometric means.

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[63] Many factors (e.g., higher summer temperatures, lower late summer flows, low spring flows, etc.) affect the ability of tributary habitat to produce juvenile migrants (capacity) each year. Recent drought and temperature patterns may have had a negative effect on tributary habitat productivity, and as a result, lower than average juvenile production may have contributed in some years to downturns in adult abundance.

[64] The upcoming status review, expected in 2022, will include population-level adult returns through 2019, and will add a new rolling 5-year geomean, for 2015 to 2019. Because the 2014 adult returns represented a recent peak at the DPS level (Figure 20), the negative percent change between the 2015–2019 and 2014–2018 geomeans will likely be greater than that shown in Table 16 between the 2014–2018 and 2009–2013 geomeans, at least for some populations.

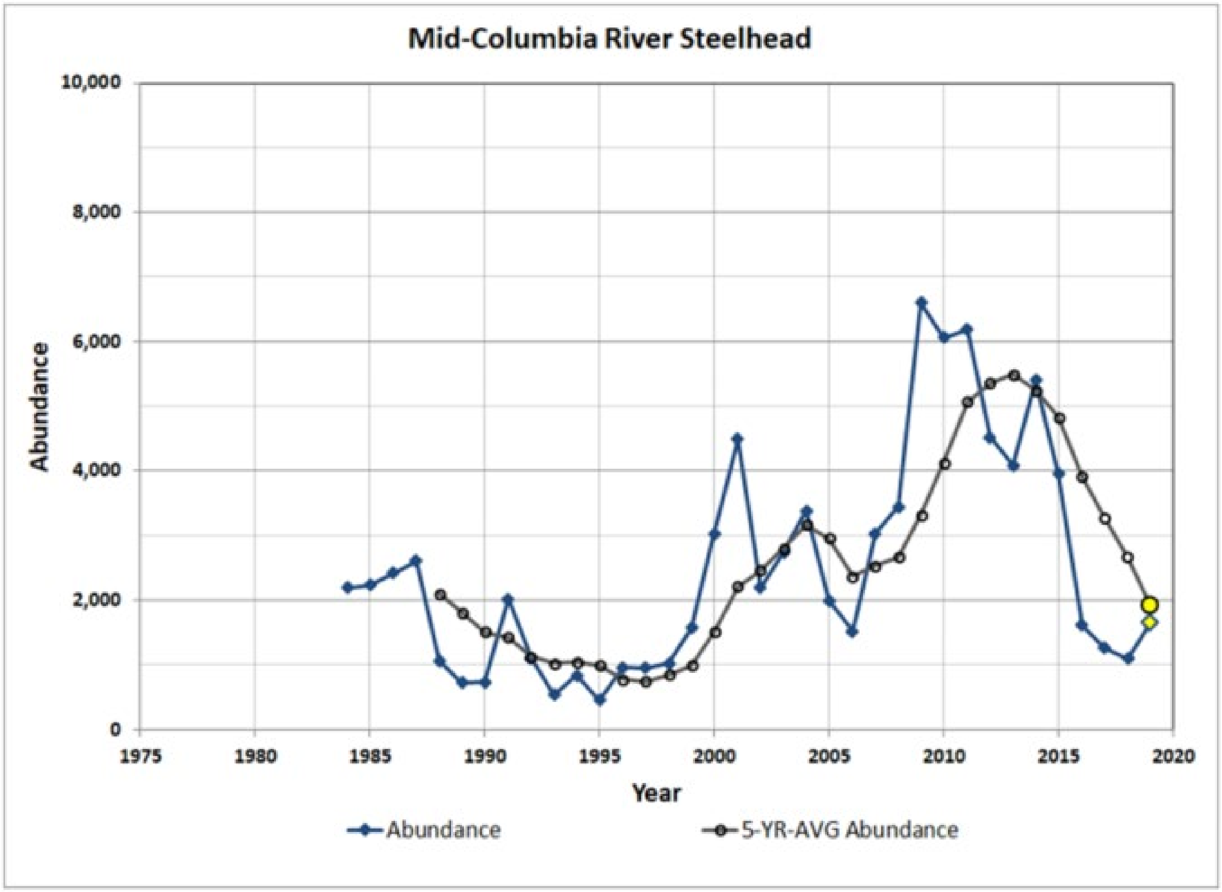

Figure 20. Annual abundance and 5-year average abundance estimates for Yakima River, natural-origin steelhead at Prosser Dam (a Major Population Group of the Mid-Columbia River Steelhead DPS) from 1984–1985 to 2018–2019. Data for year X includes passage counts occurring between July 1 of year X and June 30 of year X+1. Data for year 2019–2020 are a projection based on passage counts through December 31, 2019; average percent passage that occurs in year X; and average percent natural-origin fish. Data source: DART (2020a) -DART website's Adult Passage Query: http://www.cbr.washington.edu/dart/query/adult_graph_text

Table 25. 5-year geometric mean of natural-origin spawner counts for MCR steelhead. Number in parenthesis is the 5-year geometric mean of total spawner counts. "% change" is between the two most recent 5-year periods. "NA" means not available. At the time of drafting this opinion, 2019 data only were available for five populations. Sources: Williams 2020a, d).

Population	MPG	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	% Change	2019
Deschutes River Eastside (summer run)	Cascade Eastern Slope Tributaries	NA	494 (1025)	3770 (4722)	1574 (2019)	944 (1104)	386 (446)	-59 (-60)	NA
Deschutes River Westside (summer run)	Cascade Eastern Slope Tributaries	293 (365)	213 (311)	662 (879)	522 (633)	656 (728)	441 (462)	-33 (-37)	NA
Fifteen Mile Creek (winter run)	Cascade Eastern Slope Tributaries	380 (380)	348 (348)	914 (914)	317 (318)	455 (470)	314 (326)	-31 (-31)	NA
Klickitat River (summer and winter run)	Cascade Eastern Slope Tributaries	NA	NA	NA	NA	1395	1629	17	NA
John Day River Lower Mainstem Tributaries (summer run)	John Day River	1635 (1645)	763 (803)	3934 (4375)	801 (1090)	2042 (2389)	1278 (1337)	-37 (-44)	1009 (1009)
John Day River Upper Mainstem Tributaries (summer run)	John Day River	995 (1000)	432 (455)	664 (722)	419 (467)	974 (1001)	559 (563)	-43 (-44)	NA
Middle Fork John Day River (summer run)	John Day River	1329 (1338)	548 (577)	1300 (1414)	478 (531)	4066 (4180)	3012 (3033)	-26 (-27)	2037 (2037)

Population	MPG	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	% Change	2019
North Fork John Day River (summer run)	John Day River	720 (724)	1046 (1101)	2469 (2686)	1138 (1265)	3162 (3251)	1084 (1092)	-66 (-66)	NA
South Fork John Day River (summer run)	John Day River	340 (342)	186 (196)	398 (432)	412 (459)	1184 (1217)	807 (813)	-32 (-33)	1223 (1223)
Naches River (summer run)	Yakima River	318 (361)	229 (257)	701 (718)	786 (808)	1769 (1811)	1015 (1566)	-43 (-14)	NA
Satus Creek (summer run)	Yakima River	392 (444)	237 (267)	577 (592)	714 (734)	1615 (1652)	701 (1077)	-57 (-35)	NA
Toppenish Creek (summer run)	Yakima River	106 (121)	113 (127)	528 (542)	479 (493)	651 (667)	255 (378)	-61 (-43)	NA
Yakima River Upper Mainstem (summer run)	Yakima River	64 (66)	446 (47)	106 (109)	152 (154)	341 (358)	351 (502)	3 (40)	NA
Umatilla River (summer run)	Umatilla/Walla Walla Rivers	1250 (1550)	889 (1535)	2062 (2910)	1890 (2548)	3039 (3718)	2484 (2866)	-18 (-23)	NA
Walla Walla River (summer run)	Umatilla/Walla Walla Rivers	NA	587 (594)	894 (921)	662 (685)	1164 (1190)	546 (619)	-53 (-48)	281 (322)
Touchet (summer run)	Umatilla/Walla Walla Rivers	343 (388)	367 (415)	380 (407)	334 (426)	427 (560)	189 (239)	-56 (-57)	87 (139)

These data generally show that major population groups of MCR steelhead have increased in abundance since the 1990s, but experienced reductions during the more recent period when hydrosystem operations, the availability and quality of tributary and estuary habitat, and hatchery practices were relatively constant or improving, but ocean conditions were poor. Although these conditions (e.g., temperature and salinity, coastal food webs), appear to have been more favorable to steelhead survival and adult returns in 2018, they were still affected by recent warming trends. Increased numbers of sea lions in the lower Columbia River in the last 10 years could also be a contributing factor.

NMFS will evaluate the implications for viability risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure, as well as the updated estimates of abundance shown in Table 25.

Status of UWR Steelhead

Background. On March 25, 1999, NMFS listed the UWR steelhead as threatened (64 FR 14517) and reaffirmed that status on January 5, 2006 (71 FR 834). The status was upheld on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that this ESU should retain its threatened status (81 FR 33468). Critical habitat for UWR steelhead was designated August 22, 2011 (76 FR 52317). The summary that follows describes the status of UWR steelhead. Additional information can be found in the recovery plan (ODFW and NMFS 2011) and the most recent status review for this species (NWFSC 2015).

The UWR steelhead DPS includes all naturally spawned anadromous, winter-run *O. mykiss* originating below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls to, and including, the Calapooia River (Figure 21). There is only one major population group in this DPS, composed of four historical populations (Myers et al. 2006), all four populations remain extant and produce low to moderate numbers of natural-origin steelhead each year. Winter steelhead hatchery releases within the boundary of the UWR steelhead DPS ended in 1999; however, there is still a hatchery program for non-native summer steelhead.

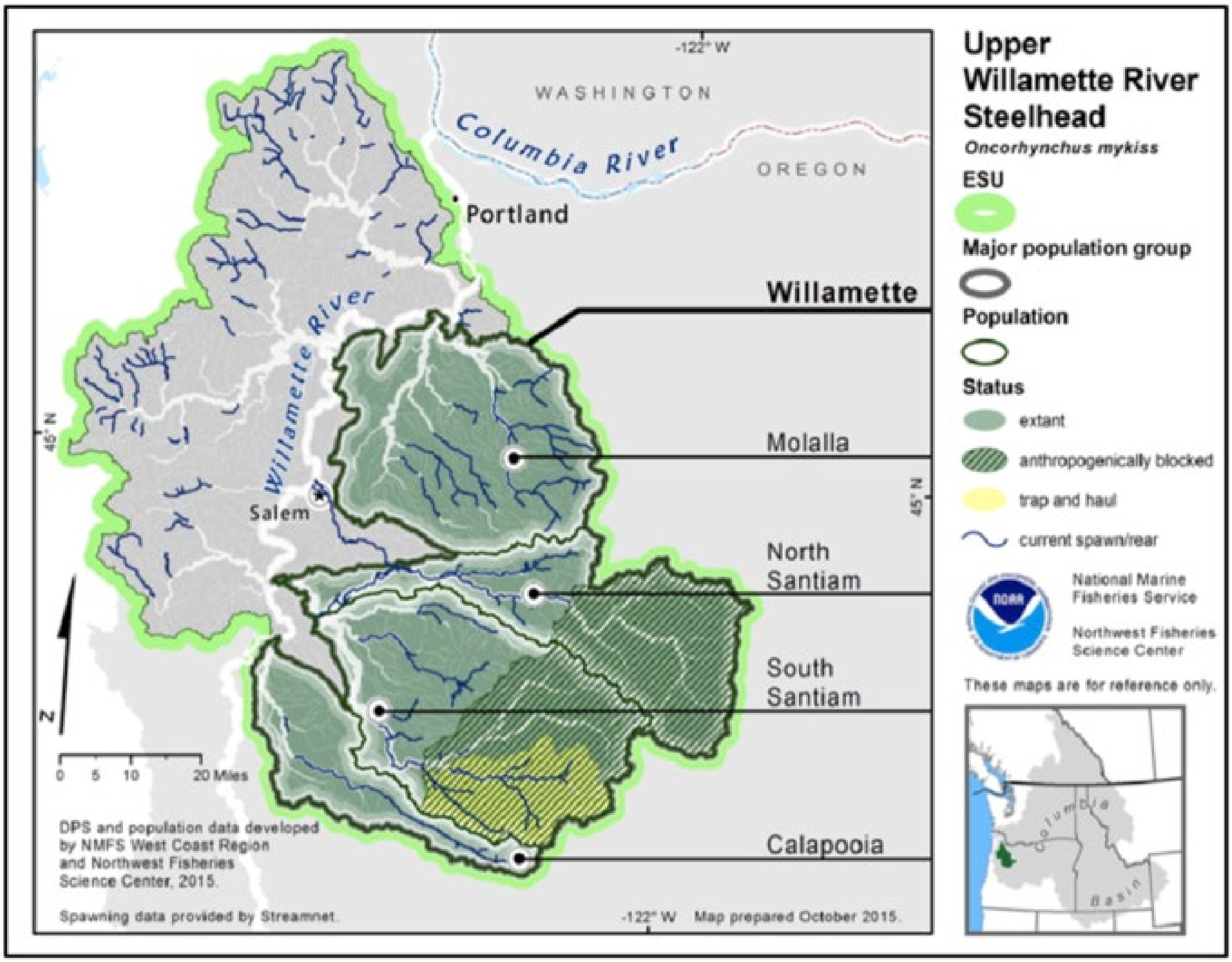

Figure 21. Map of the UWR winter steelhead DPS's spawning and rearing areas, illustrating the four populations within the one major population group. The westside tributaries of the DPS were not defined as a primary population area needed to meet recovery goals for the DPS (ODFW and NMFS 2011).

Life-History and Factors for Decline. Before construction of a fish ladder at Willamette Falls in the early 1900s, flow conditions allowed steelhead to ascend Willamette Falls only during the late winter and spring. As a result, UWR steelhead evolved as winter-run fish, returning to freshwater in January through April, passing Willamette Falls from mid-February to mid-May, and spawning in March through June, with peak spawning in late April and early May. They typically migrate farther upstream than Chinook salmon and can spawn in smaller, higher gradient streams and side channels. UWR steelhead may spawn more than once, although the frequency of repeat spawning is relatively low. Juvenile steelhead rear in headwater tributaries and upper portions of the subbasins for 1 to 4 years (most often 2 years), then migrate quickly downstream in April through May, through the mainstem Willamette River and Columbia River estuary and into the ocean. UWR steelhead typically forage in the ocean for 1 to 4 years (most often 2 years) and during this time are thought to migrate north to Canada and Alaska and into the North Pacific including the Alaska Gyre (ODFW and NMFS 2011).

At the time of listing of this DPS, NMFS noted concerns with genetic integrity of the DPS due to the construction of fish ladders at Willamette Falls as early as 1885, which facilitated the successful introduction of out-of-basin steelhead into the upper Willamette river basin. Also noted were blockage of historical spawning habitat by the Willamette Project dams and other smaller dams or impassable culverts throughout the region, and habitat degradation related to forestry, agriculture, and urbanization in the Willamette Valley. After fluctuating for several decades, abundance of natural-origin winter steelhead ascending the Willamette Falls fish ladder had been declining steeply since 1988, and the run in 1995 was the lowest in 30 years (Busby et al. 1996, 63 FR 11798).

Recovery Plan. The ESA recovery plan for UWR steelhead (ODFW and NMFS 2011) includes delisting criteria for the DPS, along with identification of factors currently limiting its recovery, and management actions necessary for recovery. The biological delisting criteria are based on recommendations by the W/LC TRT. They are hierarchical in nature, with DPS-level criteria based on the status of natural-origin UWR steelhead assessed at the population level. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the DPS will require sufficient improvement in its abundance, productivity, spatial structure, and diversity.

Abundance, Productivity, Spatial Structure, and Diversity. In its most recent status review for UWR steelhead (NWFSC 2015), NMFS noted that overall, the declines in abundance noted during the previous review (Ford et al. 2011) had continued through the period 2010 to 2015, and that populations in this DPS had experienced long-term declines in spawner abundance. Although the declines noted were relatively moderate, the most recent review noted that continued declines would be a cause for concern (NWFSC 2015). The most recent review noted considerable uncertainty in many of the abundance estimates for this DPS (with the possible exception of tributary dam counts). Radio-tagging studies suggested that a considerable proportion of winter-run steelhead ascending Willamette Falls do not enter the spawning areas that constitute this DPS; the review noted that these fish might be non-native, early winter-run steelhead that have colonized the western tributaries, misidentified summer-run steelhead, or late winter-run steelhead that have colonized tributaries not historically part of the DPS (NWFSC 2015).

In terms of spatial structure, access to historical spawning and rearing areas remained restricted by large dams in the North and South Santiam subbasins. The most recent status review noted that improvements to fish passage at Bennett Dam and operational temperature control at Detroit Dam might be providing some stability in abundance for the North Santiam River population, but that it was unclear if sufficient high-quality habitat was available below Detroit Dam to support the population reaching its recovery goal. Similarly, the most recent status review noted that the South Santiam River population might not be able to achieve its recovery goal without access to historical spawning and rearing habitat above Green Peter Dam and/or improved juvenile downstream passage at Foster Dam (NWFSC 2015).

The most recent status review noted that winter steelhead hatchery programs in the Upper Willamette River basin had been terminated in the late 1990s, an action that would help to alleviate diversity concerns related to hatchery fish. At the time of the most recent status review, the only steelhead programs in the upper Willamette River were releasing non-native summer steelhead. Annual total releases had been relatively stable at around 600,000 fish since 2009, although the distribution had changed, with fewer fish being released in the North and South Santiam Rivers and corresponding increases in the McKenzie and Middle Fork Willamette Rivers. There was some concern regarding the effect of introduced summer steelhead on native late-winter steelhead (NWFSC 2015).

Overall, NMFS concluded in the most recent status review that none of the populations in the DPS were meeting their recovery goals and that all were most likely in the moderate risk category (NWFSC 2015).

Limiting Factors. Understanding the limiting factors and threats that affect the UWR steelhead DPS provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed. The recovery plan for UWR steelhead (ODFW and NMFS 2011) identifies key and secondary limiting factors and threats for each population by area and life stage. These include:

- Restricted access to historical spawning and rearing habitat in the North and South Santiam subbasins by the Willamette Project flood control/hydropower dams operated by the Corps. Willamette Project dams block or delay adult fish passage to major portions of the historical holding and spawning habitat for UWR steelhead in the North Santiam and South Santiam subbasins. In addition, most Willamette Project dams have limited facilities or operational provisions for safely passing juvenile steelhead downstream of the facilities. In the absence of effective passage programs, UWR steelhead will continue to be confined to lowland reaches, where land development, water temperatures, and water quality are limiting, and where pre-spawning mortality levels are generally high.
- Hydropower-related limiting factors extend to the Columbia River estuary, where adverse effects on estuarine habitat quality and quantity are related to the cumulative effects of Columbia River basin dams. Effects include an altered seasonal flow regime and Columbia River plume due to flow management (ODFW and NMFS 2011).
- Land use practices including agriculture, timber harvest, mining and grazing activities, diking, damming, development of transportation, and urbanization, which have reduced access to historically productive habitats and reduced the quality of remaining habitat by weakening important watershed processes and functions (ODFW and NMFS 2011).
- Predation by birds, native and non-native fish, and marine mammals, including increasing marine mammal predation at Willamette Falls (Brown et al. 2017). Piscivorous birds, including Caspian terns and cormorants, and fishes, including northern pikeminnow, take significant numbers of juvenile steelhead. Steelhead smolts are especially vulnerable to Caspian tern predation in the Columbia River (Evans et al. 2018). Pikeminnow are significant predators of yearling juvenile migrants in the Willamette and Columbia Rivers (Friesen and Ward 1999). The

magnitude of pinniped predation for UWR steelhead in the estuary is not known, though the presence of California sea lions and Steller sea lions at the Astoria Mooring Basin has been increasing over the past few years. Similarly, the number of sea lions observed at Willamette Falls has also been increasing.

- The presence of hatchery-reared and feral hatchery-origin fish that may affect the growth and survival of juvenile late-winter steelhead. In the North and South Santiam Rivers, juveniles are largely confined by dams to below much of their historical spawning and rearing habitat. Releases of large numbers of hatchery-origin summer steelhead may temporarily exceed rearing capacities and displace winter juvenile steelhead.
- Historical harvest, although significant reforms were implemented in the early 1990s, and whereas harvest may have been a listing factor for winter steelhead, the reforms that have been implemented have reduced fishery harvest impacts such that it is no longer identified as a limiting factor. The current exploitation rates on natural-origin steelhead from sport fisheries are in the range of 0 to 3 percent, and steelhead are not intercepted in ocean fisheries to a measurable degree. There is some additional incidental mortality in the commercial net fisheries for hatchery Chinook salmon and steelhead in the lower Columbia River (ODFW and NMFS 2011).
- Climate change effects, including increased stream temperatures, changes in precipitation/streamflow, and years of low ocean productivity.

Information on Status of the Species since the 2016 Status Review. Abundance data for UWR steelhead are available from counts at the Willamette Falls fishway. UWR steelhead as counted at Willamette Falls were at a relatively steady but low abundance at the time of the most recent status review (NWFSC 2015). Since then, counts of adult UWR steelhead at Willamette Falls have declined dramatically, with 2017 and 2018 counts reaching only 15 to 30 percent of the 5-year geometric mean for the years 2010 through 2014 (Table 26).

Table 26. UWR Steelhead adult abundance at Willamette Falls. The 5-year geometric mean of Willamette Falls counts from 2010 through 2014 was calculated at the time of the last status review (NWFSC 2015). Counts for later years were obtained from the Willamette Falls annual fish counts (NMFS 2019, ODFW 2020).

5-Year Geometric Mean	Total Natural-Origin Adults
2010-2014	6,164
2015-2019	2,628

It is likely that any recent downturn is linked to poor ocean conditions (e.g., temperature and salinity, coastal food webs. These conditions) appeared to be more favorable to steelhead survival and adult returns in 2018, but were still impacted by recent warming trends.

NMFS will evaluate the implications for extinction risk of these more recent returns, and additional data at the population level, in the upcoming 5-year status review, expected in 2022.

The status review will consider new information on population abundance productivity, diversity, and spatial structure.

Status of UCR Steelhead

Background. On October 17, 1997, NMFS listed the UCR steelhead DPS as an endangered species (62 FR 43937), then designated it as a threatened species on January 5, 2006 (71 FR 834). The DPS was reclassified as endangered on January 13, 2007 (74 FR 42605). In 2009, the status was reclassified as threatened (74 FR 42605), and that status was reaffirmed on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that the DPS should retain its threatened status (81 FR 33468). Critical habitat for the UCR steelhead DPS was designated on September 2, 2005 (70 FR 52630). The summary that follows describes the rangewide status of UCR steelhead. More information can be found in the recovery plan (UCSRB 2007) and most recent status review for this species (NMFS 2016d) [65].

The UCR steelhead DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and artificial impassable barriers in streams within the Columbia River basin, upstream from the Yakima River, Washington, to the U.S./Canada border. The DPS comprises four independent populations, which are grouped into one MPG. It also includes steelhead from five artificial propagation programs (Table 27) (71 FR 834) [66]. Historically, there were likely three MPGs (Figure 22). Two additional steelhead MPGs likely spawned above Grand Coulee and Chief Joseph Dams, but these MPGs are extirpated, and reintroduction is not required for recovery as defined in the ESA recovery plan (UCSRB 2007). NMFS has defined the UCR steelhead DPS to include only the anadromous members of this species (70 FR 67130).

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[65] In addition, a technical memo prepared for the status review contains detailed information on the biological status of the species (NWFSC 2015).

[66] For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU, see NMFS (2005). In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including UCR steelhead (81 FR 72759). The proposed changes for hatchery programs in this DPS were to change the name of the Omak Creek Hatchery Program to the Okanogan River Program. We expect to publish the final revisions in 2020.

Table 27. UCR steelhead major population groups and component populations, and hatchery programs (UCSRB 2007, 71 FR 834).

Major Population Group	***Populations***
North Cascades MPG	Wenatchee River Entiat River Methow River Okanogan River
Hatchery Programs	
Hatchery programs included in DPS	Wenatchee River Wells Complex Hatchery Program (Methow River) Winthrop National Fish Hatchery Omak Creek Ringold Hatchery

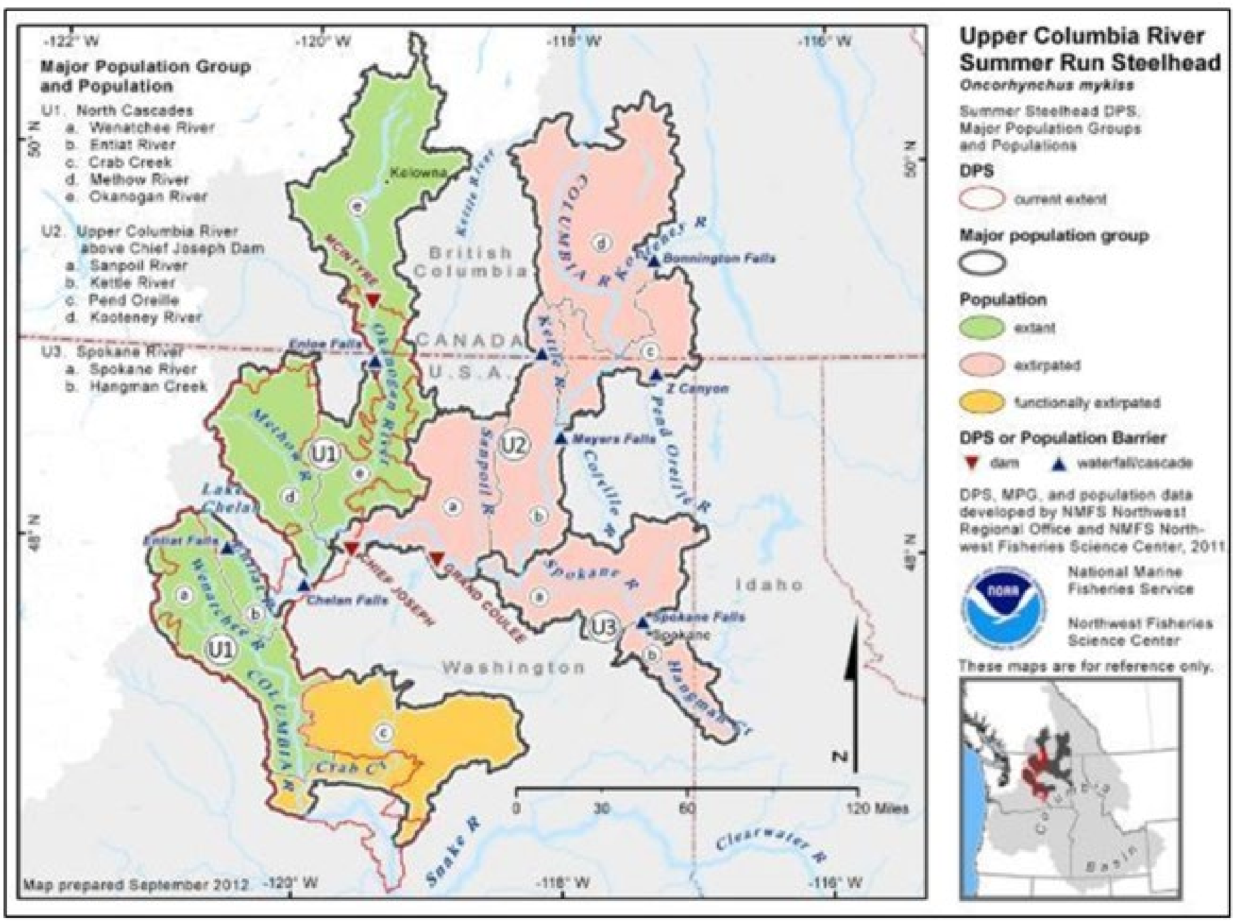

Figure 22. Map illustrating UCR steelhead DPS's populations and major population groups (NWFSC 2015).

Life History and Factors for Decline. The life-history pattern of steelhead in the UCR DPS is complex. UCR steelhead exhibit a stream-type life, with individuals exhibiting a yearling life-history strategy (NMFS 2016d). Adults return to the Columbia River in the late summer and early fall. Unlike spring-run Chinook salmon, most steelhead do not move upstream quickly to tributary spawning streams. A portion of the returning run overwinters in the mainstem Columbia River reservoirs, passing into tributaries to spawn in April and May of the following year. Spawning occurs in the late spring of the year following entry into the Columbia River. Juvenile steelhead generally spend 1 to 3 years rearing in freshwater before migrating to the ocean but have been documented spending as many as 7 years in freshwater before migrating. Most adult steelhead return to the upper Columbia River basin after 1 or 2 years at sea. UCR steelhead have a relatively high fecundity, averaging between 5,300 and 6,000 eggs (UCSRB 2007). Steelhead are iteroparous, or capable of spawning more than once before death.

Factors contributing to the decline of UCR steelhead included the intensive commercial fisheries in the lower Columbia River that began in the latter half of the 1800s, continued into the 1900s, and nearly eliminated many salmon and steelhead stocks. With time, the construction of dams and diversions, some without passage, blocked or impeded salmon and steelhead migrations. Early hatcheries, operated to mitigate the impacts of dams on fish passage and spawning and rearing habitat, employed practices such as transferring fish among basins without regard to their origin. While these practices increased the abundance of stocks, they also decreased the diversity and productivity of populations they intended to supplement. Concurrent with these activities, human population growth within the basin was increasing and land uses were adversely affecting UCR steelhead spawning and rearing habitat. In addition, non-native species were introduced by both public and private interests that directly or indirectly affected salmon and steelhead (UCSRB 2007).

All four extant populations spawn in tributaries to the Columbia River upstream of the confluence of the Snake River with the Columbia River. They pass the four lower Columbia River dams (Bonneville, The Dalles, John Day, and McNary), operations of which are part of the proposed action. All four populations also spawn upstream of the PUD-operated Priest Rapids, Wanapum, and Rock Island Dams on the upper Columbia River. The Entiat River population must pass one additional PUD dam (Rocky Reach) and the Methow and Okanogan River populations must pass two additional PUD dams (Rocky Reach and Wells Dams). The operation of these PUD dams is not part of the proposed action.

Recovery Plan. The ESA recovery plan for UCR steelhead (UCSRB 2007) includes delisting criteria for the DPS, along with identification of factors currently limiting its recovery, and management actions necessary to achieve the goals[67]. The biological delisting criteria are based on recommendations by the ICTRT[68]. They are hierarchical in nature, with DPS-level criteria based on the status of natural-origin UCR steelhead assessed at the population level. Population-level assessments are based on evaluation of population abundance, productivity,

[67] This plan was developed by the Upper Columbia Salmon Recovery Board and then reviewed and adopted by NMFS (72 FR 57303).
[68] The recovery plan also includes "threats criteria' for each of the relevant listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the DPS will require improvement in the abundance, productivity, spatial structure, and diversity of all four extant populations to the point that all four are considered viable.

Abundance, Productivity, Spatial Structure, and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within the DPS based on parameters of abundance, productivity, spatial structure, and diversity (these parameters are referred to as the viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans and based on recommendations of the ICTRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each MPG to be considered at low risk. Generally, each MPG must achieve low risk for the DPS as a whole to be considered no longer threatened or endangered. For the single UCR steelhead MPG to achieve low risk, all four of its extant population must achieve viable status (i.e., low extinction risk) (UCSRB 2007).

The most recent status review (NMFS 2016d) found that the most recent estimates (5-year geometric mean) of total and natural-origin spawner abundance had increased relative to the prior review for all four populations, but natural-origin abundance remained well below the corresponding ICTRT thresholds for viability (i.e., low extinction risk), with the exception of the Wenatchee River population. Evaluation of productivity indicated that recent annual brood year return-per-spawner estimates were well below replacement for all four populations, with the exception of a few years for the Wenatchee River population. Despite the fact that each population was consistently exhibiting natural production rates well below replacement, natural production had not declined consistently, but had fluctuated at levels well below recovery objectives, perhaps because the large numbers of hatchery fish on the spawning grounds each year were subsidizing spawning at levels well above the current natural carrying capacity of the system. Three of the four UCR steelhead populations continued to be rated at high risk for overall abundance and productivity. For one population—the Wenatchee—the combined abundance and productivity was rated at low risk (NWFSC 2015, NMFS 2016d).

The most recent status review (NMFS 2016d) determined that all UCR steelhead populations were at low risk for spatial structure, except the Okanogan (which was rated at high risk for spatial structure). All four populations were rated at high risk for diversity. Diversity risk was driven largely by high levels of hatchery spawners within natural spawning areas and lack of genetic diversity among the populations (NWFSC 2015, NMFS 2016d).

The Entiat, Methow, and Okanogan River populations remained at high overall extinction risk, while the Wenatchee River population status was considered "maintained" as of the most recent status review (NMFS 2016d). Overall, the DPS status remained unchanged from previous status reviews and was considered at high risk. In general, risk was driven by low abundance and productivity and concerns about diversity, largely driven by chronic high levels of hatchery spawners within natural spawning areas and lack of genetic diversity among the populations, especially in the Methow and Okanogan Rivers (Table 28, NMFS 2016d). Recent changes in hatchery practices in the Wenatchee River provided the potential for reduced hatchery contributions or increased spatial separation of hatchery- and natural-origin spawners, which could strengthen the influence of natural selection over time.

Table 28 lists the populations in this ESU and summarizes their abundance/productivity, spatial structure, diversity, and overall population risk status as of the most recent status review (NWFSC 2015, NMFS 2016d); it also summarizes their target risk status for delisting (UCSRB 2007).

Table 28. UCR steelhead population-level risk for abundance/productivity (A/P), diversity, integrated spatial structure/diversity (SS/D), overall extinction risk as of the most recent status review (NWFSC 2015, NMFS 2016d), and recovery plan target status (UCSRB 2007). Risk ratings range from very low (VL) to low (L), moderate (M), high (H), very high (VH), and extirpated (E). Maintained (MT) population status indicates that the population does not meet the criteria for a viable population but does support ecological functions and preserve options for recovery of the DPS.

Population	ICTRT Minimum Abundance Threshold[1]	A/P Risk Rating	Diversity Risk Rating	Integrated SS/D Risk Rating	Overall extinction risk	Recovery Plan Target Extinction Risk Rating
Wenatchee River	1,000	L	H	H	MT	L
Entiat River	500	H	H	H	H	L
Methow River	1,000	H	H	H	H	L
Okanogan River	750	H	H	H	H	L

- [1] Minimum abundance thresholds represent the number of spawners needed for a population of a given size category to achieve low risk (viability) at a given productivity (ICTRT 2007).

Limiting Factors. Understanding the limiting factors and threats that affect the UCR steelhead DPS provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting the species is to ensure that the underlying limiting factors and threats have been addressed. Limiting factors identified in the recovery plan (UCSRB 2007) for this DPS include (in no particular order):

- Habitat degradation: Human activities have altered and/or curtailed habitat-forming processes and limited the habitat suitable for steelhead in the upper Columbia River tributaries. Storage dams, diversions, roads and railways, agriculture, residential development, and forest management continue to cause changes in water flow, water temperature, sedimentation, floodplain dynamics, riparian function, and other aspects of the ecosystem, all of which are deleterious to steelhead and their habitat.

- Hydropower systems: Conditions for UCR steelhead have been fundamentally altered by the construction and operation of mainstem dams for power generation, navigation, and flood control. UCR steelhead are adversely affected by hydrosystem-related flow and water-quality effects, obstructed and/or delayed passage, and ecological changes caused by impoundments. Effects occur at the four Federal dams on the lower Columbia River and at FERC-licensed dams on the upper Columbia River.
  Harvest: Historical harvest rates have been reduced from their peak as a result of international treaties, fisheries conservation acts, the advent of weak-stock management, regional conservation goals, and the ESA listing of many salmon ESUs and steelhead DPSs. While fisheries do not target weak stocks of listed salmon or steelhead, listed fish are incidentally caught in fisheries directed at hatchery and unlisted natural-origin stocks.
- Hatcheries: In the upper Columbia region, hatcheries producing steelhead are operated to mitigate the impacts of habitat loss resulting from the construction of Grand Coulee Dam and passage and habitat impacts of the mid-Columbia PUD dams. These hatcheries provide valuable mitigation and/or conservation benefits but can cause adverse impacts if not properly managed. These risks include genetic effects that reduce fitness and survival, ecological effects such as competition and predation, facility effects on passage and water quality, mixed stock fishery effects, and masking of the true status of natural-origin populations.
- Additional factors, including changes in estuarine habitat, climate change, inadequacy of regulatory mechanisms, fluctuating ocean cycles, and predation.

In its most recent status review, NMFS (2016d) noted that:

- Despite efforts to improve tributary habitat conditions, considerable improvement is still needed to restore habitat to levels that will support viable populations.
- Direct survival of juvenile salmonids outmigrating from upper Columbia River populations has increased as a result of juvenile passage improvements at Federal and PUD dams.
- Harvest rates on UCR steelhead have been reduced from historical levels. Total exploitation rates have been stable at around the 5 to 7 percent range. Most impacts occur in tribal gillnet and dip net fisheries.
- The proportions of hatchery-origin returns in natural spawning areas remained extremely high across the DPS, especially in the Methow and Okanogan river populations, leading to high risk ratings for diversity (NWFSC 2015).
- Avian and pinniped predation on UCR steelhead had increased since the previous status review in 2011, and non-indigenous fish species remain a threat.
- Some regulatory mechanisms had improved since the previous status review, but, particularly for land-use regulatory mechanisms, there was lack of documentation or analysis of their effectiveness.
- Climate change was a concern, particularly the future effects of continued warming in marine and freshwater systems.

Information on Status of the Species since the 2016 Status Review. The best scientific and commercial data available with respect to the adult abundance of natural-origin UCR steelhead indicates a substantial downward trend in the number of natural-origin spawners at the DPS level from 2014 to 2019 (Figure 23). This recent downward trend in adult abundance is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity (see discussion below), as hydropower operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices, were relatively constant or improving over this period of time (the past 10 years) [69]. Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.

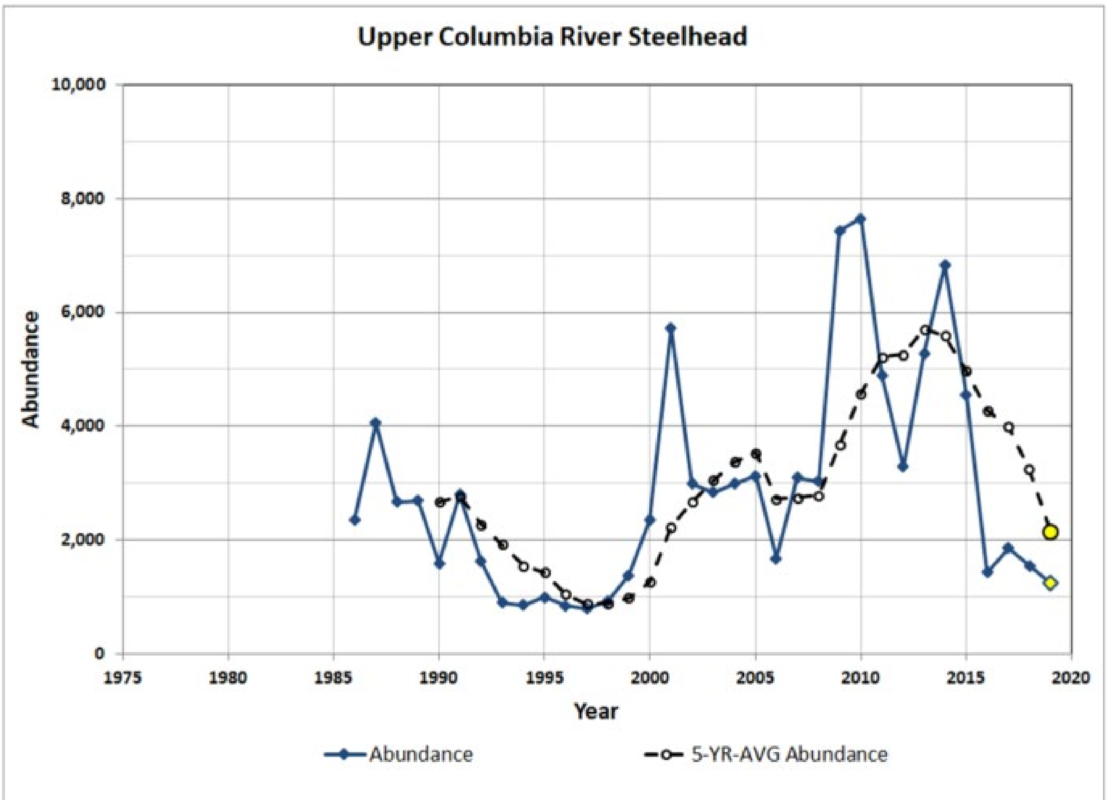

Figure 23. Annual abundance and 5-year average abundance estimates for the UCR steelhead DPS (natural-origin fish only) at Priest Rapids Dam for 1977–1978 to 2018–2019. Data for year X include passage counts occurring between July 1 of year X and June 30 of year X+1. Data for year 2019–2020 are a projection based on passage counts through December 31, 2019; average percent passage that occurs in year X; and average percent natural-origin fish. Data source: Personal communication with Andrew Murdoch of WDFW (Murdoch 2017), Ben Truscott of WDFW (Truscott 2019) and the DART (2020b) website's Adult Passage Query: http://www.cbr.washington.edu/dart/query/adult_graph_text.

[69] Many factors (e.g., higher summer temperatures, lower late summer flows, low spring flows, etc.) affect the ability of tributary habitat to produce juvenile migrants (capacity) each year. Recent drought and temperature patterns may have had a negative effect on tributary habitat productivity, and as a result, lower than average juvenile production may have contributed in some years to downturns in adult abundance.

Population level estimates of natural-origin and total (natural- and hatchery-origin) spawners through 2018 are shown in Table 29. These data also show recent and substantial downward trends in abundance for most of the populations (i.e., the "% Change" was negative, but of smaller magnitude for the Methow population) when compared to the 2009 to 2013 period (Table 29) [70]. All populations remain considerably below the minimum abundance thresholds established by the ICTRT (shown in Table 29).

Table 29. 5-year geometric mean of natural-origin spawner counts (total spawner count times the estimated fraction natural-origin, if available) for UCR steelhead. Number in parenthesis is the 5-year geometric mean of total spawner counts. "% change" is a comparison between the two most recent 5-year periods (2014-2018 to 2009-2013). At the time of drafting this opinion, 2019 data were not available for any of the populations in this DPS. Source: (Williams 2020a).

MPG	Population	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	% Change
North Cascades	Entiat River	85 (155)	37 (155)	90 (385)	100 (496)	185 (756)	105 (306)	-43 (-60)
	Methow River	270 (1382)	90 (781)	314 (3342)	516 (3747)	770 (4208)	708 (2232)	-8 (-47)
	Okanogan River	81 (789)	22 (456)	89 (1744)	179 (1359)	335 (2324)	263 (1080)	-21 (-54)
	Wenatchee River	667 (2163)	271 (946)	632 (1511)	669 (2064)	1356 (2773)	639 (1208)	-53 (-56)

NMFS will evaluate the implications for viability risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure as well as the updated estimates of abundance shown in Table 29.

UCR steelhead populations have generally increased in abundance since the 1990s, but have experienced recent reductions (Table 29), primarily due to poor ocean conditions. These conditions (e.g., temperature and salinity, coastal food webs), appeared to be more favorable to steelhead survival and adult returns in 2018, but were still impacted by recent warming trends.

[70] The upcoming status review, expected in 2022, will include population-level adult returns through 2019, and will add a new rolling 5-year geomean, for 2015 to 2019. Because the 2014 adult returns represented a peak at the DPS level, the negative percent change between the 2015–2019 and 2014–2018 geomeans will likely be greater than that shown in Table 29 between the 2014–2018 and 2009–2013 geomeans, at least for some populations.

Status of SRB Steelhead

Background. On August 18, 1997, NMFS listed the SRB steelhead DPS as a threatened species (62 FR 43937). The threatened status was reaffirmed on January 5, 2006 (71 FR 834) and most recently on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that this DPS should retain its threatened status (81 FR 33468). Critical habitat for the DPS was designated on September 2, 2005 (70 FR 52630). The summary that follows describes the status of SRB steelhead. More detailed information can be found in the recovery plan (NMFS 2017d) and most recent status review for this species (NMFS 2016b) [71].

The SRB steelhead DPS includes all naturally spawned anadromous *O. mykiss* originating below natural and manmade impassable barriers in streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho. The DPS includes 24 extant populations (and one extirpated population), which are aggregated into five MPGs based on genetic, environmental, and life-history characteristics. Historically, SRB steelhead also spawned and reared in areas above the Hells Canyon Dam Complex on the Snake River and in the North Fork Clearwater River drainage. Steelhead are currently blocked from historical habitat in these areas. The ICTRT identified one historical MPG for the area above the Hells Canyon Dam Complex, but this MPG is extirpated and not required for ESA delisting. The DPS also includes six artificial propagation programs (NMFS 2017d, 71 FR 834)[72]. Figure 24 shows a map of the DPS and its component MPGs; Table 30 lists the populations within each MPG and the hatchery programs that are part of the DPS.

[71] In addition, a technical memo prepared for the status review contains more detailed information on the biological status of the species (NWFSC 2015).

[72] For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in a DPS, see NMFS (2005). In 2016, NMFS published proposed revisions to hatchery programs included as part of ESA-listed Pacific salmon and steelhead species, including SRB steelhead (81 FR 72759). The proposed changes for hatchery program inclusion in this DPS were to add the Salmon River B-run Program and the South Fork Clearwater B-run Program, and remove the Lolo Creek and North Fork Clearwater Programs, both now considered part of the Dworshak National Fish Hatchery Program. We expect to publish the final revisions in 2020.

Table 30. SRB steelhead DPS major population groups and component populations, and hatchery programs (NMFS 2017d, 71 FR 834).

Major Population Group	*Populations*
Grande Ronde	Joseph Creek Upper Grande Ronde River Lower Grande Ronde River Wallowa River
Imnaha River	Imnaha River
Clearwater	Lower Mainstem Clearwater River North Fork Clearwater River (extirpated) Lolo Creek Lochsa River Selway River South Fork Clearwater River
Salmon River	Little Salmon Rivers Chamberlain Creek Secesh River South Fork Salmon River Panther Creek Lower Middle Fork Salmon River Upper Middle Fork Salmon River North Fork Salmon River Lemhi River Pahsimeroi River East Fork Salmon River Upper Mainstem Salmon River
Lower Snake	Tucannon River Asotin Creek
Hatchery Programs	
Hatchery programs included in DPS (6)	Tucannon River Dworshak National Fish Hatchery Lolo Creek North Fork Clearwater East Fork Salmon River Little Sheep Creek/Imnaha River Hatchery

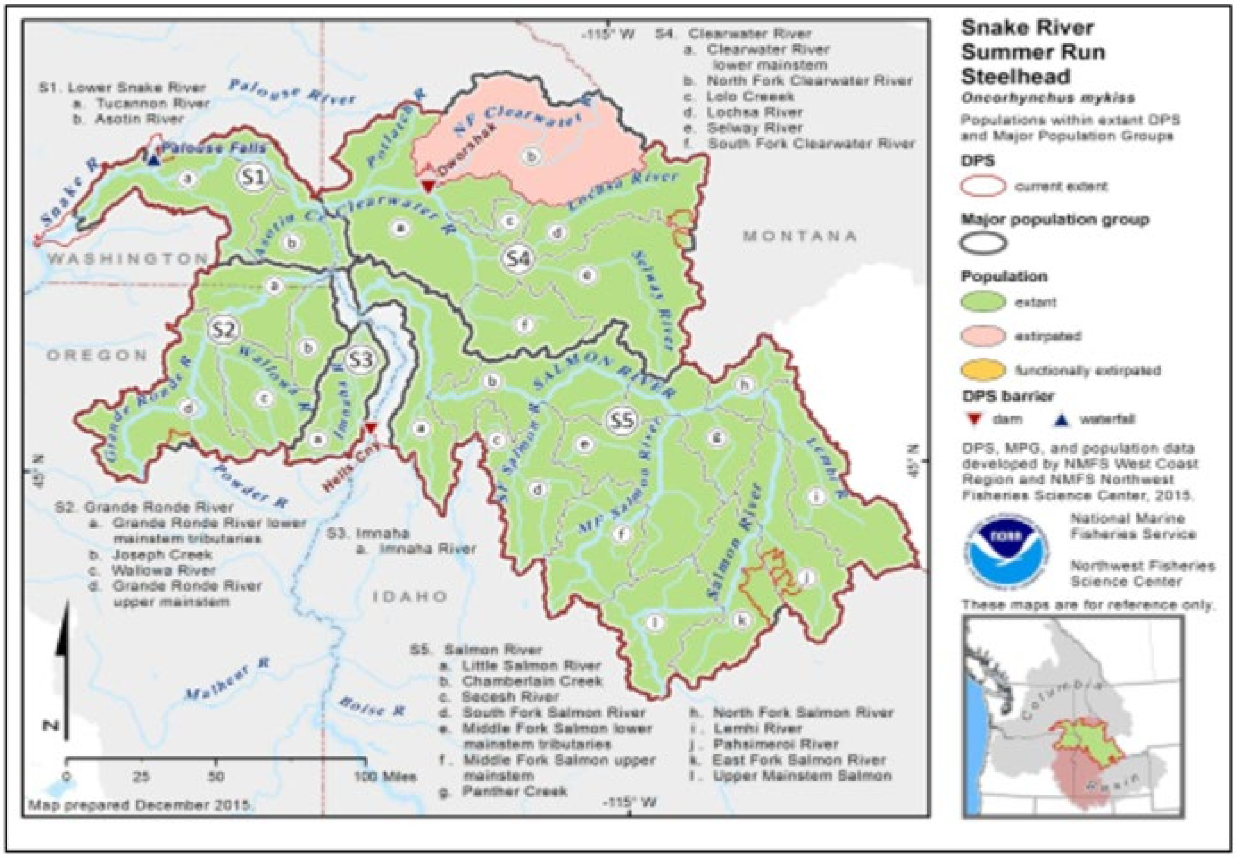

Figure 24. Map illustrating SRB steelhead DPS's populations and major population groups (NWFSC 2015).

Life-History and Factors for Decline. SRB steelhead are generally classified as summer-run fish. Summer-run steelhead are sexually immature when they return to freshwater, and require several months to mature and spawn. Adult SRB steelhead generally enter the Columbia River from June to August (NMFS 2017d). The peak passage of SRB steelhead has shifted by about two weeks from late July to early August, probably in response to warming temperatures and reduced flows (NMFS 2014a). SRB steelhead can delay their migration up the Columbia and Snake Rivers, and pull into cooler tributaries for temporary holding (NMFS 2017d). Most adults pass Lower Granite Dam by fall, although a small number (approximately 2.0 percent) remain below Lower Granite Dam over the winter and move upstream in the spring (April 3 through June 20) [73]. Adults generally hold in larger rivers for several months before moving upstream into smaller tributaries to spawn (NMFS 2017d). During this holding period, they live primarily off stored energy, with little or no feeding (Shapovalov and Taft 1954). Most adults disperse into tributaries from March through May, but potentially into June in higher elevations. Spawning

[73] Approximately 2.0 percent of all adults (hatchery plus unclipped "wild" SRB steelhead) and 4.0 percent of the unclipped "wild" steelhead move upstream from April 3 through June 20, based on a query of data from 2010-11 through 2019-20. Source: Columbia River DART accessed June 2, 2020 (DART 2020c).

begins shortly after fish reach spawning areas, typically during a rising hydrograph and before peak flows (Thurow 1987, NMFS 2017d).

Juveniles generally emerge from redds by early June in low elevation streams and by mid-July or later at higher elevations. Juveniles in the Snake River basin typically reside in freshwater for no more than 2 years, but may stay longer, depending on temperature and growth rate (Fuller et al. 1984, Kucera and Johnson 1986, Chandler and Richardson 2006, NMFS 2017d). Smolts migrate downstream during spring runoff, which occurs from March to mid-June in the Snake River basin, depending on elevation. Juvenile outmigrating steelhead often reach Bonneville Dam by mid-May, and most travel rapidly (<5 days) through the estuary and into the ocean, although there is considerable variation in travel times and timing of estuarine and ocean entry between individual fish (NMFS 2017d). Steelhead are iteroparous, or capable of spawning more than once before death. Iteroparity as a life-history trait remains in several tributaries of the Snake River basin.

Fisheries managers classify SRB steelhead into two aggregate or morphological groups, A-Index and B-Index[74], based on length of time spent in the ocean, size at return, and migration timing. Generally, A-Index steelhead are smaller (<78 cm [usually 58 to 66 cm] long), spend 1 year in the ocean, and begin their upriver freshwater migration earlier in the year than B-Index steelhead. B-Index steelhead are larger (many >78 cm long), spend 2 years in the ocean, and begin their upriver freshwater migration later in the year. These two groups represent an important component of phenotypic and genetic diversity of the SRB steelhead DPS through the asynchronous timing of ocean residence, segregation of spawning in larger and smaller streams, and possible differences in the habitats of the fish in the ocean (NMFS 2017d). A-Index steelhead occur throughout the steelhead-bearing streams in the Snake River basin and inland Columbia River, while B-Index steelhead only occur in the Clearwater River basin and the lower and middle Salmon River basin. Some populations support both A-Index and B-Index life-history expressions (NWFSC 2015).

Historically, the Snake River basin is thought to have produced more than half of all summer steelhead in the Columbia River basin. Several factors contributed to their declines. Harvest rates soared in the late 1800s and remained high until the 1970s. At the same time, increased European-American settlement resulted in the deterioration of habitat conditions due to logging, mining, grazing, farming, irrigation, development, and other land use practices that cumulatively reduced access to and productivity of spawning and rearing habitat, increased sediment contributions to streams, reduced instream flows, and increased stream temperatures (NMFS 2017d).

Large portions of historical habitat were blocked in 1901 by construction of Swan Falls Dam on the Snake River and later by construction of the three-dam Hells Canyon Complex from 1955 to 1967. Dam construction also blocked and/or hindered fish access to historical habitat in the Clearwater River basin, as a result of construction of Lewiston Dam (built in 1927 and removed in 1973) and Dworshak Dam, which extirpated steelhead in the North Fork Clearwater River

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[74] In all previous CRS consultations, we used the terms A-run and B-run. We are using this new terminology to be consistent with terminology used by fisheries managers and to reflect a better understanding of the phenotypic and genotypic diversity within SRB steelhead.

subbasin in the 1970s. The production of SRB steelhead was further affected by the development of the eight Federal dams and reservoirs in the mainstem lower Columbia/Snake River migration corridor between the late 1930s and early 1970s: four on the lower Columbia River (Bonneville, The Dalles, John Day, and McNary Dams) and four on the lower Snake River (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams) (NMFS 2017d).

Recovery Plan. The ESA recovery plan for SRB steelhead (NMFS 2017d) includes delisting criteria for the DPS, along with identification of factors currently limiting the recovery of the DPS, and management actions necessary for recovery. Biological delisting criteria are based on recommendations by the ICTRT[75]. They are hierarchical in nature, with DPS-level criteria based on the status of natural-origin SRB steelhead assessed at the population level. The plan identifies DPS- and MPG-level biological criteria, and within each MPG, it provides guidance on a target risk status for each population, consistent with the MPG-level criteria. Population-level assessments are based on evaluation of population abundance, productivity, spatial structure, and diversity (McElhany et al. 2000) and an overall extinction risk characterization. Achieving recovery (i.e., delisting) of the DPS will require sufficient improvement in its abundance, productivity, spatial structure, and diversity. Table 31 summarizes the recovery plan goals and population status as of the most recent status review (NMFS 2016b) for SRB steelhead populations.

Table 31. Population status as of the most recent status review (NWFSC 2015, NMFS 2016b) and recovery plan target status for SRB steelhead populations (NMFS 2017d).

MPG	Population	Population Status (as of 2016 status review)	Recovery Plan Proposed Target Status	ICTRT Viability Criteria Recommendations Regarding Target Status
Lower Snake	Tucannon River	high risk	viable or highly viable	The basic ICTRT criteria would call for both populations to be restored to viable status and one to highly viable.
	Asotin Creek	maintained	viable or highly viable	
Clearwater River	Lower Main Clearwater River	maintained	viable or highly viable	The basic ICTRT criteria would require at least three populations to be viable and one of these highly viable; the rest should meet criteria for maintained. The Lower Mainstem Clearwater population, as the only extant large or very large population, should be viable or highly
	South Fork Clearwater River	maintained or high risk	viable or maintained	

[75] The recovery plan also includes "threats criteria" for each of the listing factors in ESA section 4(a)(1) to help ensure that underlying causes of decline have been addressed and mitigated before considering the species for delisting.

MPG	Population	Population Status (as of 2016 status review)	Recovery Plan Proposed Target Status	ICTRT Viability Criteria Recommendations Regarding Target Status
	North Fork Clearwater River	extirpated	not part of recovery scenario	viable. At least two of the three intermediate-sized populations should be viable or highly viable. At least one A-Index and one B-Index population should be viable.
	Lolo Creek	maintained or high risk	viable or highly viable	
	Selway River	maintained	viable or maintained	
	Lochsa River	maintained	viable or highly viable	
Grande Ronde River	Lower Grande Ronde River	maintained	viable or maintained	The basic ICTRT criteria would require at least two populations to be viable, with one highly viable; the rest should meet criteria for maintained. The Upper Grande Ronde mainstem is the only large population and needs to be viable or highly viable.
	Joseph Creek	very low risk	viable, highly viable, or maintained	
	Wallowa River	moderate risk	viable or maintained	
	Upper Grande Ronde River	low risk	viable or highly viable	
Imnaha River	Imnaha River	moderate risk	highly viable	The basic ICTRT criteria would require the single population in this MPG to be highly viable.
Salmon River	Little Salmon	maintained	viable or maintained	The basic ICTRT criteria would require at least six of the 12 populations to be viable, with at least one of these highly viable; the rest should meet maintained criteria. At least four of the intermediate-size populations should meet viability criteria. At least two of the six viable populations should be B-Index.
	South Fork Salmon River	maintained	viable or highly viable	
	Secesh River	maintained	viable or maintained	

MPG	Population	Population Status (as of 2016 status review)	Recovery Plan Proposed Target Status	ICTRT Viability Criteria Recommendations Regarding Target Status
	Lower Middle Fork Salmon River Tributaries	maintained	viable or highly viable	Spatial structure should be a strong consideration in this large MPG. Populations meeting viability criteria should be spread across the Upper Salmon, Middle Fork, South Fork, and Lower Salmon subbasins. A-Index populations should also be represented in the viable populations. Where possible, the distribution of viable A- and B- Index populations should closely mirror historical (lower-risk) conditions.
	Upper Middle Fork Salmon River	maintained	viable or highly viable	
	Chamberlain Creek	maintained	viable or highly viable	
	Panther Creek	high risk	viable or maintained	
	North Fork Salmon River	maintained	viable or maintained	
	Lemhi River	maintained	viable or maintained	
	Pahsimeroi River	maintained	viable or maintained	
	East Fork Salmon River	maintained	viable or maintained	
	Upper Salmon River	maintained	viable or maintained	

Abundance, Productivity, Spatial Structure, and Diversity. NMFS evaluates species status by evaluating the status of the independent populations within the DPS based on parameters of abundance, productivity, spatial structure, and diversity (these parameters are referred to as the viable salmonid population—or VSP—parameters). Individual population status is considered within the context of delisting criteria, established in recovery plans and based on recommendations of the ICTRT. Delisting criteria define parameters for individual population status, as well as for how many and which populations must achieve a particular status for each

MPG to be considered at low risk. Generally, each MPG must achieve low risk for the DPS as a whole to be considered no longer threatened or endangered.

Due to difficulties in conducting surveys in much of their range, population-specific abundance estimates for SRB steelhead are available only for two populations (Joseph Creek and the Upper Grande Ronde River), but aggregate counts of steelhead at Lower Granite Dam provide some indication of DPS abundance. In the most recent status review (NMFS 2016b), the abundance of natural-origin steelhead at Lower Granite Dam had increased relative to the prior review: the 2011 to 2014 geometric mean of natural-origin A-Index steelhead at Lower Granite Dam was over twice the corresponding estimate for the prior review, and the updated B-Index geometric mean was over 50 percent higher than for the prior review (NWFSC 2015). No new information was available that would change ratings for spatial structure. Some updated information was available that contributed to evaluating diversity risk, and we anticipate that more information will be available for the next status review, expected in 2022, to better elucidate the contributions of individual hatchery programs and to estimate the number and origin of hatchery fish escaping to spawn in natural areas associated with each population (NWFSC 2015).

As of the most recent status review (NMFS 2016b), the overall status of the SRB steelhead DPS remained threatened, with four of the five MPGs in the DPS not meeting their objectives in the recovery plan. The Grande Ronde MPG was tentatively meeting its recovery plan objectives, which require two of the four populations in the MPG to achieve at least viable status (and one of these achieving highly viable status). The Joseph Creek population was considered highly viable and the Upper Grande Ronde River population tentatively viable. Although average abundance for both populations had dropped from the prior review period, both were still considered at low or very low risk for abundance and productivity. Data were limited for the other two populations in the MPG, but both were provisionally rated as maintained (NWFSC 2015).

The four other MPGs were not meeting their recovery objectives at the time of the most recent status review (NMFS 2016b). In the Lower Snake River MPG, the Tucannon River population was considered at high risk and the Asotin population maintained. The apparently low spawning abundance in the Tucannon River population was attributed to a high overshoot rate of returning adults. Analysis of returning PIT-tagged adults from that population (2005 to 2012 return years) indicated that overshoot rates past the Tucannon River and over Lower Granite Dam often exceed 60 percent (Bumgarner and Dedloff 2015, NWFSC 2015, Keefer et al. 2016).

The Imnaha River MPG contains one population, which must meet highly viable status for recovery (NMFS 2017d). This population was considered at moderate risk in the most recent status review (NMFS 2016b), although there is some evidence that natural production may be exceeding the minimum abundance threshold for viability. There is also evidence that hatchery returns to the population may be concentrated in particular spawning reaches, meaning that there may be substantial production areas with relatively low hatchery-origin spawners. Additional years of information from PIT-tags and/or refinements to the genetic stock identification program should result in improved estimates in future status reviews (NWFSC 2015).

In the Clearwater River MPG, improved information on natural-origin spawner abundance indicated in the most recent status review that the Lower Clearwater, Lochsa River, and Selway

River populations had improved in overall status relative to prior reviews, but they were still considered maintained (NMFS 2016b). The South Fork Clearwater and Lolo Creek populations were also tentatively considered maintained, due in part to uncertainties regarding productivity and hatchery spawner composition (NWFSC 2015). In the Salmon River MPG (which includes 12 extant populations and one extirpated population (Panther Creek), all extant populations were considered maintained (NWFSC 2015, NMFS 2016b).

Information from Genetic Stock Identification sampling provided an opportunity to evaluate the relative contribution of B-Index returns within each stock group. No population fell exclusively into the B-Index, although there were clear differences among populations in the relative contributions of the B-Index life-history type (NWFSC 2015). The more specific information available on the distribution of natural returns among stock groups and populations indicated that differences in abundance/productivity status among populations was likely related more to geography or elevation than the morphological forms (i.e., A-Index and B-Index).

Table 32 lists the MPGs and populations in this DPS and summarizes their abundance/ productivity, spatial structure, diversity, and overall population risk status, based on information in the most recent status review (NWFSC 2015, NMFS 2016b).

Table 32. SRB steelhead population-level risk for abundance/productivity (A/P), diversity, integrated spatial structure/diversity (SS/D), and overall status as of the most recent status review (NWFSC 2015, NMFS 2016b). Risk ratings ranged from very low (VL) to low (L), moderate (M), high (H), very high (VH), and extirpated (E). Maintained (MT) population status indicates that the population does not meet the criteria for a viable (low risk) population but does support ecological functions and preserve options for recovery of the DPS. "?" reflects uncertainty in the ratings.

Major Population Group	Spawning Populations (Watershed)	ICTRT Minimum Abundance Threshold[1]	A/P Risk Rating	Diversity Risk Rating	Integrated SS/D Risk Rating	Overall Extinction Risk Rating
Lower Snake River	Tucannon River	1,000	H?	M	M	H?
	Asotin Creek	500	M?	M	M	MT?
Grande Ronde River	Lower Grande Ronde River	1,000	insufficient data	M	M	MT?
	Joseph Creek	500	VL	L	L	VL (Highly viable)
	Upper Grande Ronde River	1,500	L	M	M	L (Viable)
	Wallowa River	1,000	H?	L	L	M?
Clearwater River	Lower Clearwater River	1,500	M?	L	L	MT?
	South Fork Clearwater River	1,000	H	M	M	MT?/H?
	Lolo Creek	500	H	M	M	MT/H?
	Selway River	1,000	M?	L	L	MT?

Major Population Group	Spawning Populations (Watershed)	ICTRT Minimum Abundance Threshold[1]	A/P Risk Rating	Diversity Risk Rating	Integrated SS/D Risk Rating	Overall Extinction Risk Rating
	Lochsa River	1,000	M?	L	L	MT?
	North Fork Clearwater River	NA	E	E	E	E
Salmon River	Little Salmon River	500	M?	M	M	MT?
	South Fork Salmon	1,000	M?	L	L	MT?
	Secesh River	500	M?	L	L	MT?
	Chamberlain Creek	500	M?	L	L	MT?
	Lower MF Salmon	1,000	M?	L	L	MT?
	Upper MF Salmon	1,000	M?	L	L	MT?
	Panther Creek	500	M	M	H	H?
	North Fork Salmon	500	M	M	M	MT?
	Lemhi River	1,000	M	M	M	MT
	Pahsimeroi River	1,000	M	M	M	MT?
	East Fork Salmon	1,000	M	M	M	MT?
	Upper Main Salmon	1,000	M	M	M	MT?
Imnaha	Imnaha River	1,000	M?	M	M	M?

[1] Minimum abundance thresholds represent the number of spawners needed for a population of a given size category to achieve low risk (viability) at a given productivity (ICTRT 2007).

Limiting Factors. Understanding the limiting factors and threats that affect the SRB steelhead DPS provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed. Limiting factors identified in the recovery plan (NMFS 2017d) for this DPS include (in no particular order):

- Tributary habitat degradation: Past and/or present land use hinders SRB steelhead productivity through the following limiting factors: impaired fish passage (e.g., culverts, water diversions, and weirs at hatchery facilities); reduced stream complexity and channel structure; excess fine sediment; elevated summer water temperatures; diminished streamflow during critical periods; reduced floodplain connectivity and function; and degraded riparian conditions.
- Estuarine habitat degradation: Past and current land use (including dredging, filling, diking, and channelizing of lower Columbia River tributaries) and alterations to Columbia River flow regimes by reservoir storage and release operations have reduced the quality and quantity of estuarine habitat.
- Hydropower: Federal hydropower projects in the lower Snake and Columbia River mainstem affect juvenile and adult SRB steelhead, which must pass up to eight mainstem dams. The fish are also affected to a lesser degree by the management of water released from the Hells Canyon Complex on the middle Snake River, Dworshak Dam on the North Fork Clearwater River, and other projects, including upper basin storage reservoirs in the U.S. and Canada. Limiting factors include those related to dam passage mortality; loss of habitat due to conversion of riverine habitat to slower moving reservoirs with

modified shorelines; and changes in temperature regimes due to flow modifications in all mainstem reaches.

- Harvest: Direct and indirect effects associated with past and present fisheries continue to affect the abundance, productivity, and diversity of SRB steelhead. However, while harvest-related mortality contributed significantly to the species' decline, harvest impacts have been reduced substantially and have remained relatively constant in recent years.
- Hatchery programs: Hatchery programs can improve the abundance of steelhead populations with low abundance and support reintroduction into areas where they have been blocked or extirpated. However, hatchery propagation also poses risks to natural-origin salmon. These risks include genetic risks, reduced fitness, altered life-history traits, increased competition for food and habitat, amplified predation, and transferring of diseases.
- Predation: Anthropogenic changes have altered the relationships between salmonids and other fish, bird, and pinniped species. Predation by pinnipeds, birds, and piscivorous fish in the mainstem Columbia and Snake Rivers and some tributaries has increased to the point that it is a factor limiting the viability of SRB steelhead.
- Additional factors include exposure to toxic contaminants, and the effects of climate change and ocean cycles.

In its most recent status review, NMFS (2016b) noted that:

- Improvements had been made in tributary and estuary habitat conditions due to restoration and protection efforts, but habitat concerns remain throughout the Snake River basin, particularly in regard to streamflow, floodplain management, and water temperature.
- Changes to hydropower operations and passage had increased juvenile survival rates.
- In late July and September 2013, low summer flows combined with high air temperatures and little wind created thermally stratified conditions in Lower Granite reservoir and the adult ladder, disrupting fish passage for more than a week. The events resulted in approximately 12 percent of the migrating steelhead failing to pass Lower Granite Dam.
- The adoption of the 2008 to 2017 *U.S. v. Oregon* Management Agreement had, on average, reduced impacts of freshwater fisheries to all Snake River ESUs and DPSs.
- SRB steelhead hatchery programs were being reviewed to determine, among other things, where and to what extent hatchery steelhead were interacting with natural populations. The practice of releasing steelhead into mainstem areas where they are difficult to monitor and manage had been reduced since the previous review.
- New information indicated that avian and pinniped predation on SRB steelhead had increased since the previous status review.
- Regulatory mechanisms had generally improved since the previous status review.
- Uncertainty regarding the long-term impacts of climate change and the ability of SRB steelhead to adapt added additional risks to species recovery.
- Key protective measures included continued releases of cool water from Dworshak Dam during late summer, continued flow augmentation to enhance flows in the lower Snake River in July and August, and continued efforts to improve adult passage at Lower Granite Dam.

Information on Status of the Species since the 2016 Status Review. The best scientific and commercial data available with respect to the adult abundance of SRB steelhead indicates a substantial downward trend in the abundance of natural-origin spawners at the DPS-level from 2014 to 2019 (Figure 25). Population-level estimates of natural-origin and total (natural- plus hatchery-origin) spawners through 2018 or 2019 are shown for three populations of SRB steelhead in Table 33. The number of natural-origin spawners in the Upper Grande Ronde Mainstem population appears to have been at or above the minimum abundance threshold established by the ICTRT (shown in Table 33), while the Tucannon River and Asotin Creek populations have remained below their respective thresholds). The 2019 abundance level for the Tucannon River population was lower than the most recent 5-year geomean[76].

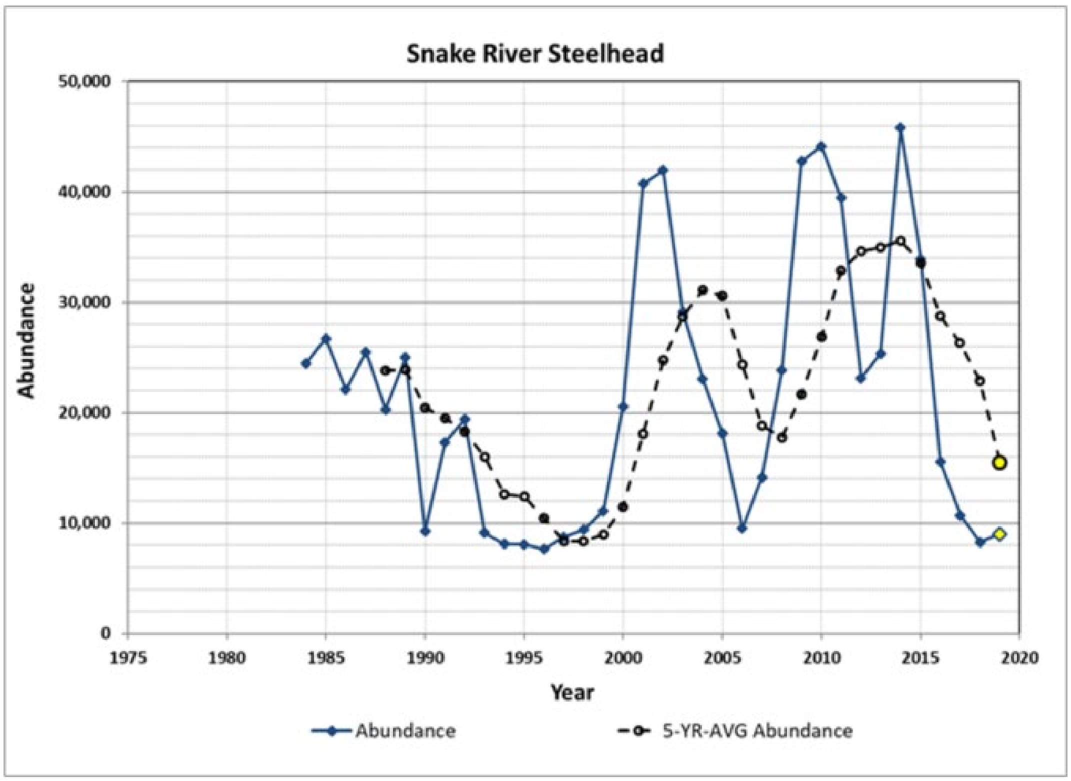

Figure 25. Annual abundance and 5-year average abundance estimates for the Snake River steelhead DPS (natural-origin fish only) at Lower Granite Dam from 1984–1985 to 2018–2019. Data for year X include passage counts occurring from July 1 of year X to June 30 of year X+1. Data for year 2019–2020 are a projection based on passage counts through December 31, 2019, average percent passage that occurs in year X, and average percent natural-origin fish. Data source: 2020 Joint Staff Report on Stock Status and Fisheries (ODFW and WDFW 2020) and Hebdon (2020).

[76] The upcoming status review, expected in 2022, will include population-level adult returns through 2019, and will add a new rolling 5-year geomean, for 2015-2019. Because the 2014 adult returns represented a peak at the DPS level, the negative percent change between the 2015-2019 and 2014-2018 geomeans will likely be greater than that shown in Table 2.3-4 between the 2014-2018 and 2009-2013 geomeans, at least for some populations.

Table 33. 5-year geometric mean of natural-origin spawner counts for SRB steelhead. Number in parenthesis is the 5-year geometric mean of total spawner counts including hatchery fish. "% change" is a comparison between the two most recent 5-year periods (2014–2018 compared to 2009–2013). "NA" means not available. At the time of drafting this opinion, 2019 data were available only for the Tucannon River population. Source: Williams (2020a, 2020d).

Population	MPG	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	% Change	2019
Grande Ronde	Upper Grande Ronde River Mainstem	900 (1173)	1575 (1898)	1232 (1454)	1067 (1073)	2689 (2724)	1786 (1799)	-34 (-34)	NA
Lower Snake	Tucannon River	NA	NA	NA	1442 (1988)	438 (1576)	264 (920)	-40 (-42)	117 (592)
Lower Snake	Asotin Creek	253 (444)	288 (439)	574 (648)	489 (542)	778 (787)	424 (427)	-46 (-46)	NA

The populations for which data are shown in Table 33 are surveyed by monitoring at weirs, conducting mark-recapture studies, PIT-tag detections, or redd counts. For many other SRB steelhead populations, spawning ground surveys are not feasible due to high spring flows that would wash out weirs and low visibility that precludes redd counts. The IDFG, Columbia River Inter-Tribal Fish Commission (CRITFC), and the NWFSC therefore collect tissue samples from adult steelhead trapped at Lower Granite Dam and assign these fish to genetic stocks by comparing them to samples taken inside the boundary of each spawning population (Table 34). The genetic stock identification (GSI) groups are broader than spawning populations, but fit within the MPGs. The most recent 5-year geometric means indicate large decreases in natural-origin abundance for most of the genetic stocks/MPGs, with a smaller decrease for the Upper Clearwater genetic stock group. Numbers for 2019 were much lower than the 2014 to 2018 geomean.

Table 34. 5-year geometric means of natural-origin abundance for genetic stocks of SRB steelhead at approximately the MPG level. Genetic Stock Identification (GSI) was based on a comparison of samples taken from returning adults at Lower Granite Dam to data from the Snake River Steelhead Natural Origin Abundance and Stock Composition at Lower Granite Dam database (Sources: Williams 2020b, d).

GSI Group	1989-1993	1994-1998	1999-2003	2004-2008	2009-2013	2014-2018	% Change	2019
Lower Salmon	704	337	832	709	1403	580	-59	154
Middle Fork Salmon	1566	749	1852	1578	3246	1643	-49	454
South Fork Salmon	762	364	901	767	1441	831	-42	210
Upper Salmon	2809	1344	3320	2829	5388	2860	-47	1,035
Lower Clearwater	1586	759	1875	1597	2836	1940	-32	454
South Fork Clearwater	1271	608	1502	1280	2750	1201	-56	541
Upper Clearwater	1373	657	1623	1384	2415	2024	-16	707

These data show that SRB steelhead MPGs generally increased in abundance after the 1990s, but experienced reductions during the more recent period when hydrosystem operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices were relatively constant or improving, but ocean conditions were poor. Although these conditions (e.g., temperature and salinity, coastal food webs) appear to have been more favorable to juvenile steelhead survival in 2018, juveniles were still affected by recent warming trends. Increased numbers of sea lions in the lower Columbia River in the last 10 years could also be a contributing factor to the recent reductions.

NMFS will evaluate the implications for viability risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will consider new information on population productivity, diversity, and spatial structure as well as the updated estimates of abundance shown in Tables 33 and 34.

Status of Southern DPS Green Sturgeon

The southern DPS of green sturgeon was listed as threatened on April 7, 2006 (71 FR 17757).. We completed a 5-year review for this DPS in 2015 and recommended the DPS retain its threatened classification. The recovery plan for this DPS was finalized in August, 2018 (NMFS 2018b). A key recovery strategy is to reestablish additional spawning areas in currently occupied rivers in California.

Abundance and Productivity. Recent studies are providing preliminary information on the population abundance of Southern DPS green sturgeon. The current estimate of spawning adult abundance is between 824-1,872 individuals (NMFS 2015b). The spawning population of the Southern DPS in the Sacramento River congregates in a limited area of the river compared to potentially available habitat. The reason for this is unknown. This is concerning given that a catastrophic or targeted poaching event impacting just a few holding areas could affect a significant portion of the adult population. No comparable data on holding area occupancy within the Sacramento River were available at the time of the last status review making it difficult to assess whether the current observations reflect an improvement or decline in the species status (NMFS 2015b).

Spatial Structure and Diversity. Two DPSs have been defined for green sturgeon (*Acipenser medirostris*), a northern DPS (spawning populations in the Klamath and Rogue rivers) and a southern DPS (spawners in the Sacramento River). Southern green sturgeon includes all naturally-spawned populations of green sturgeon that occur south of the Eel River in Humboldt County, California. Telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey Bay, California (Moser and Lindley 2007; Lindley et al. 2008, 2011) and, within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island and near San Francisco and Monterey bays (Huff et al. 2012). Within the nearshore marine environment, tagging and fisheries data indicate that Northern and Southern DPS green sturgeon prefer marine waters of less than a depth of 110 m (Erickson and Hightower 2007).

Limiting Factors. The principal factor for the decline of southern green sturgeon is the reduction of its spawning area to a single known population limited to a small portion of the Sacramento River. It is currently at risk of extinction primarily because of elimination of freshwater spawning habitat, degradation of freshwater and estuarine habitat quality, water diversions, fishing, and other causes (USDC 2010). Adequate water flow and temperature are issues of concern. Water diversions pose an unknown but potentially serious threat within the Sacramento and Feather Rivers and the Sacramento River Delta. Poaching also poses an unknown but potentially serious threat because of high demand for sturgeon caviar. The effects of contaminants and nonnative species are also unknown but potentially serious. As mentioned above, retention of green sturgeon in both recreational and commercial fisheries is now prohibited within the western states, but the effect of capture/release in these fisheries is unknown. There is evidence of fish being retained illegally, although the magnitude of this activity likely is small (NOAA Fisheries 2011).

Status of Southern DPS Eulachon

Listing History. On March 18, 2010, NMFS listed the southern DPS eulachon as a threatened species (75 FR 13012), reaffirming this conclusion in its most recent 5-year status review (NMFS 2016d). Critical habitat was designated on October 20, 2011 (76 FR 65324). More information on the biology, ecology, and status of this species can be found in the recovery plan (NMFS 2017e). Table 35 summarizes listing and recovery plan information, status summary, and threats for eulachon.

Table 35. Status review summary and threats to the viability of southern DPS eulachon.

Status Summary	Threats (BRT Ratings)
The southern DPS of eulachon comprises fish that spawn in rivers south of the Nass River in British Columbia to, and including, the Mad River in California. Four "subpopulations" are considered in NMFS' recovery plan as a minimum set of "populations" that are needed to meet biologically based and threats-based delisting criteria: the Klamath River, the Columbia River, the Fraser River, and the British Columbia coastal rivers. Starting in 1994, there was an abrupt decline in the abundance of eulachon returning to all subpopulations, including the Columbia River. Despite a brief period of improved returns in 2001 to 2003, the returns and associated commercial landings were at low levels from the mid-1990s through the 2000s. Eulachon abundance in monitored rivers improved in the 2013 to 2015 return years, before declining again in 2016 through 2019, most likely due to recent poor ocean conditions. However, for 2020 the run in the Columbia River has improved moderately likely due to favorable ocean conditions.	High: climate change impacts on ocean conditions High–Moderate: ocean fisheries bycatch Moderate: climate change impacts on freshwater habitat Moderate: predation Moderate–Low: water quality Moderate–Very Low: dams and water diversions Moderate–Very Low: shoreline construction Moderate–Very Low: dredging

Eulachon in the listed southern DPS are primarily a marine pelagic species that spawn in the lower reaches of coastal rivers and whose primary prey is plankton (Gustafson et al. 2010). They are typically found in near-benthic habitats in open marine waters of the continental shelf with depths between 66 and 400 feet (Hay and McCarter 2000).

The southern DPS eulachon comprises fish that spawn in rivers south of the Nass River in British Columbia to, and including, the Mad River in California. Four subpopulations[77]—the Klamath River, the Columbia River, the Fraser River, and the British Columbia coastal rivers—are considered in NMFS' recovery plan as a minimum set of "populations" that are needed to meet biologically based (abundance, productivity, spatial distribution, and genetic and life-history diversity) and threats-based delisting criteria (NMFS 2017e).

[77] There are many "populations" of eulachon within the range of the species. For their threats analysis, the BRT did not include all known or possible eulachon spawning areas. As such, the BRT partitioned the southern DPS eulachon into geographic areas, i.e., subareas/subpopulations, for their threats assessment. Thus, the subpopulation structure used by the BRT leaves out some "populations" within the DPS (e.g., Elwha River, Naselle River, Umpqua River, and Smith River) that we now know may have (or have had) some important contribution to the overall productivity, spatial distribution, and genetic and life-history diversity of the species (NMFS 2017c). At present, it is not known whether eulachon are one large metapopulation or comprise multiple demographically independent populations.

Presently, most eulachon production south of the U.S.–Canada border originates in the Columbia River basin, including the Columbia, Cowlitz, Grays, Kalama, Lewis, and Sandy Rivers (Gustafson et al. 2010). Historically, eulachon were occasionally reported to spawn in tributaries as far upstream as the Hood River (Oregon) and the Klickitat River (Washington) (NMFS 2017e). Since Bonneville Dam was completed in 1937, there have been occasional observations of eulachon at, or even above (passing through the ship locks), the dam in years when eulachon were highly abundant (NMFS 2017e).

Starting in 1994, southern DPS eulachon experienced an abrupt decline in abundance throughout its range. Eulachon abundance in monitored rivers improved in the 2013 to 2015 return years, but recent poor conditions in the northeastern Pacific Ocean appear to have driven sharp declines in the river systems in 2016 and 2017.

No reliable fishery-independent, historical abundance estimates exist for eulachon. From 2000 through 2019, mean spawning stock biomass estimates in the Columbia River ranged from a low of about 783,000 fish in 2005 to a high of nearly 186 million fish in 2014, and in 2019 an estimate of 46.7 million fish. Spawning stock biomass estimates in the Fraser River (1995 to 2019) ranged from a low of about 110,000 to 150,000 fish in 2010 to a high of about 42 million to 56 million fish in 1996. Fishery-independent estimates are not available for the Klamath River or British Columbia coastal rivers (NMFS 2017e).

The BRT rated climate change impacts on ocean conditions as the highest threat to the persistence of eulachon subpopulations, followed by bycatch in coastal shrimp fisheries. The latter was likely reduced in recent years with the addition of lights and excluder devices to shrimp gear, developed specifically to reduce eulachon bycatch. Dams and water diversions, climate change impacts on freshwater habitat, predation, water quality, shoreline construction, and dredging were all rated as having moderate impacts for at least one subpopulation (NMFS 2017e).

2.2.2 Status of the Critical Habitats

This section examines the status of designated critical habitat affected by the proposed action by examining the condition and trends of essential physical and biological features throughout the designated areas. These features are essential to the conservation of the listed species because they support one or more of the species' life stages (*e.g.*, sites with conditions that support spawning, rearing, migration and foraging).

Salmon and Steelhead. For salmon and steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC_5) in terms of the conservation value they provide to each listed species they support.[78] The conservation rankings are high, medium, or low. To determine the conservation value of each watershed to species viability, NMFS's critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (for example, spawning gravels, wood and water

[78] The conservation value of a site depends upon "(1) the importance of the populations associated with a site to the ESU [or DPS] conservation, and (2) the contribution of that site to the conservation of the population through demonstrated or potential productivity of the area" (NOAA Fisheries 2005).

condition, side channels), the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area (NOAA Fisheries 2005, 2015). Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were essential due to factors such as limited availability (*e.g*., one of a very few spawning areas), a unique contribution of the population it served (*e.g*., a population at the extreme end of geographic distribution), or if it serves another important role (*e.g*., obligate area for migration to upstream spawning areas).

The physical or biological features of freshwater spawning and incubation sites, include water flow, quality and temperature conditions and suitable substrate for spawning and incubation, as well as migratory access for adults and juveniles (Tables 36 and 37). These features are essential to conservation because without them the species cannot successfully spawn and produce offspring. The physical or biological features of freshwater migration corridors associated with spawning and incubation sites include water flow, quality and temperature conditions supporting larval and adult mobility, abundant prey items supporting larval feeding after yolk sac depletion, and free passage (no obstructions) for adults and juveniles. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

Table 36. Primary constituent elements (PCEs) of critical habitats designated for ESA-listed salmon and steelhead species considered in the opinion (except SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, and SONCC coho salmon), and corresponding species life history events.

Primary Constituent Elements Site Type	Primary Constituent Elements Site Attribute	Species Life History Event
Freshwater spawning	Substrate Water quality Water quantity	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Floodplain connectivity Forage Natural cover Water quality Water quantity	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	Free of artificial obstruction Natural cover Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine areas	Forage Free of artificial obstruction Natural cover Salinity Water quality Water quantity	Adult sexual maturation and "reverse smoltification" Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine areas	Forage Free of artificial obstruction Natural cover Water quantity Water quality	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing

Table 37. Essential features of critical habitats designated for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, SONCC coho salmon, and corresponding species life history events.

Essential Features Site	Essential Features Site Attribute	Species Life History Event
Spawning and juvenile rearing areas	Access (sockeye) Cover/shelter Food (juvenile rearing) Riparian vegetation Space (Chinook, coho) Spawning gravel Water quality Water temp (sockeye) Water quantity	Adult spawning Embryo incubation Alevin growth and development Fry emergence from gravel Fry/parr/smolt growth and development
Adult and juvenile migration corridors	Cover/shelter Food (juvenile) Riparian vegetation Safe passage Space Substrate Water quality Water quantity Water temperature Water velocity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Areas for growth and development to adulthood	Ocean areas – not identified	Nearshore juvenile rearing Subadult rearing Adult growth and sexual maturation Adult spawning migration

CHART Salmon and Steelhead Critical Habitat Assessments

The CHART for each recovery domain assessed biological information pertaining to occupied by listed salmon and steelhead, determine whether those areas contained PCEs essential for the conservation of those species and whether unoccupied areas existed within the historical range of the listed salmon and steelhead that are also essential for conservation. The CHARTs assigned a 0 to 3 point score for the PCEs in each HUC_5 watershed for:

Factor 1. Quantity,
Factor 2. Quality – Current Condition,
Factor 3. Quality – Potential Condition,
Factor 4. Support of Rarity Importance,
Factor 5. Support of Abundant Populations, and
Factor 6. Support of Spawning/Rearing.

Thus, the quality of habitat in a given watershed was characterized by the scores for Factor 2 (quality – current condition), which considers the existing condition of the quality of PCEs in the HUC_5 watershed; and Factor 3 (quality – potential condition), which considers the likelihood of achieving PCE potential in the HUC_5 watershed, either naturally or through active conservation/restoration, given known limiting factors, likely biophysical responses, and feasibility.

Willamette-Lower Columbia Recovery Domain. Critical habitat was designated in the WLC recovery domain for UWR Chinook salmon, LCR Chinook salmon, LCR steelhead, and UWR steelhead, and LCR coho salmon. In addition to the Willamette and Columbia River mainstems, important tributaries on the Oregon side of the WLC include Youngs Bay, Big Creek, Clatskanie River, and Scappoose River in the Oregon Coast subbasin; Hood River in the Gorge; and the Sandy, Clackamas, Molalla, North and South Santiam, Calapooia, McKenzie, and Middle Fork Willamette rivers in the West Cascades subbasin.

Land management activities have severely degraded stream habitat conditions in the Willamette River mainstem above Willamette Falls and in associated subbasins. In the Willamette River mainstem and lower sub-basin mainstem reaches, high density urban development and widespread agricultural effects have reduced aquatic and riparian habitat quality and complexity, and altered sediment and water quality and quantity, and watershed processes. The Willamette River, once a highly braided river system, has been dramatically simplified through channelization, dredging, and other activities that have reduced rearing habitat by as much as 75 %. In addition, the construction of 37 dams in the basin blocked access to more than 435 miles of stream and river spawning habitat. The dams alter the temperature regime of the Willamette River and its tributaries, affecting the timing and development of naturally-spawned eggs and fry. Logging in the Cascade and Coast Ranges, and agriculture, urbanization, and gravel mining on valley floors have contributed to increased erosion and sediment loads throughout the WLC domain.

The mainstem Willamette River has been channelized and stripped of large wood. Development began to encroach on the riparian forest beginning in the 1870s (Sedell and Froggatt 1984). The total area of river channels and islands in the Willamette River decreased from 41,000 to 23,000 acres, and the total length of all channels decreased from 355 miles to 264 miles, between 1895 and 1995 (Gregory et al. 2002a). They noted that the lower reach, from the mouth of the river to Newberg (RM 50), is confined within a basaltic trench, and that due to this geomorphic constraint, less channel area has been lost than in upstream areas. The middle reach from Newberg to Albany (RM 50 to 120) incurred losses of 12 % of primary channel area, 16 % of side channels, 33 % of alcoves, and 9 % of island area. Even greater changes occurred in the upper reach, from Albany to Eugene (RM 187). There, approximately 40 % of both channel length and channel area were lost, along with 21 % of the primary channel, 41 % of side channels, 74 % of alcoves, and 80 % of island areas.

The banks of the Willamette River have more than 96 miles of revetments; approximately half were constructed by the USACE. Generally, the revetments were placed in the vicinity of roads or on the outside bank of river bends, so that while only 26 % of the total length is revetted, 65 % of the meander bends are revetted (Gregory et al. 2002b). The majority of dynamic sections have been armored, reducing adjustments in channel bed and sediment storage by the river, and thereby diminishing both the complexity and productivity of aquatic habitats (Gregory et al. 2002b).

Riparian forests have diminished considerably in the lower reaches of the Willamette River (Gregory et al. 2002c). Sedell and Froggatt (1984) noted that agriculture and cutting of streamside trees were major agents of change for riparian vegetation, along with snagging of large wood in the channel. The reduced shoreline, fewer and smaller snags, and reduced riparian forest comprise large functional losses to the river, reducing structural features, inputs of wood and litter, shade, entrained allochthonous materials, and flood flow filtering capacity. Extensive changes began before the major dams were built, with navigational and agricultural demands dominating the early use of the river. The once expansive forests of the Willamette River floodplain provided valuable nutrients and organic matter during flood pulses, food sources for macroinvertebrates, and slow-water refugia for fish during flood events. These forests also cooled river temperatures as the river flowed through its many channels.

Hyporheic flow in the Willamette River has been examined through discharge measurements and is significant in some areas, particularly those with gravel deposits (Wentz et al. 1998; Fernald et al. 2001). The loss of channel complexity and meandering that fosters creations of gravel deposits decreases the potential for hyporheic flows, as does gravel mining. Hyporheic flow processes water and affects its quality on reemerging into the main channel, stabilizing variations in physical and chemical water characteristics. Hyporheic flow is important for ecological functions, some aspects of water quality (such as temperature and dissolved oxygen), and some benthic invertebrate life stages. Alcove habitat, which has been limited by channelization, combines low hydraulic stress and high food availability with the potential for hyporheic flows across the steep hydraulic gradients in the gravel separating them from the main channel (Fernald et al. 2001).

On the mainstem of the Columbia River, hydropower projects, including the Federal Columbia River Hydropower System (FCRPS), have significantly degraded salmon and steelhead habitats (Bottom et al. 2005; Fresh et al. 2005; NMFS 2011; NMFS 2013a). The series of dams and reservoirs that make up the FCRPS block an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia River and replenish shorelines along the Washington and Oregon coasts.

Industrial harbor and port development are also significant influences on the Lower Willamette and Lower Columbia rivers (Bottom et al. 2005; Fresh et al. 2005; NMFS 2013a). Since 1878, 100 miles of river channel within the mainstem Columbia River, its estuary, and Oregon's Willamette River have been dredged as a navigation channel by the USACE. Originally dredged to a 20-foot minimum depth, the Federal navigation channel of the Lower Columbia River is now maintained at a depth of 43 feet and a width of 600 feet. The Lower Columbia River supports five ports on the Washington State side: Kalama, Longview, Skamania County, Woodland, and Vancouver. In addition to loss of riparian habitat, and disruption of benthic habitat due to dredging, high levels of several sediment chemicals — such as arsenic and polycyclic aromatic hydrocarbons — have been identified in Lower Columbia River watersheds in the vicinity of the ports and associated industrial facilities.

The most extensive urban development in the Lower Columbia River subbasin has occurred in the Portland/Vancouver area. Outside of this major urban area, the majority of residences and businesses rely on septic systems. Common water quality issues with urban development and residential septic systems include higher water temperatures, lowered dissolved oxygen, increased fecal coliform bacteria, and increased chemicals associated with pesticides and urban runoff.

The Columbia River estuary has lost a significant amount of the tidal marsh and tidal swamp habitats that are critical to juvenile salmon and steelhead, particularly small or ocean-type species (Bottom et al. 2005; Fresh et al. 2005; NMFS 2013a). Edges of marsh areas provide sheltered habitats for juvenile salmon and steelhead where food, in the form of amphipods or other small invertebrates which feed on marsh detritus, is plentiful, and larger predatory fish can be avoided. Historically, floodwaters of the Columbia River inundated the margins and floodplains along the estuary, allowing juvenile salmon and steelhead access to a wide expanse of low-velocity marshland and tidal channel habitats. In general, the riverbanks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain becoming habitat for salmon and steelhead during flooding river discharges or flood tides. Sherwood et al. (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. This study further estimated an 80 % reduction in emergent vegetation production and a 15 % decline in benthic algal production.

Habitat and food-web changes within the estuary, and other factors affecting salmon population structure and life histories, have altered the estuary's capacity to support juvenile salmon (Bottom et al. 2005; NMFS 2013a). Diking and filling have reduced the tidal prism and eliminated emergent and forested wetlands and floodplain habitats. These changes have likely reduced the estuary's salmon-rearing capacity. Moreover, water and sediment in the Lower Columbia River and its tributaries have toxins that are harmful to aquatic resources (Lower Columbia River Estuary Partnership 2007). Contaminants of concern include dioxins and furans, heavy metals, polychlorinated biphenyls (PCBs) and organochlorine pesticides such as DDT. Simplification of the population structure and life-history diversity of salmon possibly is yet another important factor affecting juvenile salmon viability. Restoration of estuarine habitats, particularly diked emergent and forested wetlands, reduction of avian predation by terns, and flow manipulations to restore historical flow patterns have likely begun to enhance the estuary's capacity to support salmon, although historical changes in population structure and salmon life histories may prevent salmon from making full use of estuarine habitats.

The CHART for the WLC recovery domain determined that most HUC_5 watersheds with PCEs for salmon or steelhead are in fair-to-poor or fair-to-good condition (NOAA Fisheries 2005). However, most of these watersheds have some or a high potential for improvement. Only watersheds in the upper McKenzie River and its tributaries are in good to excellent condition with no potential for improvement (Table 38).

Table 38. **Willamette-Lower Columbia Recovery Domain:** Current and potential quality of HUC_5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon (CK), chum salmon (CM), and steelhead (ST) (NOAA Fisheries 2005). Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC_5 Code(s)	Listed Species	Current Quality	Restoration Potential
Columbia Gorge #1707010xxx			
Wind River (511)	CK/ST	2/2	2/2
East Fork Hood (506), & Upper (404) & Lower Cispus (405) rivers	CK/ST	2/2	2/2
Plympton Creek (306)	CK	2	2
Little White Salmon River (510)	CK	2	0
Grays Creek (512) & Eagle Creek (513)	CK/CM/ST	2/1/2	1/1/2
White Salmon River (509)	CK/CM	2/1	1/2
West Fork Hood River (507)	CK/ST	1/2	2/2
Hood River (508)	CK/ST	1/1	2/2
Unoccupied habitat: Wind River (511)	Chum conservation value "Possibly High"		
Cascade and Coast Range #1708000xxx			
Lower Gorge Tributaries (107)	CK/CM/ST	2/2/2	2/3/2
Lower Lewis (206) & North Fork Toutle (504) rivers	CK/CM/ST	1/3/1	2/1/2
Salmon (101), Zigzag (102), & Upper Sandy (103) rivers	CK/ST	2/2	2/2
Big Creek (602)	CK/CM	2/2	2/2
Coweeman River (508)	CK/CM/ST	2/2/1	2/1/2
Kalama River (301)	CK/CM/ST	1/2/2	2/1/2
Cowlitz Headwaters (401)	CK/ST	2/2	1/1
Skamokawa/Elochoman (305)	CK/CM	2/1	2
Salmon Creek (109)	CK/CM/ST	1/2/1	2/3/2
Green (505) & South Fork Toutle (506) rivers	CK/CM/ST	1/1/2	2/1/2
Jackson Prairie (503) & East Willapa (507)	CK/CM/ST	1/2/1	1/1/2
Grays Bay (603)	CK/CM	1/2	2/3
Upper Middle Fork Willamette River (101)	CK	2	1
Germany/Abernathy creeks (304)	CK/CM	1/2	2
Mid-Sandy (104), Bull Run (105), & Lower Sandy (108) rivers	CK/ST	1/1	2/2
Washougal (106) & East Fork Lewis (205) rivers	CK/CM/ST	1/1/1	2/1/2
Upper Cowlitz (402) & Tilton rivers (501) & Cowlitz Valley Frontal (403)	CK/ST	1/1	2/1
Clatskanie (303) & Young rivers (601)	CK	1	2
Rifle Reservoir (502)	CK/ST	1	1
Beaver Creek (302)	CK	0	1
Unoccupied Habitat: Upper Lewis (201) & Muddy (202) rivers; Swift (203) & Yale (204) reservoirs	CK & ST Conservation Value "Possibly High"		
Willamette River #1709000xxx			
Upper (401) & South Fork (403) McKenzie rivers; Horse Creek (402); & McKenzie River/Quartz Creek (405)	CK	3	3
Lower McKenzie River (407)	CK	2	3

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC5 Code(s)	**Listed Species**	**Current Quality**	**Restoration Potential**
South Santiam River (606)	CK/ST	2/2	1/3
South Santiam River/Foster Reservoir (607)	CK/ST	2/2	1/2
North Fork of Middle Fork Willamette (106) & Blue (404) rivers	CK	2	1
Upper South Yamhill River (801)	ST	2	1
Little North Santiam River (505)	CK/ST	1/2	3/3
Upper Molalla River (905)	CK/ST	1/2	1/1
Abernethy Creek (704)	CK/ST	1/1	1/2
Luckiamute River (306) & Yamhill (807) Lower Molalla (906) rivers; Middle (504) & Lower (506) North Santiam rivers; Hamilton Creek/South Santiam River (601); Wiley Creek (608); Mill Creek/Willamette River (701); & Willamette River/Chehalem Creek (703); Lower South (804) & North (806) Yamhill rivers; & Salt Creek/South Yamhill River (805)	CK/ST	1	1
Hills (102) & Salmon (104) creeks; Salt Creek/Willamette River (103), Hills Creek Reservoir (105), Middle Fork Willamette/Lookout Point (107); Little Fall (108) & Fall (109) creeks; Lower Middle Fork of Willamette (110), Long Tom (301), Marys (305) & Mohawk (406) rivers	CK	1	1
Willamina Creek (802) & Mill Creek/South Yamhill River (803)	ST	1	1
Calapooia River (303); Oak (304) Crabtree (602), Thomas (603) & Rickreall (702) creeks; Abiqua (901), Butte (902) & Rock (903) creeks/Pudding River; & Senecal Creek/Mill Creek (904)	CK/ST	1/1	0/1
Row River (201), Mosby (202) & Muddy (302) creeks, Upper (203) & Lower (205) Coast Fork Willamette River	CK	1	0
Unoccupied habitat in North Santiam (501) & North Fork Breitenbush (502) rivers; Quartzville Creek (604) and Middle Santiam River (605)	CK & ST Conservation Value “Possibly High”		
Unoccupied habitat in Detroit Reservoir/Blowout Divide Creek (503)	Conservation Value: CK “Possibly Medium”; ST Possibly High”		
Lower Willamette #1709001xxx			
Collawash (101), Upper Clackamas (102), & Oak Grove Fork (103) Clackamas rivers	CK/ST	2/2	3/2
Middle Clackamas River (104)	CK/ST	2/1	3/2
Eagle Creek (105)	CK/ST	2/2	1/2
Gales Creek (002)	ST	2	1
Lower Clackamas River (106) & Scappoose Creek (202)	CK/ST	1	2
Dairy (001) & Scoggins (003) creeks; Rock Creek/Tualatin River (004); & Tualatin River (005)	ST	1	1
Johnson Creek (201)	CK/ST	0/1	2/2
Lower Willamette/Columbia Slough (203)	CK/ST	0	2

Critical habitat was proposed for LCR coho salmon in 2013, and designated in 2016. Table 39 shows the summaries for the CHART rating, and conservation value of HUC 5 watersheds.

Table 39. Summary of CHART scores and ratings of conservation value for habitat areas occupied by the LCR coho salmon DPS (NOAA Fisheries 2015).

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
			1	2	3	4	5	6				
Middle Columbia/ Hood	East Fork Hood River	1707010506	2	2	1	1	1	2	9	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. One of three HUC5s supporting Hood River coho, each with a substantial amount of available habitat relative to other watersheds in the Gorge Stratum.	High	
Middle Columbia/ Hood	West Fork Hood River	1707010507	2	2	1	1	1	2	9	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. One of three HUC5s supporting Hood River coho, each with a substantial amount of available habitat relative to other watersheds in the Gorge Stratum.	High	
Middle Columbia/ Hood	Hood River	1707010508	2	1	2	1	1	2	9	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. One of three HUC5s supporting Hood River coho, each with a substantial amount of available habitat relative to other watersheds in the Gorge Stratum.	High	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Middle Columbia/ Hood	White Salmon River	1707010509	1	2	2	1	1	1	8	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. The CHART noted that reaches above the recently-removed Condit Dam may be essential for conservation, especially given the limited number of watersheds in the Gorge Stratum and the good potential for additional coho production at the boundary of this DPS.	High	
Middle Columbia/Hood	Little White Salmon River	1707010510	1	2	0	1	1	2	7	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Although PCEs are limited in this HUC5, it may be important as cold water refugia for coho from the White Salmon and Hood River basins.	High	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Middle Columbia/Hood	Wind River	1707010511	3	2	2	1	1	2	11	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high level of viability. However, steeper terrain in this watershed likely makes it of lower conservation value to coho than other HUC5s in the Gorge Stratum. The CHART did not identify any low-value watersheds in the Gorge Stratum due to the limited number of HUC5s supporting coho here.	Medium	
Middle Columbia/Hood	Middle Columbia/ Grays Creek	1707010512	1	2	2	1	1	3	10	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. However, the limited amount of tributary habitatin this watershed likely makes it of lower conservation valueto coho than other HUC5s in the Gorge Stratum. The CHART did not identify any low-value watersheds in the Gorge Stratum due to the limited number of HUC5s supporting coho here.	Medium	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Middle Columbia/Hood	Middle Columbia/ Eagle Creek	1707010513	1	2	2	1	1	3	10	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. However, the limited amount of tributary habitatin this watershed likely makes it of lower conservation valueto coho than other HUC5s in the Gorge Stratum. The CHART did not identify any low-value watersheds in the Gorge Stratum due to the limited number of HUC5s supporting coho here.	Medium	High
Lower Columbia/ Sandy	Salmon River	1708000101	2	2	2	3	2	2	13	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. The Sandy River population is second only to the Clackamas in recent wild spawner abundance, and the Salmon River formerly supported the largest coho run in the Sandy River system.	High	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Columbia/ Sandy	Zigzag River	1708000102	3	2	2	3	2	2	14	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. The Sandy River population is second only to the Clackamas in recent wild spawner abundance. Tributary spawning PCEs are still extensive in this HUC5.	High	
Lower Columbia/ Sandy	Upper SandyRiver	1708000103	3	2	2	3	2	2	14	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. The Sandy River population is second only to the Clackamas in recent wild spawner abundance. Tributaryspawning PCEs are still extensive in this HUC5.	High	
Lower Columbia/ Sandy	Middle Sandy River	1708000104	1	1	2	3	2	2	11	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Tributary PCEs are more limited in this HUC5 relative to upstream/headwater HUC5s that the CHART determined had a higher conservation value.	Medium	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Columbia/ Sandy	Bull Run River	1708000105	1	1	2	3	2	2	11	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Tributary PCEs are more limited in this HUC5 relative to other headwater HUC5s that the CHART determined had a higher conservation value.	Medium	
Lower Columbia/ Sandy	Washougal River	1708000106	2	1	2	1	2	2	10	Moderate HUC5 score. PCEs support a population that is expected to play a lesser, contributing role in recovery withonly a moderate level of viability. The CHART noted that although PCEs are still fairly extensive in this HUC5, historical coho production was some of the lowest in the DPS.	Medium	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Columbia/ Sandy	Columbia Gorge Tributaries	1708000107	2	2	2	2	1	3	12	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high level of viability. A substantial amount of tributary habitat in this watershed relative to the two other Columbia corridor HUC5supstream. This is the only HUC5 with spawning habitat supporting the Lower Gorge Tributaries population. Also, there are significant restoration efforts underway here, and regular high concentrations of spawners.	High	High
Lower Columbia/ Sandy	Lower Sandy River	1708000108	1	1	2	3	2	2	11	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Tributary PCEs are more limited in this HUC5 relative to upstream/headwater HUC5s that the CHART determined had a higher conservation value.	Medium	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Columbia/ Sandy	Salmon Creek	1708000109	2	1	2	1	2	3	11	Moderate HUC5 score. PCEs support a population that is expected to play a lesser stabilizing role in recovery with only a very low level of viability. Although this watershed is highly urbanized, the CHART noted that there is still a significant amount of habitat available in this HUC5, especially in the upper reaches of Salmon Creek.	Medium	
Lewis	Upper Lewis River	1708000201	2	3	3	2	2	2	14	High HUC5 score. PCEs support a population that is expected to play a lesser, contributing role in recovery with only a low level of viability. This HUC5 contains important mid- to high-elevation forested habitats for spawning. Coho access this watershed via a trap and haul program , and the CHART noted important re-introduction programs underway for this area. The CHART also noted that PCEs are still fairly extensive in this HUC5 and the historical production from this population was considerable.	High	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lewis	Muddy River	1708000202	2	3	3	2	2	2	14	High HUC5 score. PCEs support a population that is expected to play a lesser, contributing role in recovery with only a low level of viability. This HUC5 contains important mid- to high-elevation forested habitats for spawning. Coho access this watershed via a trap and haul program , and the CHART noted important re-introduction programs underway for this area. The CHART also noted that PCEs are still fairly extensive in this HUC5 and the historical production from this population was considerable.	High	
Lewis	Swift Reservoir	1708000203	1	1	1	2	2	2	9	Moderate HUC5 score. PCEs support a population that is expected to play a lesser, contributing role in recovery with only a low level of viability. Coho access this watershed viaa trap and haul program. Tributary PCEs are significantly degraded due to inundation by Swift reservoir. This HUC5 isimportant primarily as a rearing/migration corridor for juveniles from upstream spawning areas.	Medium	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lewis	Yale Reservoir	1708000204	1	1	1	2	2	2	9	Moderate HUC5 score. PCEs support a population that is expected to play a lesser, contributing role in recovery with only a low level of viability. Coho access this watershed viaa trap and haul program. Tributary PCEs are significantly limited and degraded due to inundation by Yale reservoir. This HUC5 is important primarily as a rearing/migration corridor for juveniles from upstream spawning areas.	Low	High
Lewis	East Fork Lewis River	1708000205	2	1	2	2	2	3	12	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. The CHART noted that, in addition to the recovery planning emphasis in this HUC5, the East Fork Lewis River is the only major undammed stream within the Washington side of the Columbia River basin.	High	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lewis	Lower Lewis River	1708000206	2	1	2	2	2	2	11	Moderate HUC5 score. Most PCEs in this HUC5 support a population that is expected to play a lesser, contributing role in recovery with only a low level of viability. The lowermost section of the Lewis River also supports the East Fork Lewis population (see above). Coho access the upper portion of thiswatershed via a trap and haul program. Tributary PCEs are significantly limited and degraded due to inundation by Merwin reservoir. This HUC5 is important primarily as a rearing/migration corridor for juveniles from upstream spawning areas but does contain substantial tributary habitat as well.	Medium	High
Lower Columbia/ Clatskanie	Kalama River	1708000301	1	2	2	1	1	3	10	Moderate HUC5 score. PCEs support a population that is expected to play a lesser, contributing role in recovery withonly a moderate level of viability. The CHART noted that PCEs are not extensive here and historical coho production was some of the lowest in the DPS.	Medium	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Columbia/ Clatskanie	Beaver Creek/ Columbia River	1708000302	1	1	1	1	0	3	7	Moderate HUC5 score. PCEs support portions of two populations that are expected to play a primary role in recovery with a very high level of viability. However, thePCEs are much more limited in this HUC5 relative to the adjacent watersheds supporting these populations. The CHART did not identify any low-value watersheds in the Coast Stratum due to the limited number of HUC5s supporting coho here.	Medium	
Lower Columbia/ Clatskanie	Clatskanie River	1708000303	3	1	2	1	1	2	10	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with very a highlevel of viability. PCEs are extensive in this HUC5 and the majority of habitat supporting this population is located here and in the adjacent Plympton Creek HUC5.	High	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Columbia/ Clatskanie	Germany/Abernathy	1708000304	3	1	2	1	2	3	12	Moderate HUC5 score. PCEs support a population that is expected to play a lesser, contributing role in recovery with amedium level of viability. Therefore the CHART determinedthat the conservation value of this HUC5 was lower than others in the Coast Stratum. The CHART did not identify anylow-value watersheds in the Coast Stratum due to the limited number of HUC5s supporting coho here.	Medium	
Lower Columbia/ Clatskanie	Skamokawa/ Elochoman	1708000305	3	2	2	1	2	3	13	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. PCEs are extensive in this HUC5, which is the only watershed supporting this population.	High	
Lower Columbia/ Clatskanie	Plympton Creek	1708000306	2	2	2	1	1	2	10	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very highlevel of viability. PCEs are extensive in this HUC5 and the majority of habitat supporting this population is located here and in the adjacent Clatskanie River HUC5.	High	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Upper Cowlitz	Headwaters Cowlitz River	1708000401	1	2	1	1	1	2	8	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. PCEs are very limited in this HUC5 compared to other watersheds downstream.	Medium	
Upper Cowlitz	Upper Cowlitz River	1708000402	2	1	2	1	2	2	10	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Coho access this watershed via a trap and haul program. The CHART noted that PCEs are still fairly extensive in this HUC5 and the historical production from this population was some of the highest in the DPS.	High	High
Upper Cowlitz	Cowlitz Valley Frontal	1708000403	2	1	2	1	2	2	10	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Coho access this watershed via a trap and haul program. The CHART noted that PCEs are still fairly extensive in this HUC5 and the historical production from this population was some of the highest in the DPS.	High	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Upper Cowlitz	Upper Cispus River	1708000404	2	2	2	1	2	2	11	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Coho access this watershed via a trap and haul program. The CHART noted that PCEs are still fairly extensive in this HUC5 and the historical production from this population was considerable.	High	
Upper Cowlitz	Lower CispusRiver	1708000405	2	2	2	1	2	2	11	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Coho access this watershed via a trap and haul program. The CHART noted that PCEs are still fairly extensive in this HUC5 and the historical production from this population was considerable.	High	High
Lower Cowlitz	Tilton River	1708000501	2	1	2	1	1	2	9	Moderate HUC5 score. PCEs support a population that is expected to play a lesser, stabilizing role in recovery with a only a very low level of viability. Coho access this watershedvia a trap and haul program. PCEs are more degraded here than in other adjacent watersheds in the upper Cowlitz River basin.	Medium	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Cowlitz	Riffe Reservoir	1708000502	1	1	1	1	1	2	7	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Coho access this watershed via a trap and haul program. Tributary PCEs are significantly degraded due to inundation by the reservoir. This HUC5 is important primarily as a rearing/migration corridor for juveniles from upstream spawning areas for the Cispus River and Upper Cowlitz River populations.	Low	High
Lower Cowlitz	Jackson Prairie	1708000503	3	1	2	3	2	2	13	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Tributary PCEs, although degraded, are still very extensive in this HUC5. The CHART noted that this population could be considered an archetype for the late-run (Type N) coho stock.	High	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Cowlitz	North Fork Toutle River	1708000504	1	1	2	3	2	2	11	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high level of viability. The CHART noted that this population (North Fork Toutle) could be considered an archetype for the early- run (Type S) coho stock, and may show some resilience to catastrophic/volcanic sediment loads. The CHART also notedthat historical production from this population was considerable.	High	
Lower Cowlitz	Green River	1708000505	2	1	2	3	2	2	12	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high level of viability. The CHART noted that this population (North Fork Toutle) could be considered an archetype for the early- run (Type S) coho stock, and may show some resilience to catastrophic/volcanic sediment loads. The CHART also notedthat PCEs are still fairly extensive in this HUC5 and the historical production from this population was considerable.	High	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors)						Total HUC5 Score(0-18)	Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Cowlitz	South Fork Toutle River	1708000506	2	1	2	3	2	3	13	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high level of viability. The CHART noted that this population (South Fork Toutle) could be considered an archetype for the early- run (Type S) coho stock, and may show some resilience to catastrophic/volcanic sediment loads. The CHART also notedthat PCEs are still fairly extensive in this HUC5 and the historical production from this population was considerable.	High	
Lower Cowlitz	East Willapa	1708000507	3	1	2	3	3	3	15	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Tributary PCEs, although degraded, are still very extensive in this HUC5. The CHART noted that this population (Lower Cowlitz River) could be considered an archetype for the late-run (Type N) coho stock.	High	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Cowlitz	Coweeman	1708000508	3	1	2	2	2	3	13	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. Tributary PCEs are still extensive in this HUC5 and the CHART noted that there has been relatively little hatchery fish influence on this population (Coweeman).	High	High
Lower Columbia	Youngs River	1708000601	3	1	2	1	2	3	12	Moderate HUC5 score. PCEs support a population that is expected to play a lesser, stabilizing role in recovery with only a very low level of viability. The CHART did not identify any low-value watersheds in the Coast Stratum due to the limited number of HUC5s supporting coho here.	Medium	
Lower Columbia	Big Creek	1708000602	3	2	2	2	2	3	14	Moderate HUC5 score. PCEs support a population that is expected to play a lesser, stabilizing role in recovery with only a very low level of viability. The CHART did not identify any low-value watersheds in the Coast Stratum due to the limited number of HUC5s supporting coho here.	Medium	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Columbia	Grays Bay	1708000603	3	1	2	1	2	3	12	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a high levelof viability. PCEs are extensive in this HUC5, which is the only watershed supporting this population.	High	
Middle Willamette	Abernethy Creek	1709000704	1	1	2	3	0	2	9	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very high level of viability. However, the PCEs are much more limitedin this HUC5 relative to the adjacent Clackamas River watersheds supporting this population.	Low	
Clackamas	Collawash River	1709001101	1	3	3	3	2	2	14	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very highlevel of viability. This is one of only two populations in the entire DPS that is not at high risk or possibly extinct.	High	

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Clackamas	Upper Clackamas River	1709001102	3	3	3	3	2	2	16	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very highlevel of viability. This is one of only two populations in the entire DPS that is not at high risk or possibly extinct.	High	
Clackamas	Oak Grove Fork Clackamas River	1709001103	1	2	2	3	2	2	12	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very highlevel of viability. This is one of only two populations in the entire DPS that is not at high risk or possibly extinct.	High	
Clackamas	Middle Clackamas River	1709001104	2	2	1	3	3	2	13	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very highlevel of viability. This is one of only two populations in the entire DPS that is not at high risk or possibly extinct.	High	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Clackamas	Eagle Creek	1709001105	2	2	2	3	1	2	12	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very highlevel of viability. This is one of only two populations in the entire DPS that is not at high risk or possibly extinct.	High	
Clackamas	Lower Clackamas River	1709001106	3	1	2	3	3	2	14	High HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very highlevel of viability. This is one of only two populations in the entire DPS that is not at high risk or possibly extinct.	High	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Willamette	Johnson Creek	1709001201	2	1	2	3	1	2	11	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very high level of viability. This is one of only two populations in the entire DPS that is not at high risk or possibly extinct. Other HUC5s in the Clackamas River basin contain the majority of spawning habitat for this population. However, the CHARTnoted that this HUC5 may provide important refuge habitat for Clackamas River coho and it's more urbanized setting may promote unique adaptations.	High	High
Lower Willamette	Scappoose Creek	1709001202	3	1	2	1	2	2	11	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very high level of viability. This is one of only two populations in the entire DPS that is not at high risk or possibly extinct. Relativeto the other HUC5 supporting the Scappoose population (Clatskanie River HUC5), PCEs are more extensive in this watershed and it contains the majority of spawning habitat for this population.	High	High

Subbasin	Watershed	Area/ Watershed (HUC5) Code	Scoring System (factors) Total HUC5 Score(0-18)							Comments/Other Considerations	CHART Rating of HUC5 Conservation Value	Rating of Connect-ivity Corridor
Lower Willamette	Columbia Slough/ Willamette River	1709001203	1	0	2	3	2	2	10	Moderate HUC5 score. PCEs support a population that is expected to play a primary role in recovery with a very high level of viability. This is one of only two populations in the entire DPS that is not at high risk or possibly extinct. There is likely little or no spawning in the tributaries of this HUC5, however the off-channel habitat is particularly important for rearing and migrating juvenile coho.	Medium	High
Multiple	Lower Columbia Corridor (Sandy/ Washougal to Ocean)	NA	-	-	-	-	-	-	Not scored	Area not scored since many reaches are outside HUC5 boundaries. However, the CHART concluded that rearing andmigration PCEs throughout this corridor are highly essential to ESU conservation.		High

Interior Columbia Recovery Domain. Critical habitat has been designated in the IC recovery domain, which includes the habitat for MCR steelhead. Major tributaries in the Oregon portion of the IC recovery domain include the Deschutes, John Day, Umatilla, Walla Walla, Grande Ronde, and Imnaha rivers.

Habitat quality in tributary streams in the IC recovery domain varies from excellent in wilderness and roadless areas to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Critical habitat throughout much of the IC recovery domain has been degraded by intense agriculture, alteration of stream morphology (*i.e*., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems for critical habitat in developed areas.

Migratory habitat quality in this area has been severely affected by the development and operation of the FCRPS dams and reservoirs in the mainstem Columbia River, Bureau of Reclamation tributary projects, and privately-owned dams in the Snake and Upper Columbia river basins. For example, construction of Hells Canyon Dam eliminated access to several likely production areas in Oregon and Idaho, including the Burnt, Powder, Weiser, Payette, Malheur, Owyhee, and Boise river basins (Good et al. 2005), and Grand Coulee and Chief Joseph dams completely block anadromous fish passage on the upper mainstem Columbia River.

Hydroelectric development modified natural flow regimes, resulting in higher water temperatures, changes in fish community structure leading to increased rates of piscivorous and avian predation on juvenile salmon and steelhead, and delayed migration for both adult and juveniles. Physical features of dams such as turbines also kill migrating fish. In-river survival is inversely related to the number of hydropower projects encountered by emigrating juveniles. Similarly, development and operation of extensive irrigation systems and dams for water withdrawal and storage in tributaries have altered hydrological cycles.

A series of large regulating dams on the middle and upper Deschutes River affect flow and block access to upstream habitat, and have extirpated one or more populations from the Cascades Eastern Slope major population. Also, operation and maintenance of large water reclamation systems such as the Umatilla Basin and Yakima Projects have significantly modified flow regimes and degraded water quality and physical habitat in this domain.

Many stream reaches designated as critical habitat in the IC recovery domain are over-allocated, with more allocated water rights than existing streamflow. Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence et al. 1996). Reduced tributary stream flow has been identified as a major limiting factor for all listed salmon and steelhead species in this recovery domain except SR fall-run Chinook salmon and SR sockeye salmon.

Many stream reaches designated as critical habitat are listed on the state of Oregon's Clean Water Act section 303(d) list for water temperature. Many areas that were historically suitable rearing and spawning habitat are now unsuitable due to high summer stream temperatures. Removal of riparian vegetation, alteration of natural stream morphology, and withdrawal of water all contribute to elevated stream temperatures. Contaminants such as insecticides and herbicides from agricultural runoff and heavy metals from mine waste are common in some areas of critical habitat.

The IC recovery domain is a very large and diverse area. The CHART determined that few watersheds with PCEs for steelhead are in good to excellent condition with no potential for improvement. Overall, most IC recovery domain watersheds are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or high potential for improvement. In Washington, the Upper Methow, Lost, White, and Chiwawa watersheds are in good-to-excellent condition with no potential for improvement. In Oregon, only the Lower Deschutes, Minam, Wenaha, and Upper and Lower Imnaha Rivers HUC_5 watersheds are in good-to-excellent condition with no potential for improvement. In Idaho, a number of watersheds with PCEs for steelhead (Upper Middle Salmon, Upper Salmon/Pahsimeroi, Middle Fork Salmon, Little Salmon, Selway, and Lochsa rivers) are in good-to-excellent condition with no potential for improvement. Additionally, several Lower Snake River HUC_5watersheds in the Hells Canyon area, straddling Oregon and Idaho, are in good-to-excellent condition with no potential for improvement (Table 40).

Table 40. **Interior Columbia Recovery Domain:** Current and potential quality of HUC_5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon (CK) and steelhead (ST) (NOAA Fisheries 2005). Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC_5 Code(s)	Listed Species	Current Quality	Restoration Potential
Upper Columbia # 1702000xxx			
White (101), Chiwawa (102), Lost (801) & Upper Methow (802) rivers	CK/ST	3	3
Upper Chewuch (803) & Twisp rivers (805)	CK/ST	3	2
Lower Chewuch River (804); Middle (806) & Lower (807) Methow rivers	CK/ST	2	2
Salmon Creek (603) & Okanogan River/Omak Creek (604)	ST	2	2
Upper Columbia/Swamp Creek (505)	CK/ST	2	1
Foster Creek (503) & Jordan/Tumwater (504)	CK/ST	1	1
Upper (601) & Lower (602) Okanogan River; Okanogan River/Bonaparte Creek (605); Lower Similkameen River (704); & Lower Lake Chelan (903)	ST	1	1
Unoccupied habitat in Sinlahekin Creek (703)	ST Conservation Value "Possibly High"		
Upper Columbia #1702001xxx			
Entiat River (001); Nason/Tumwater (103); & Lower Wenatchee River (105)	CK/ST	2	2

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Lake Entiat (002)	CK/ST	2	1
Columbia River/Lynch Coulee (003); Sand Hollow (004); Yakima/Hansen Creek (604), Middle Columbia/Priest Rapids (605), & Columbia River/Zintel Canyon (606)	ST	2	1
Icicle/Chumstick (104)	CK/ST	1	2
Lower Crab Creek (509)	ST	1	2
Rattlesnake Creek (204)	ST	0	1
Yakima #1703000xxx			
Upper (101) & Middle (102) Yakima rivers; Teanaway (103) & Little Naches (201) rivers; Naches River/Rattlesnake Creek (202); & Ahtanum (301) & Upper Toppenish (303) & Satus (305) creeks	ST	2	2
Umtanum/Wenas (104); Naches River/Tieton River (203); Upper Lower Yakima River (302); & Lower Toppenish Creek (304)	ST	1	2
Yakima River/Spring Creek (306)	ST	1	1
Lower Snake River #1706010xxx			
Snake River/Granite (101), Getta (102), & Divide (104) creeks; Upper (201) & Lower (205) Imnaha River; Snake River/Rogersburg (301); Minam (505) & Wenaha (603) rivers	ST	3	3
Grande Ronde River/Rondowa (601)	ST	3	2
Big (203) & Little (204) Sheep creeks; Asotin River (302); Catherine Creek (405); Lostine River (502); Bear Creek (504); & Upper (706) & Lower (707) Tucannon River	ST	2	3
Middle Imnaha River (202); Snake River/Captain John Creek (303); Upper Grande Ronde River (401); Meadow (402); Beaver (403); Indian (409), Lookingglass (410) & Cabin (411) creeks; Lower Wallowa River (506); Mud (602), Chesnimnus (604) & Upper Joseph (605) creeks	ST	2	2
Ladd Creek (406); Phillips/Willow Creek (408); Upper (501) & Middle (503) Wallowa rivers; & Lower Grande Ronde River/Menatche Creek (607)	ST	1	3
Five Points (404); Lower Joseph (606) & Deadman (703) creeks	ST	1	2
Tucannon/Alpowa Creek (701)	ST	1	1
Mill Creek (407)	ST	0	3
Pataha Creek (705)	ST	0	2
Snake River/Steptoe Canyon (702) & Penawawa Creek (708)	ST	0	1
Flat Creek (704) & Lower Palouse River (808)	ST	0	0
Upper Salmon and Pahsimeroi #1706020xxx			
Germania (111) & Warm Springs (114) creeks; Lower Pahsimeroi River (201); Alturas Lake (120), Redfish Lake (121), Upper Valley (123) & West Fork Yankee (126) creeks	ST	3	3
Basin Creek (124)	ST	3	2
Salmon River/Challis (101); East Fork Salmon River/McDonald Creek (105); Herd Creek (108); Upper East Fork Salmon River (110); Salmon River/Big Casino (115), Fisher (117) & Fourth of July (118) creeks; Upper Salmon River (119); Valley Creek/Iron Creek (122); & Morgan Creek (132)	ST	2	3

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Salmon River/Bayhorse Creek (104); Salmon River/Slate Creek (113); Upper Yankee Fork (127) & Squaw Creek (128); Pahsimeroi River/Falls Creek (202)	ST	2	2
Yankee Fork/Jordan Creek (125)	ST	1	3
Salmon River/Kinnikinnick Creek (112); Garden Creek (129); Challis Creek/Mill Creek (130); & Patterson Creek (203)	ST	1	2
Road Creek (107)	ST	1	1
Unoccupied habitat in Hawley (410), Eighteenmile (411) & Big Timber (413) creeks	Conservation Value for ST "Possibly High"		
Middle Salmon, Panther and Lemhi #1706020xxx			
Salmon River/Colson (301), Pine (303) & Moose (305) creeks; Indian (304) & Carmen (308) creeks, North Fork Salmon River (306); & Texas Creek (412)	ST	3	3
Deep Creek (318)	ST	3	2
Salmon River/Cow Creek (312) & Hat (313), Iron (314), Upper Panther (315), Moyer (316) & Woodtick (317) creeks; Lemhi River/Whimpey Creek (402); Hayden (414), Big Eight Mile (408), & Canyon (408) creeks	ST	2	3
Salmon River/Tower (307) & Twelvemile (311) creeks; Lemhi River/Kenney Creek (403); Lemhi River/McDevitt (405), Lemhi River/Yearian Creek (406); & Peterson Creek (407)	ST	2	2
Owl (302) & Napias (319) creeks	ST	2	1
Salmon River/Jesse Creek (309); Panther Creek/Trail Creek (322); & Lemhi River/Bohannon Creek (401)	ST	1	3
Salmon River/Williams Creek (310)	ST	1	2
Agency Creek (404)	ST	1	1
Panther Creek/Spring Creek (320) & Clear Creek (323)	ST	0	3
Big Deer Creek (321)	ST	0	1
Mid-Salmon-Chamberlain, South Fork, Lower, and Middle Fork Salmon #1706020xxx			
Lower (501), Upper (503) & Little (504) Loon creeks; Warm Springs (502); Rapid River (505); Middle Fork Salmon River/Soldier (507) & Lower Marble Creek (513); & Sulphur (509), Pistol (510), Indian (511) & Upper Marble (512) creeks; Lower Middle Fork Salmon River (601); Wilson (602), Upper Camas (604), Rush (610), Monumental (611), Beaver (614), Big Ramey (615) & Lower Big (617) creeks; Middle Fork Salmon River/Brush (603) & Sheep (609) creeks; Big Creek/Little Marble (612); Crooked (616), Sheep (704), Bargamin (709), Sabe (711), Horse (714), Cottonwood (716) & Upper Chamberlain Creek (718); Salmon River/Hot Springs (712); Salmon River/Kitchen Creek (715); Lower Chamberlain/McCalla Creek (717); & Slate Creek (911)	ST	3	3
Marsh (506); Bear Valley (508) Yellow Jacket (604); West Fork Camas (607) & Lower Camas (608) creeks; & Salmon River/Disappointment Creek (713) & White Bird Creek (908)	ST	2	3

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Upper Big Creek (613); Salmon River/Fall (701), California (703), Trout (708), Crooked (705) & Warren (719) creeks; Lower South Fork Salmon River (801); South Fork Salmon River/Cabin (809), Blackmare (810) & Fitsum (812) creeks; Lower Johnson Creek (805); & Lower (813), Middle (814) & Upper Secesh (815) rivers; Salmon River/China (901), Cottonwood (904), McKenzie (909), John Day (912) & Lake (913) creeks; Eagle (902), Deer (903), Skookumchuck (910), French (915) & Partridge (916) creeks	ST	2	2
Wind River (702), Salmon River/Rabbit (706) & Rattlesnake (710) creeks; & Big Mallard Creek (707); Burnt Log (806), Upper Johnson (807) & Buckhorn (811) creeks; Salmon River/Deep (905), Hammer (907) & Van (914) creeks	ST	2	1
Silver Creek (605)	ST	1	3
Lower (803) & Upper (804) East Fork South Fork Salmon River; Rock (906) & Rice (917) creeks	ST	1	2
Little Salmon #176021xxx			
Rapid River (005)	ST	3	3
Hazard Creek (003	ST	3	2
Boulder Creek (004)	ST	2	3
Lower Little Salmon River (001) & Little Salmon River/Hard Creek (002)	ST	2	2
Selway, Lochsa and Clearwater #1706030xxx			
Selway River/Pettibone (101) & Gardner (103) creeks; Bear (102), White Cap (104), Indian (105), Burnt Knob (107), Running (108) & Goat (109) creeks; & Upper Selway River (106); Gedney (202), Upper Three Links (204), Rhoda (205), North Fork Moose (207), Upper East Fork Moose (209) & Martin (210) creeks; Upper (211), Middle (212) & Lower Meadow (213) creeks; Selway River/Three Links Creek (203); & East Fork Moose Creek/Trout Creek (208); Fish (302), Storm (309), Warm Springs (311), Fish Lake (312), Boulder (313) & Old Man (314) creeks; Lochsa River/Stanley (303) & Squaw (304) creeks; Lower Crooked (305), Upper Crooked (306) & Brushy (307) forks; Lower (308), Upper (310) White Sands, Ten Mile (509) & John's (510) creeks	ST	3	3
Selway River/Goddard Creek (201); O'Hara Creek (214) Newsome (505) creeks; American (506), Red (507) & Crooked (508) rivers	ST	2	3
Lower Lochsa River (301); Middle Fork Clearwater River/Maggie Creek (401); South Fork Clearwater River/Meadow (502) & Leggett creeks; Mill (511), Big Bear (604), Upper Big Bear (605), Musselshell (617), Eldorado (619) & Mission (629) creeks, Potlatch River/Pine Creek (606); & Upper Potlatch River (607); Lower (615), Middle (616) & Upper (618) Lolo creeks	ST	2	2
South Fork Clearwater River/Peasley Creek (502)	ST	2	1
Upper Orofino Creek (613)	ST	2	0
Clear Creek (402)	ST	1	3

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Three Mile (512), Cottonwood (513), Big Canyon (610), Little Canyon (611) & Jim Ford (614) creeks; Potlatch River/Middle Potlatch Creek (603); Clearwater River/Bedrock (608), Jack's (609) Lower Lawyer (623), Middle Lawyer (624), Cottonwood (627) & Upper Lapwai (628) creeks; & Upper (630) & Lower (631) Sweetwater creeks	ST	1	2
Lower Clearwater River (601) & Clearwater River/Lower Potlatch River (602), Fivemile Creek (620), Sixmile Creek (621) and Tom Taha (622) creeks	ST	1	1
Mid-Columbia #1707010xxx			
Wood Gulch (112); Rock Creek (113); Upper Walla Walla (201), Upper Touchet (203), & Upper Umatilla (301) rivers; Meacham (302) & Birch (306) creeks; Upper (601) & Middle (602) Klickitat River	ST	2	2
Glade (105) & Mill (202) creeks; Lower Klickitat River (604); Mosier Creek (505); White Salmon River (509); Middle Columbia/Grays Creek (512)	ST	2	1
Little White Salmon River (510)	ST	2	0
Middle Touchet River (204); McKay Creek (305); Little Klickitat River (603); Fifteenmile (502) & Fivemile (503) creeks	ST	1	2
Alder (110) & Pine (111) creeks; Lower Touchet River (207), Cottonwood (208), Pine (209) & Dry (210) creeks; Lower Walla Walla River (211); Umatilla River/Mission Creek (303) Wildhorse Creek (304); Umatilla River/Alkali Canyon (307); Lower Butter Creek (310); Upper Middle Columbia/Hood (501); Middle Columbia/Mill Creek (504)	ST	1	1
Stage Gulch (308) & Lower Umatilla River (313)	ST	0	1
John Day #170702xxx			
Middle (103) & Lower (105) South Fork John Day rivers; Murderers (104) & Canyon (107) creeks; Upper John Day (106) & Upper North Fork John Day (201) rivers; & Desolation Creek (204)	ST	2	2
North Fork John Day/Big Creek (203); Cottonwood Creek (209) & Lower NF John Day River (210)	ST	2	1
Strawberry (108), Beech (109), Laycock (110), Fields (111), Mountain (113) & Rock (114) creeks; Upper Middle John Day River (112); Granite (202) & Wall (208) creeks; Upper (205) & Lower (206) Camas creeks; North Fork John Day/Potamus Creek (207); Upper Middle Fork John Day River (301) & Camp (302), Big (303) & Long (304) creeks; Bridge (403) & Upper Rock (411) creeks; & Pine Hollow (407)	ST	1	2
John Day/Johnson Creek (115); Lower Middle Fork John Day River (305); Lower John Day River/Kahler Creek (401), Service (402) & Muddy (404) creeks; Lower John Day River/Clarno (405); Butte (406), Thirtymile (408) & Lower Rock (412) creeks; Lower John Day River/Ferry (409) & Scott (410) canyons; & Lower John Day River/McDonald Ferry (414)	ST	1	1
Deschutes #1707030xxx			
Lower Deschutes River (612)	ST	3	3

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Middle Deschutes River (607)	ST	3	2
Upper Deschutes River (603)	ST	2	1
Mill Creek (605) & Warm Springs River (606)	ST	2	1
Bakeoven (608) & Buck Hollow (611) creeks; Upper (701) & Lower (705) Trout Creek	ST	1	2
Beaver (605) & Antelope (702) creeks	ST	1	1
White River (610) & Mud Springs Creek (704)	ST	1	0
Unoccupied habitat in Deschutes River/McKenzie Canyon (107) & Haystack (311); Squaw Creek (108); Lower Metolius River (110), Headwaters Deschutes River (601)	ST Conservation Value "Possibly High"		

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The project encompasses two separate geographic areas on the Mt. Hood National Forest: The Government Camp area, and the Cooper Spur ski area. However, there will not be any effects to LFH[79] from the continued operation of the Cooper Spur ski area. Therefore, we are only including the effects of the proposed Government Camp parcels development in the action area.

In Government Camp, two 7th-field watersheds are part of the project area: Camp Creek and the Little Zigzag River (Figure 2, above). Both are tributaries to the Zigzag Canyon 6th-field watershed. Effects associated with tree removal, construction, and other ground disturbing activities will be contained within the Camp Creek, and Little Zigzag River watersheds. However, because stormwater runoff will be caused by the proposed action at the Government Camp parcel, the action area extends far beyond the project boundary. This is because stormwater chemicals are persistent, and travel long distances in solution, or attached to suspended sediments, where they are expected to settle and cause traceable effects to resident biota. Based on this, the action area extends from the waterbody receiving the stormwater, and down through all connected waterbodies to the Pacific Ocean. This includes the tributary to Camp Creek, Camp Creek, Zigzag River, Sandy River, and Columbia River.

[79] LFH = Listed Fish Habitat, defined as any stream reach potentially occupied by a ESA protected fish species, any stream reach designated as Critical Habitat, or any stream reach designated as Essential Fish Habitat.

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

As described in the Status of the Species and Critical Habitat sections, factors that limit the recovery of species considered in this opinion vary with the overall condition of aquatic habitats on private, state, and Federal lands. Within the action area, many stream and riparian areas have been degraded by the effects of land and water use, including road construction, forest management, agriculture, mining, transportation, urbanization, and water development. Each of these economic activities has contributed to a myriad of interrelated factors for the decline of species considered in this opinion. Among the most important of these are changes in stream channel morphology, degradation of spawning substrates, reduced instream roughness and cover, loss and degradation of estuarine rearing habitats, loss of wetlands, loss and degradation of riparian areas, water quality (*e.g.*, temperature, sediment, dissolved oxygen, contaminants) degradation, blocked fish passage, direct take, and loss of habitat refugia. Climate change is likely to play an increasingly important role in determining the abundance of ESA-listed species, and the conservation value of designated critical habitats, and is described in Section 2.2, above.

During the last five years, NMFS has engaged in various Section 7 consultations on Federal projects impacting these populations and their habitats in the action area and those impacts have been taken into account in this opinion. On the USFS portion of the action area, these consultations include MHNF timber sale opinions, restoration actions that occurred under the ARBO II (NMFS 2013c), and routine maintenance actions that occurred under RAMBO (NMFS 2018c). Because of the large action area, consultations on the portion of the action area outside of the USFS include SLOPES V Transportation, SLOPES In/Over Water Structures, and SLOPES Restoration.

Mt. Hood National Forest

Aquatic habitat conditions within the action area on the MHNF vary depending on the location, past land management activities, and natural events such as floods, fire, and debris torrents. However, the watersheds in the action area on the MHNF that are functioning the best tend to be found higher in the basins and also have higher percentage of federal lands. This includes the Zigzag River watershed. Federal lands now shelter much of the highest quality salmon and steelhead habitat remaining in the Pacific Northwest. The Zigzag River has recently had targeted watershed restoration projects completed as prioritized under a USFS Watershed Restoration

Action Plan (WRAP). More information can be found here: https://www.fs.usda.gov/resources/mthood/landmanagement/resourcemanagement.

Habitat conditions where land management has occurred range from poor to good, depending on the type and scale of disturbance, proximity to streams, timing and duration of land management activities, and sensitivity of channel type to perturbation. The subwatersheds in this portion of the action area have been altered by some of the following: recreation development, urban infrastructure, large wildfires as well as fire suppression, past logging practices, municipal water diversions, municipal sewage facilities, and road networks. Separately and cumulatively, these activities have resulted in loss of function of natural processes related to water quality and quantity, riparian and floodplain function and connectivity, in-channel habitat, and obstruction free migration corridors for aquatic organisms. Table 41. Shows the baseline conditions for the 5th field watershed within the MHNF portion of the action area.

Table 41. Baseline conditions for fifth-field watersheds within the Action Area. PF=Properly Functioning, FAR=Functioning At Risk, NPF=Not Properly Functioning. The definitions for these habitat indicators can be found in the following document: Analytical Process for Developing Biological Assessments for Federal Actions Affecting Fish Within the Northwest Forest Plan Area (U.S. Department of Agriculture, Forest Service; U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Fisheries; U.S. Department of Interior, Bureau of Land Management, U.S. Department of Interior, Fish and Wildlife Service; 2004)

AP Indicator Baseline Condition	Zigzag River (1708000102)	Middle Sandy River (1708000104)	Lower Sandy River (1708000107)
Temperature	PF	FAR	FAR
Sediment/Substrate/Turbidity	FAR	FAR	FAR
Chemicals/Nutrients	PF	FAR	FAR
Physical Barriers	PF	FAR	FAR
Large Woody Debris	FAR	NPF	NPF
Pool Quality/Frequency	FAR	NPF	NPF
Off-Channel Habitat	FAR	FAR	FAR
Refugia	FAR	FAR	FAR
Width/Depth Ratio	FAR	NPF	NPF
Streambank Condition	PF	FAR	FAR
Floodplain Connectivity	FAR	NPF	NPF
Peak/Base Flow	PF	NPF	NPF
Drainage Network	FAR	NPF	NPF
Road Density	FAR	NPF	NPF
Riparian Reserves	FAR	FAR	FAR
Disturbance History	PF	NPF	NPF
Disturbance Regime	PF	FAR	NPF

LCR Steelhead

The Sandy River (OR) population of LCR steelhead is in the action area, and is a core population. This population has a Low persistence probability rating, and an overall extinction risk rating of "high" (NMFS 2013a). LCR steelhead are found in the action area of the Sandy River Basin (NOAA 2013). These steelhead occupy a greater range of habitat than any other listed salmonid species in their range, extending from high elevation mountain streams to the Columbia River. Only LCR winter-run steelhead are present in the Zigzag River Basin. Sandy River historic returns may have once numbered 20,000 adults (ODFW 2002, as found in Sandy River Basin Partners [2005]). The mean return size for the period of 1999 to 2008 was 777 native adults (NOAA Fisheries 2016). With the removal of dams on the Sandy and Little Sandy Rivers in 2007 and 2008, and implementation of extensive restoration actions, steelhead returns have increased, with a mean return size of 3,029 in 2010 through 2018 (ODFW unpublished data). The mean return size for winter-run steelhead in the Hood River Basin for the period of 1999 to 2008 was 558 native adults (NOAA Fisheries 2016).

In the Sandy River, winter-run steelhead typically enter the basin in significant numbers from February through May, with peak spawning occurring in mid-April. Following emergence, steelhead fry will often seek refuge from fast currents by inhabiting stream margins and pool backwater habitats (as found in Sandy River Basin Partners 2005). As they begin to mature and grow larger, juveniles will typically inhabit deeper water habitats of pools, riffles, and runs. Steelhead juveniles may rear 2 to 3 years in their natal stream before migrating as smolts to the ocean. As such, the quality of the habitat they inhabit during this time is critical to their survival. Smolt emigration takes place primarily from March through June during spring freshets (Sandy River Basin Partners 2005).

LCR Chinook Salmon

The Sandy River (OR) population of LCR Chinook salmon is in the action are, and is a core, genetic legacy population. This population has a Moderate persistence probability rating, and overall extinction risk rating of "very high. LCR Chinook salmon are present in the action area of the Sandy River Basins (NOAA 2013). LCR Chinook salmon are found throughout the Sandy River including the Zigzag River 5th-field watershed. Historic returns may have once numbered 15,000 adults (City of Portland 2004). The mean return size for the Sandy River for the period of 1999 to 2007 was 1,108 native origin spawning adults (NOAA Fisheries 2016). Following dam removal and habitat restoration actions, the mean return size for 2008 to 2017 was 2,050 (Sandy Basin Watershed Council 2017).

LCR Chinook in the Sandy River watershed enter the river in early spring, most commonly in April and May. Peak migration occurs in June, with a smaller peak occurring in September. Spawning occurs primarily in August through October. Juveniles emigrate in the fall or the following spring after emergence and return generally at age 4 or 5.

LCR Coho Salmon

The Sandy River (OR) population of LCR coho salmon are in the action area. Because NMFS had not yet listed the ESU in 2003 when the WLC TRT designated core and genetic legacy populations for other ESUs, there are no such designations for LCR coho salmon. However, the Clackamas and Sandy subbasins contain the only populations in the ESU that have clear records of continuous natural spawning (McElhany et al. 2007; NMFS 2013a). This population has an overall extinction risk rating of “very high”. LCR coho are present in the action area throughout the Sandy River Basin and in Zigzag River 5th-field watershed. The Sandy River population includes both an early hatchery-origin run of coho, with peak presence occurring in September and October, and a late wild run generally peaking from October through December (NOAA 2013).

Fry emergence primarily occurs from February through April and peaks in March (Sandy River Basin Partners 2005). Following emergence, juvenile coho typically seek stream margin habitats and backwater pools for initial rearing (ODFW 1997). As they continue to grow in size, juveniles seek low velocity pool and off-channel habitats for summer and winter rearing. Juvenile coho rely heavily on slack water habitats with complex large woody debris for protection from winter freshets. Juvenile coho in the Sandy River typically emigrate to the ocean as smolts at about 12 to 14 months of age (ODFW 1997). The timing of juvenile coho outmigration is usually late March through June, peaking in April and May (ODFW 1997). Coho salmon in the Lower Columbia River and Southwest Washington Coast Evolutionary Significant Unit typically rear in the ocean for two summers and return as 3-year-olds.

Columbia River

All species considered in this opinion occur in this portion of the action area: The confluence of the Sandy River and Columbia River, downstream to the mouth of the Pacific Ocean. Because this is such a large area, all populations discussed in the Status of the Species and Critical Habitat section are included. The status of these populations vary in abundance and productivity, diversity spatial structure, and overall extinction risk.

The development of hydropower and water storage projects within the Columbia River basin have resulted in the inundation of many mainstem spawning and shallow-water rearing areas (loss of spawning gravels and access to spawning and rearing areas); altered water quality (reduced spring turbidity levels), water quantity (seasonal changes in flows and consumptive losses resulting from use of stored water for agricultural, industrial, or municipal purposes), water temperature (including generally warmer minimum winter temperatures and cooler maximum summer temperatures), water velocity (reduced spring flows and increased cross-sectional areas of the river channel), food (alteration of food webs, including the type and availability of prey species), and safe passage (increased mortality rates of migrating juveniles) (Ferguson et al. 2005; Williams et al. 2005).

Johnson et al. (2013) found polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane (DDT) in juvenile salmon and salmon diet samples from the lower Columbia River and estuary at concentrations above estimated thresholds for effects on growth and survival. The Columbia River between Portland, Oregon, and Longview, Washington, appears to be an important source of contaminants for juvenile salmon and a region in which salmon were exposed to toxicants associated with urban development and industrial activity. Highest concentrations of PCBs were found in fall Chinook salmon stocks with subyearling life histories, including populations from the upper Columbia and Snake rivers, which feed and rear in the tidal freshwater and estuarine portions of the river for extended periods. Spring Chinook salmon stocks with yearling life histories that migrate more rapidly through the estuary generally had low PCB concentrations, but high concentrations of DDTs. Pesticides can be toxic to primary producers and macroinvertebrates, thereby limiting salmon population recovery through adverse, bottom-up impacts on aquatic food webs (Macneale et al. 2010).

Listed fish species considered in this opinion are exposed to high rates of predation during all life stages. Fish, birds, and marine mammals, including harbor seals, sea lions, and killer whales all prey on juvenile and adult salmon. The Columbia River Basin has a diverse assemblage of native and introduced fish species, some of which prey on salmon, steelhead, and eulachon. The primary resident fish predators of salmonids in many areas of the State of Oregon inhabited by anadromous salmon are northern pikeminnow (native), smallmouth bass (introduced), and walleye (introduced). Other predatory resident fish include channel catfish (introduced), Pacific lamprey (native), yellow perch (introduced), largemouth bass (introduced), and bull trout (native). Increased predation by non-native predators has and continues to decrease population abundance and productivity.

Avian predation is another factor limiting salmonid recovery in the Columbia River Basin. Throughout the basin, piscivorous birds congregate near hydroelectric dams and in the estuary near man-made islands and structures. Avian predation has been exacerbated by environmental changes associated with river developments. Water clarity caused by suspended sediments settling in impoundments increases the vulnerability of migrating smolts. Delay in project reservoirs, particularly immediately upstream from the dams, increases smolt exposure to avian predators, and juvenile bypass systems concentrate smolts, creating potential feeding stations for birds. Dredge spoil islands, associated with maintaining the Columbia River navigation channel, provide habitat for nesting Caspian terns and other piscivorous birds. Caspian terns, double-crested cormorants, glaucous-winged/western gull hybrids, California gulls, and ring-billed gulls are the principal avian predators in the basin. As with piscivorous predators, predation by birds has and continues to decrease population abundance and productivity.

Water quality throughout the action area is degraded to various degrees because of contaminants that are harmful to species considered in this consultation. Aerial deposition, discharges of treated effluents, and stormwater runoff from residential, commercial, industrial, agricultural, recreational, and transportation land uses are all source of these contaminants. For example, 4.7 million pounds of toxic chemicals were discharged into surface waters of the Columbia River Basin (a 39% decrease from 2003) and another 91.7 million pounds were discharged in the air and on land in 2011 (U.S. EPA 2011). This reduction can be attributed, in part, to significant state, local and private efforts to modernize and strengthen tools available to treat and manage stormwater runoff (U.S. EPA 2009; U.S. EPA 2011).

In a typical year in the U.S., pesticides are applied at a rate of approximately five billion pounds of active ingredients per year (Kiely et al. 2004). Therefore, pesticide contamination in the nation's freshwater habitats is ubiquitous and pesticides usually occur in the environment as mixtures. The USGS National Water-Quality Assessment (NAWQA) Program conducted studies and monitoring to build on the baseline assessment established during the 1990s to assess trends of pesticides in basins across the Nation, including the Willamette River basin. More than 90 percent of the time, water from streams within agricultural, urban, or mixed-land-use watersheds had detections of 2 or more pesticides or degradates, and about 20 percent of the time they had detections of 10 or more. Fifty-seven percent of 83 agricultural streams had concentrations of at least one pesticide that exceeded one or more aquatic-life benchmarks at least one time during the year (68 percent of sites sampled during 1993–1994, 43 percent during 1995–1997, and 50 percent during 1998–2000) (Gilliom et al. 2006).

The role of stormwater runoff in degrading water quality has been known for years but reducing that role has been notoriously difficult because the runoff is produced everywhere in the developed landscape, the production and delivery of runoff are episodic and difficult to attenuate, and runoff accumulates and transports much of the collective waste of the developed environment (NRC 2009). In most rivers in Oregon, the full spatial distribution and load of contaminants is not well understood. Hydrologically low-energy areas, where fine-grained sediment and associated contaminants settle, are more likely to have high water temperatures, concentrations of nitrogen and phosphorus that may promote algal blooms, and concentrations of aluminum, iron, copper, and lead that exceed ambient water quality criteria for chronic toxicity to aquatic life (Fuhrer et al. 1996). Even at extremely low levels, contaminants still make their way into salmon tissues at levels that are likely to have sublethal and synergistic effects on individual Pacific salmon, such as immune toxicity, reproductive toxicity, and growth inhibition (Baldwin et al. 2011; Carls and Meador 2009; Hicken et al. 2011; Johnson et al. 2013), that may be sufficient to reduce their survival and therefore the abundance and productivity of some populations (Baldwin et al. 2009; Spromberg and Meador 2006).

The adverse effect of contaminants on aquatic life often increases with temperature because elevated temperatures accelerate metabolic processes and thus the penetration and harmful action of toxicants. The full presence of contaminants throughout the program action area is poorly understood, but the concentration of many increase in downstream reaches (Fuhrer et al. 1996; Johnson et al. 2013; Johnson et al. 2005; Morace 2012). The fate and transport of contaminants varies by type, but are all determined by similar biogeochemical processes (Alpers et al. 2000b; Alpers et al. 2000a; Bricker 1999; Chadwick et al. 2004; Johnson et al. 2005). After deposition, each contaminant typically processes between aqueous and solid phases, sorption and deposition into active or deep sediments, diffusion through interstitial pore space, and re-suspension into the water column. Uptake by benthic organisms, plankton, fish, or other species may occur at any stage except deep sediment, although contaminants in deep sediments become available for biotic uptake when re-suspended by dredging or other disturbances.

Whenever a contaminant is in an aqueous phase or associated with suspended sediments, it is subject to the processes of advection and dispersion toward the Pacific Ocean. However, once soluble metal releases are reduced or terminated, the solute half-time in Columbia River water is months versus about 20 years for adsorbed metals on surficial (or resuspended) bed sediments. The much slower rate of decline for sediment, as compared to the solute phase, is attributed to resuspension, transport and redeposition of irreversibly bound metals from upstream sedimentary deposits. This implies downstream exposure of benthic or particle-ingesting biota can continue for years following source remediation and/or termination of soluble metal releases (Johnson et al. 2005). Adsorbed contaminants are highest in clay and silt, which can only be deposited in areas of reduced water velocity, such as behind dams and the backwater or off-channel areas preferred as rearing habitat by juveniles of some Pacific salmon (Johnson et al. 2005; ODEQ

2012). Similar estimates for the residence time of contaminants in the freshwater plume are unavailable, although the plume itself has been tracked as a distinct coastal water mass that may extend up to 50 miles beyond the mouth of the Columbia River, where the dynamic interaction of tides, river discharge, and winds can cause significant variability in the plume's location at the interannual, seasonal scale, and even at the event scale of hours (Burla et al. 2010; Kilcher et al. 2012; Thomas and Weatherbee 2006).

The environmental baseline includes the anticipated impacts of all Federal actions in the action area that have already undergone formal consultation. Because the action area includes portions of the Columbia River, a large number of actions across Oregon and Washington affect the condition of the environmental baseline. These include SLOPES programmatic actions for construction, minor discharge, over- and in-water structures, transportation, streambank stabilization, surveys, and utility lines in habitat affecting ESA-listed fish species. The Corps, and Bonneville Power Administration (BPA), have consulted on large water management actions, such as operation of the Federal Columbia River Power System. The BPA, NOAA Restoration Center, and USFWS have also consulted on large restoration programs that consist of actions designed to address species limiting factors or make contributions that would aid in species recovery. Restoration actions may have short term adverse effects, but generally result in long-term improvements to habitat condition and population abundance, productivity, and spatial structure. After going through consultation, many ongoing actions, such as stormwater facilities, roads, culverts, bridges and utility lines, have less impact on listed salmon and steelhead.

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

As explained earlier in the Proposed Action section, the effects analysis will be broken into two different zones within the action area. Effects associated with tree removal, construction, stormwater runoff, and other ground disturbing activities will be contained in, and in close proximity to the Government Camp parcel. However, because stormwater runoff will occur at the Government Camp parcel, the effects analysis will include a much larger area due to the persistence of stormwater contaminants.

The effects analysis is further organized into three separate categories: 1. Effect to Habitat Indicators, 2. Effects to ESA-Listed Species, and 3. Effects to Critical Habitat.

2.5.1 Effects to Habitat Indicators.

Government Camp Parcel

As part of the land exchange, Meadows proposes to develop the Government Camp parcel. Because no specific development plans have been finalized or approved by Clackamas County or any other applicable State permitting authorities, Meadows identified how the Government Camp parcels would be developed and used, which are primarily based on zoning regulations of Clackamas County, including prescriptive stream buffers, and stormwater management. Camp Creek is located on the Government Camp parcel. Clackamas County would require a 70-foot buffer. However, Meadows will provide a 150-feet buffer to protect the stream. Meadows could develop a maximum of 146 residential lots. The average lot size will be approximately 10,890 square feet (1/4 acre).The lot size is defined in the Clackamas County Zoning and Development Ordinance (Section 317) for the purposes of determining the maximum density or housing units. The actual lot size will vary depending on the product and building orientation. The lot coverage (impervious surface) would not exceed 50%. This includes a total of 23.68 acres of new impervious surface (18.25 acres from lot development), plus (5.43 acres from road development). Based on commitments made during consultation, Meadows will treat stormwater from impervious surfaces with a combination of NMFS SLOPES V STU stormwater standards, and Clackamas County stormwater standards, whichever treatment element is more stringent.

Construction of the Government Camp parcel will have direct physical and chemical effects on the environment that commonly begin with pre-construction activity, such as surveying, minor vegetation clearing, and placement of stakes and flagging guides. This requires movement of personnel and sometimes machines over the action area. The next stage, site preparation, may require development of access roads, construction staging areas, and materials storage areas that affect more of the action area. If additional earthwork is necessary to clear, excavate, fill, or shape the site, more vegetation and topsoil may be removed, and deeper soil layers exposed. The final stage of construction is site restoration.

Specifically, the effects from development of the Government Camp parcel will include an increase in stream temperature, decrease of instream wood recruitment, increase in suspended sediment, and increase in contaminants.

Stream Temperature. Removing trees in riparian areas can reduce the amount of shade, which exposes streams to increased thermal loading (Moore and Wondzell 2005). In clearcuts, small effects on shade were observed in studies that examined no-cut buffers 46 m (150 feet) wide (Anderson et al. 2007, Leinenbach et al. 2013, Groom et al. 2011a, Groom et al. 2011b). The limited response observed in these studies can be attributed to the lack of trees that were capable of casting a shadow more than 46 m (150 feet) during most of the day in the summer (Leinenbach 2011).

Although stream shade correlates with the width of no-cut buffers, the relationship is quite variable, depending on site-specific factors such as stream size, substrate type, stream discharge, topography (Caissie 2006), channel aspect, and forest structure and species composition. Inputs of cold water from the streambed, seepage areas on the stream bank, and tributaries can help cool the stream on hot summer days if they are sufficiently large relative to the stream discharge (Wondzell 2012). The density of vegetation in riparian areas affects shade and thermal loading to a stream due to the penetration of solar radiation through gaps in the canopy and among the branches and stems (Brazier and Brown 1973, DeWalle 2010). In some instances (such as narrow streams with dense, overhanging streamside vegetation, or stands on the north sides of streams with an east-west orientation), no-cut buffers as narrow as 30 feet adjacent to clearcuts can maintain stream shade (Brazier and Brown 1973).

Camp Creek is a perennial stream, and is shaded with adequate canopy cover from the riparian shrubs and trees. As explained above, it is expected that the 150-foot buffer will protect the majority of stream shade, and minimize an increase in stream temperature (Anderson et al. 2007, Leinenbach 2011Leinenbach et al. 2013, Groom et al. 2011a, Groom et al. 2011b). In addition, Camp Creek has cold, spring water inputs.

In-Stream Wood Recruitment. Large wood provides important habitat for a range of ESA fish species. Large riparian trees that die and fall into and near streams, such as within floodplains and wetlands, regulate sediment and flow routing, influence stream channel complexity and stability, increase pool volume and area, and provide hydraulic refugia and cover for fish (Bisson et al. 1987, Gregory et al. 1987, Hicks et al. 1991, Ralph et al. 1994, Bilby and Bisson 1998). The loss of wood is a primary limiting factor for salmonid production in almost all watersheds west of the Cascade Mountains (ODFW and NMFS 2011, NMFS 2013a).

Large wood helps retain coarse sediment, which is particularly important because it helps to create and maintain alluvial aquifers, which in turn help to modulate stream temperatures through the process of hyporheic exchange, while sediment storage in upstream reaches reduces fine sediment that degrades and entombs salmon redds. The ability of large wood and other obstructions to attenuate peak flows also helps to reduce bed scour, which can also destroy redds. Within spawning areas, large wood also helps to reduce bed mobility, which also helps to keep redds intact and minimize their loss through the movement of the spawning substrate during high flows.

Removal of wood mass within one site potential tree height (SPTH) of a stream has the greatest potential of affecting recruitment of woody material (FEMAT 1993). For near-stream riparian inputs, empirical and modeling studies suggest that stream wood input rates decline exponentially with distance from the stream and vary by stand type and age (Figure 26) (McDade et al. 1990, Van Sickle and Gregory 1990, Gregory et al. 2003). According to the USFS, the SPTH for this area is 170 feet.

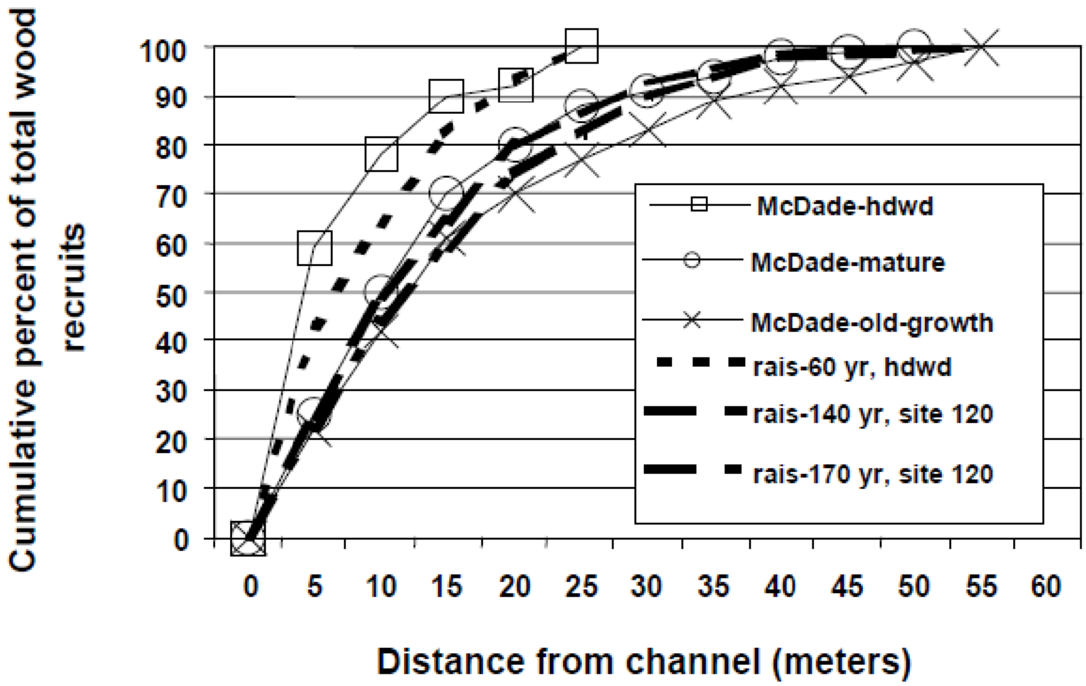

Figure 26. Comparison of predictions of total wood accumulation with distance from channel using the Organon forest growth model and RAIS instream wood recruitment model verse the observations of McDade et al (1990) for streams in the Cascade Mountains of Oregon and Washington. (From Spies et al. 2013, page 18.)

Near-stream wood recruitment tends to be more evenly distributed throughout a drainage network, whereas episodic landslides tend to create large concentrations of wood at tributary junctions, which contributes to habitat complexity and ecological productivity (Bigelow et al. 2007). The presence of large wood in debris flows slows the speed of the flow and reduces the run-out distance of debris flows on the valley floors (Lancaster et al. 2003). Stream-side sources of wood can provide the largest key pieces to streams, and contribute to gravel storage that converts bedrock reaches to alluvial reaches, and create smaller, more numerous pools, and create habitat complexity (Montgomery et al. 1996, Bigelow et al. 2007). Both types of wood delivery are necessary for functioning and productive stream ecosystems.

Camp Creek is a perennial stream, and has adequate canopy cover from the riparian shrubs and trees. Meadows proposes a 150-foot buffer for Camp Creek. These buffers would retain approximately 98-100% of existing wood recruitment. This will help protect nearly all in-stream wood recruitment from the riparian area. However, trees removed upslope of the riparian area could prevent wood loading to streams from episodic landslides (Bigelow et al. 2007).

Suspended Sediment. Sediment disturbance may occur during construction, including establishing access roads, and staging areas requires the use of heavy equipment for vegetation removal and earthwork. During and after wet weather, increased runoff resulting from soil and vegetation disturbance at the construction site during both preconstruction and construction phases is likely to suspend and transport more sediment to receiving waters as long as construction continues so that multiyear projects are likely to cause more sedimentation.

Removing trees can increase sediment supply to streams via increased mass wasting (primarily landslides) (Sugden 2018, Sidle and Ochiai 2006, Swanson and Dryness 1975, Swanston and Swanson 1976, Furniss et al. 1991, McClelland et al. 1997, Robison et al. 1999) or surface erosion (most commonly from road surfaces (Haupt 1959, Swanson and Dyrness 1975, Swanston and Swanson 1976, Beschta 1978, Megahan 1987).

Streamside buffer strips are generally not as effective in preventing channelized flow, but are effective where sheet erosion occurs; however, the effectiveness of buffer strips for preventing sediment movement within the buffer increases with the presence of herbaceous vegetation and slash (Warrington et al. 2017, Belt et al. 1992). Several studies document the ability of buffer strips to reduce erosion and sediment delivery. Vegetated buffer areas ranging in width from 40 to 100 feet appear to prevent sediment from reaching streams (Burroughs and King 1989, Corbett and Lynch 1985, Gomi et al. 2005). Lakel et al. (2010) concluded that streamside management zones (buffers) between 25 and 100 feet were effective in trapping sediment before it could enter streams.

The 150-foot buffer on Camp Creek will ensure that most, but not all fine sediment generated by tree removal, and construction will not reach the stream (Burroughs and King 1989, Corbett and Lynch 1985, Gomi et al. 2005). During a stream survey July 28, 2021, the USFS stated that stream buffer is well-vegetated with ground cover, and will likely prevent the transport of the majority of soils to the stream for sheet erosion (Belt et al. 1992). However, the vegetated buffers will not necessarily prevent all channelized flow (Warrington et al. 2017, Belt et al. 1992). Because the proposed development will occur on slopes up to 25%, there is a chance that sediment will enter Camp Creek. Although Camp Creek at the Government Camp site is not considered LFH, LCR Chinook salmon, LCR coho salmon, and LCR steelhead occur downstream in Camp Creek.

Government Camp Parcel to the Pacific Ocean

Increase in Contaminants from Stormwater Runoff. Stormwater runoff from the impervious surfaces, including roads, bridges, driveways, and roofs delivers a wide variety of pollutants to aquatic ecosystems, such as nutrients, metals, petroleum-related compounds, sediment washed off the road surface, and agricultural chemicals used in highway maintenance (Buckler and Granato 1999; Colman *et al.* 2001; Driscoll *et al.* 1990; Kayhanian *et al.* 2003). The proposed design criterion for stormwater management will treat stormwater flows associated with more than 95% of the annual average rainfall. Runoff from impervious surfaces within the Government Camp parcel will betreated at or near the point at which rainfall occurs using low impact development, bioretention, filter subsoils, and other practices that have been identified as excellent treatments to reduce or eliminate contaminants for highway runoff (Barrett *et al.* 1993; Center for Watershed Protection and Maryland Department of the Environment 2000 (revised 2009); Herrera Environmental Consultants 2006; Hirschman *et al.* 2008; National Cooperative Highway Research Program 2006).[80]

[80] See also Memos from Ronan Igloria, HDR (Henningson, Durham, and Richardson, Inc.), to Jennifer Sellers and William Fletcher, Oregon Department of Transportation, dated December 28, 2007 (Stormwater Treatment Strategy Development – Water Quality Design Storm Performance Standard), February 28, 2008 (Stormwater Treatment

Stormwater treatment practices, such as bioretention, bioslopes, infiltration ponds, and porous pavement, supplemented with appropriate soil amendments as needed,[81] are excellent treatments to reduce or eliminate contaminants from runoff (Barrett *et al.* 1993; Center for Watershed Protection and Maryland Department of the Environment 2000 (revised 2009); Hirschman *et al.* 2008; National Cooperative Highway Research Program 2006; Washington State Department of Ecology 2004; Washington State Department of Ecology 2012). Stormwater treatment may also include source control BMPs, which prevent pollution, or other adverse effects of stormwater, from occurring. Source control BMPs include methods as various as using mulches and covers on disturbed soil, putting roofs over outside storage areas, and berming areas to prevent stormwater run-on and pollutant runoff.

Flow control BMPs typically control the volume rate, frequency, and flow duration of stormwater surface runoff. The need to provide flow control BMPs depends on whether a development site discharges to a stream system or wetland, either directly or indirectly. Stream channel erosion control can be accomplished by BMPs that detain runoff flows and also by those which physically stabilize eroding streambanks. Both types of measures may be necessary in urban watersheds. Construction of a detention pond is the most common means of meeting flow control requirements. Construction of an infiltration facility is the preferred option but is feasible only where more porous soils are available.

Meadows proposes to capture, manage, and treat runoff with a mix of SLOPES V STU (NMFS 2014), and Clackamas County stormwater standards. Although these are typical stormwater management systems used for residential development, we recognize that treatment will not eliminate all pollutants in the runoff that will be generated. Thus, adverse effects of stormwater runoff will persist for the as long as the impervious surface is present on the landscape.

2.5.2 Effects to ESA-listed Fish

The effects of the Government Camp development on habitat indicators were discussed in the section above (include increased stream temperature, decreased in-stream wood recruitment, increased suspended sediment, and increased contaminants), and will cause adverse effects on LFH. Increased stream temperature, decreased in-stream wood recruitment, and increased suspended sediment will affect LCR Chinook salmon, LCR coho, and LCR steelhead equally because of the close proximity of these species to the Government Camp site. However, increased contaminants will affect all species considered in this Opinion because stormwater contaminants travel long distances, and are persistent in the water column, where all other species considered in this Opinion are present in the Columbia River.

Increase in Suspended Sediments

Likely effects from project-related increases in suspended sediment on ESA-listed species include, but are not limited to: (1) reduction in feeding rates and growth, (2) physical injury, (3)

Strategy Development – Water Quantity Design Storm Performance Standard - Final), and April 15, 2008 (Stormwater Treatment Strategy Development – BMP Selection Tool).

[81] See also Memos from Ronan Igloria, HDR (Henningson, Durham, and Richardson, Inc.), to Jennifer Sellers and William Fletcher, Oregon Department of Transportation (Igloira 2007; Igloira 2008; Igloria 2008).

physiological stress, (4) behavioral avoidance, and (5) reduction in macroinvertebrate populations.

The exposure of juvenile and adult salmon and steelhead to increased turbidity and changes in substrate character from sediment generated by the proposed action is reasonably certain to elicit significant responses from a relatively small number of salmon and steelhead occupying Camp Creek, downstream of the proposed development. Chinook salmon and steelhead would likely respond to the increased suspended sediment by attempting to move to locations with lower concentrations of fine sediment. Failure to avoid increased suspended sediment is likely to result in gill irritation or abrasion, which can reduce respiratory efficiency or lead to infection, and a reduction in juvenile feeding efficiency due to reduced visibility. Compromised gill function is likely to increase juvenile mortality. Survival of eggs may be reduced for some years in some limited areas that are downstream of construction sites if sufficient fine sediment is deposited to reduce the availability of interstitial space and impede delivery of sufficient oxygen to incubating embryos until natural scouring effects restore the preferred sediment distribution size.

An increase in turbidity from suspension of fine sediments can adversely affect fish and filter-feeding macro-invertebrates downstream from the project site. At moderate levels, turbidity has the potential to reduce primary and secondary productivity; at higher levels, turbidity may interfere with feeding and may injure and even kill both juvenile and adult fish (Berg and Northcote 1985, Spence et al. 1996). However, Bjornn and Reiser (1991) found that adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that may be experienced during storm and snowmelt runoff episodes.

Exposure duration is a critical determinant of the occurrence and magnitude of physical or behavioral effects caused by turbidity (Newcombe and Jensen 1996). Salmonids have evolved in systems that periodically experience short-term pulses (days to weeks) of high suspended sediment loads, often associated with flood events, and are adapted to such seasonal high pulse exposures. However, research indicates that chronic exposure can cause physiological stress responses that can increase maintenance energy and reduce feeding and growth (Servizi and Martens 1991). In a review of 80 published reports of fish responses to suspended sediment in streams and estuaries, Newcombe and Jensen (1996) documented increasing severity of ill effects with increases in dose (concentration multiplied by exposure duration).

Migrating and spawning adult salmon and steelhead, and rearing and migrating juveniles could be exposed to increased suspended sediment. Effects from suspended sediment are likely to be small on incubating eggs and pre-emergent fry. This is because BMPs for timber harvest, timber hauling, and road work will minimize the amount of sediment reaching streams.

Rearing and migrating juveniles will likely be affected; however, as habitat for these life stages overlaps with the effects from suspended sediment. These negative effects would be limited in duration, lasting several months during the wet season which overlaps with spawning and egg incubation. Although increased suspended sediment would cause interruption of essential behavior, it would not likely reach levels sufficient to kill or permanently injure juvenile and adult salmon and steelhead.

Increased Stream Temperatures

Juvenile salmon and steelhead will be exposed to a very small increase in stream temperatures from tree removal for construction of the development, typically in July and August. Increases in stream temperature can increase the risk of reduced growth, reduced competitive success of juveniles in relation to non-salmonid fish, increased disease virulence, and reduced disease resistance (Reeves et al. 1987, McCullough et al. 2001, Marine 1992, Marine and Cech 2004). Although there may be a very small, localized increase in stream temperature from the removal of trees, there will not likely be any adverse effects to LFH. This is because any increase of stream temperature on Camp Creek at the project site will attenuate by the time it reaches LFH in Camp Creek further downstream.

Increased Chemical Contaminants

The runoff generated from impervious surfaces will deliver a wide variety of pollutants to the tributary to Camp Creek, such as nutrients, metals, and petroleum-related compounds (Buckler and Granato 1999; Colman et al. 2001; Driscoll et al. 1990; Kayhanian et al. 2003). These ubiquitous pollutants are a source of potent adverse effects to salmon and steelhead, even at ambient levels (Hecht et al. 2007; Johnson et al. 2007; Loge et al. 2006; Sandahl et al. 2007; Spromberg and Meador 2006), and are among the identified threats to sturgeon. Aquatic contaminants often travel long distances in solution or attached to suspended sediments, or gather in sediments until they are mobilized and transported by the next high flow (Alpers et al. 2000b; Alpers et al. 2000a; Anderson et al. 1996). These contaminants also accumulate in the prey and tissues of juvenile salmon where, depending on the level of exposure, they cause a variety of lethal and sublethal effects on salmon and steelhead, including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Fresh et al. 2005; Hecht et al. 2007; Lower Columbia River Estuary Partnership 2007). Although these effects will be most evident in Camp Creek, most impacts will attenuate as contaminants move downstream into the Zigzag, Sandy, and ultimately the Columbia River.

2.5.3 Effects on Critical Habitat

Designated critical habitat within the action area for salmon and steelhead considered in this opinion consists of freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors and their essential PBFs as listed below. The effects of the proposed action on these features are summarized as a subset of the habitat-related effects of the action that were discussed more fully above. In addition, the effects on Critical Habitat are separated by LCR species, and all other species considered in this Opinion. This is because LCR Chinook salmon, LCR coho salmon, and LCR steelhead are in close proximity to the Government Camp parcel, whereas the remainder of the species considered in this Opinion, are located a longer distance from the Government Camp parcel in the Zigzag River, Sandy River, and Columbia River.

LCR Chinook salmon, LCR coho salmon, and LCR steelhead. As stated earlier, habitat effects on LCR Chinook salmon, LCR coho salmon, and LCR steelhead include decreased in-stream wood recruitment, increased suspended sediment, and increased contaminants. The effects on Critical Habitat for these species is summarized below.

1. <u>Freshwater spawning sites</u>
    a. Substrate – Substrate embeddedness downstream of sediment generating activities described in the Suspended Sediment section is likely to result in temporary decreases in available spawning areas because embedded substrate makes it more difficult for fish to dig redds, clogs interstitial spaces, reduces intergravel velocities, and reduces dissolved oxygen concentrations in redds.
    b. Water quality – Water quality will be temporarily and locally degraded by increases in suspended sediment from construction of the site. We described the sediment effects in the Freshwater Spawning-Substrate section above. There will be a long-term decrease in water quality from stormwater inputs from impervious surfaces.
    c. Water quantity – Water quantity will be temporarily increased from stormwater inputs from impervious surfaces. The stormwater treatment design criteria will limit increases in peak flow. Therefore, only a very small localized effect is expected near the Government Camp development. This increase in peak flow will not be measureable as it travels downstream because it will join additional stream confluences and the effect will become absorbed in those greater flows.

2. <u>Freshwater rearing sites</u>
    a. Floodplain connectivity – The proposed action will cause a minor, long-term effect on floodplain connectivity from increased compaction, and riparian disturbance.
    b. Forage – Increases in suspended sediment from construction of the development, and increases in chemical contamination will cause minor reductions in the production of macroinvertebrates.
    c. Natural cover – Reductions in wood recruitment will be minor. The 150-foot buffer will provide the majority of available wood recruitment to the tributary to Camp Creek.
    d. Water quality – Same as described in Freshwater spawning.
    e. Water quantity – Same as described in Freshwater spawning.

3. <u>Freshwater migration corridors</u>
    a. Free of artificial obstruction – Delays in adult upstream passage from suspended sediment are unlikely to occur because adults are highly mobile with the ability to avoid these localized and temporary effects. Similarly, out-migrating juveniles are also likely to avoid localized and temporary water quality degradation events with only a slight delay in migration due to their mobility.
    b. Natural cover – Same as described in Freshwater rearing.
    c. Water quality – Same as described in Freshwater spawning.
    d. Water quantity – Same as described in Freshwater spawning.

UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, OC coho salmon, SONCC coho salmon, SR sockeye salmon, UWR steelhead, MCR steelhead, UCR steelhead, SRB

steelhead, southern DPS green sturgeon, and southern DPS eulachon. As stated earlier, the only habitat related effects on these species, will include increased contaminants from stormwater input. The effects on Critical Habitat for these species is summarized below.

4. Freshwater spawning sites
    a. Substrate – No effect.
    b. Water quality –There will be a long-term, minor decrease in water quality from stormwater inputs from impervious surfaces.
    c. Water quantity – No effect.

5. Freshwater rearing sites
    a. Floodplain connectivity – No effect.
    b. Forage –Increases in chemical contamination will cause minor reductions in the production of macroinvertebrates.
    c. Natural cover – No effect.
    d. Water quality – Same as described in Freshwater spawning.
    e. Water quantity – No effect.

6. Freshwater migration corridors
    a. Free of artificial obstruction – No effect.
    b. Natural cover – No effect.
    c. Water quality – Same as described in Freshwater spawning.
    d. Water quantity – No effect.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

The contribution of non-Federal activities to the current condition of ESA-listed species and designated critical habitats within the action area was described in the Status of the Species and Critical Habitats and Environmental Baseline sections, above. Among those activities were agriculture, forest management, road construction, urbanization, water development, and river restoration. Those actions were driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of social groups dedicated to the river restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

Resource-based industries caused many long-lasting environmental changes that harmed ESA-listed species and their critical habitats, such as state-wide loss or degradation of stream channel morphology, spawning substrates, instream roughness and cover, estuarine rearing habitats, wetlands, riparian areas, water quality (*e.g.*, temperature, sediment, dissolved oxygen, contaminants), fish passage, and habitat refugia. Those changes reduced the ability of populations of ESA-listed species to sustain themselves in the natural environment by altering or interfering with their behavior in ways that reduce their survival throughout their life cycle. The environmental changes also reduced the quality and function of critical habitat PBFs that are necessary for successful spawning, production of offspring, and migratory access necessary for adult fish to swim upstream to reach spawning areas and for juvenile fish to proceed downstream and reach the ocean. Without those features, the species cannot successfully spawn and produce offspring. As noted above, however, the declining level of resource-based industrial activity and rapidly rising industry standards for resource protection are likely to reduce the intensity and severity of those impacts in the future.

The economic and environmental significance of natural resource-based economy is currently declining in absolute terms and relative to a newer economy based on mixed manufacturing and marketing with an emphasis on high technology (Brown 2011). Nonetheless, resource-based industries are likely to continue to have an influence on environmental conditions within the action area for the indefinite future. However, over time those industries have adopted management practices that avoid or reduce many of their most harmful impacts, as is evidenced by the extensive conservation measures included with the proposed action, but which were unknown or in uncommon use until even a few years ago.

While natural resource extraction within the action area may be declining, general resource demands are increasing with growth in the size and standard of living of the local and regional human population (Metro 2010, Metro 2011). Population growth is a good proxy for multiple, dispersed activities and provides the best estimate of general resource demands because as local human populations grow, so does the overall consumption of local and regional natural resources. Between 2000 and 2010, the combined population of Oregon and Washington grew from 9.3 to 10.5 million, an increase of approximately 13.3%. Washington grew somewhat faster than Oregon, 14.1% and 12.0%, respectively (U.S. Census Bureau 2010). By 2020, the population of Oregon and Washington is projected to grow to 11.8 million (Oregon Office of Economic Analysis 2011, Washington Office of Financial Management 2010). Most of the population centers in Oregon and Washington occur west of the Cascade Mountains. The NMFS assumes that future private and state actions will continue within the action areas, increasing as population rises.

The most common private activity likely to occur in the USFS portion of the action area addressed by this consultation is unmanaged recreation. Although the USFS manages recreational activities to some degree (*i.e.,* campgrounds, trailheads, off-road-vehicle trails), a considerable amount of dispersed unmanaged recreation occurs. Expected impacts to salmon and steelhead from this type of recreation include minor releases of suspended sediment, impacts to water quality, short-term barriers to fish movement, and minor changes to habitat structures. Streambanks, riparian vegetation, and spawning redds can be disturbed wherever human use is concentrated.

Recreational fishing within the action area is expected to continue to be subject to ODFW regulations. The level of take of ESA-listed salmon and steelhead within the action area from angling is unknown, but is expected to remain at current levels. Most streams within the action area closed to harvest of salmon and steelhead and are subject to catch-and-release restrictions for juvenile salmonids.

In the larger action area from stormwater inputs, the adverse effects of non-Federal actions stimulated by general resource demands are likely to continue in the future driven by changes in human population density and standards of living. These effects are likely to continue to a similar or reduced extent in the rural areas. Oregon's land use laws and progressive policies related to long-range planning will help to limit those impacts by ensuring that concern for a healthy economy that generates jobs and business opportunities is balanced by concern for protection of farms, forests, rivers, streams and natural areas (Metro 2000; Metro 2008; Metro 2011). In addition to careful land use planning to minimize adverse environmental impacts, larger population centers may also partly offset the adverse effects of their growing resource demands with more river restoration projects designed to provide ecosystem-based cultural amenities, although the geographic distribution of those actions, and therefore any benefits to ESA-listed species or critical habitats, may occur far from the centers of human populations.

Similarly, demand for cultural and aesthetic amenities continues to grow with human population, and is reflected in decades of concentrated effort by Tribes, states, and local communities to restore an environment that supports flourishing wildlife populations, including populations of species that are now ESA-listed (CRITFC 1995; NWPCC 2012; OWEB 2011). Reduced economic dependence on traditional resource-based industries has been associated with growing public appreciation for the economic benefits of river restoration, and growing demand for the cultural amenities that river restoration provides. Thus, many non-Federal actions have become responsive to the recovery needs of ESA-listed species. Those actions included efforts to ensure that resource-based industries adopt improved practices to avoid, minimize, or offset their adverse impacts. Similarly, many actions are focused on completion of river restoration projects specifically designed to broadly reverse the major factors now limiting the survival of ESA-listed species at all stages of their life cycle. Those actions have improved the availability and quality of estuarine and nearshore habitats, floodplain connectivity, channel structure and complexity, riparian areas and in-stream wood recruitment, stream substrates, stream flow, water quality, and fish passage. In this way, the goal of ESA-listed species recovery has become institutionalized as a common and accepted part of the economic and environmental culture. We expect this trend to continue into the future as awareness of environmental and at-risk species issues increases among the general public.

It is not possible to predict the future intensity of specific non-Federal actions related to resource-based industries at this large scale due to uncertainties about the economy, funding levels for restoration actions, and individual investment decisions. However, the adverse effects of resource-based industries in the action area are likely to continue in the future, although their net adverse effect is likely to decline slowly as beneficial effects spread from the adoption of industry-wide standards for more protective management practices. These effects, both negative and positive, will be expressed most strongly in rural areas where these industries occur, and therefore somewhat in contrast to human population density. The future effects of river restoration are also unpredictable for the same reasons, but their net beneficial effects may grow with the increased sophistication and size of projects completed and the additive effects of completing multiple projects in some watersheds.

In summary, resource-based activities such as timber harvest, agriculture, mining, shipping, and energy development are likely to continue to exert an influence on the quality of freshwater and estuarine habitat in the action area. The intensity of this influence is difficult to predict and is dependent on many social and economic factors. However, the adoption of industry-wide standards to reduce environmental impacts and the shift away from resource extraction to a mixed manufacturing and technology based economy should result in a gradual decrease in influence over time. In contrast, the population of Oregon is expected to increase in the next several decades with a corresponding increase in natural resource consumption. Additional residential and commercial development and a general increase in human activities are expected to cause localized degradation of freshwater and estuarine habitat. Interest in restoration activities is also increasing as is environmental awareness among the public. This will lead to localized improvements to freshwater and estuarine habitat. When considered together, these cumulative effects are likely to have a small negative effect on salmon and steelhead population abundance, productivity, and some short-term negative effects on spatial structure. Similarly, the condition of critical habitat PBFs will be slightly degraded by the cumulative effects.

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

The proposed action is the transfer of land between the USFS and Meadows, and Meadows' subsequent development of the Government Camp parcel. In this document, we broke the Action Area and Effects Analysis into two parts: The construction of the Government Camp parcel, and the effects from construction; and the larger Action Area from the Government Camp parcel to the mouth of the Pacific Ocean from stormwater inputs.

Effects to Species.

Government Camp Parcel

LCR Chinook Salmon. The USFS' proposed action would affect the Sandy River population of LCR Chinook salmon. The Sandy River population is a core, genetic legacy population, and has a Moderate persistence probability rating. The recovery plan target for this population is to increase the persistence probability to High (NMFS 2013a).

LCR coho salmon. The USFS' proposed action would affect the Sandy River population of LCR coho salmon. The Sandy River population has a Very Low persistence probability rating. The recovery plan target for this population is to increase the persistence probability to High (NMFS 2013a).

LCR steelhead. The USFS' proposed action would affect the Sandy River population of LCR steelhead. The Sandy River population is a core population with a Low persistence probability rating. The recovery plan target for this population is to increase the persistence probability to Very High (NMFS 2013a).

The environmental baseline is degraded by natural disturbances such as wildfires, forest insect and disease outbreaks, landslides, glacial debris flows, and floods. The watersheds on the MHNF have also been impacted by a history of human-caused disturbances, such as logging, road construction, hydro-power development, irrigation and municipal water diversions, and wildfire suppression. This history is reflected in the condition rating for the various habitat indicators (Table 24, above).

Although LCR Chinook salmon, LCR coho salmon, and LCR steelhead are affected by these limiting factors, Federal lands managed under the NWFP have shown an overall improvement in aquatic ecosystems over the past 20 years (Reeves et al. 2018). These improvements include a diversity and complexity of watershed features; spatial and temporal connectivity within and between watersheds; physical integrity; water quality; sediment input storage, and transport; instream flows (e.g., both peak and low flows); floodplain inundation; riparian plant species composition and structural diversity; and habitat to support well-distributed populations of native plant, invertebrate, and vertebrate aquatic-and riparian-dependent species (Reeves et al. 2018).

Cumulative adverse effects on LCR Chinook salmon, LCR coho salmon, and LCR steelhead in the action area would continue from unmanaged recreation, wildfire suppression, and urbanization. As population continues to grow in and surrounding the action area, so does the overall consumption of local and regional natural resources. The NMFS assumes that future private and state actions would continue within the action areas, increasing as population rises. Because of this, adverse effects on LCR Chinook salmon, LCR coho salmon, and LCR steelhead would likely continue from these cumulative effects.

Effects from the construction of the Government Camp parcel include increases in suspended sediment from earthwork during construction, and decreased in-stream wood recruitment from removing trees in the riparian area. We do not expect any significant aggregate or synergistic effects of the development of the Government Camp parcel. This is because the effects of the proposed action will be minimized by providing a 150-foot buffer on Camp Creek. In addition, the development is small compared to the habitat available to the LCR Chinook population, LCR coho salmon, and LCR steelhead.

The proposed action is likely to cause a slight decrease in the rate of egg and fry survival, and injury in juveniles and adults because of increased suspended sediment from construction; and decreased in-stream wood recruitment from removing trees in the riparian area. However, these effects are not expected to cause a biologically meaningful effect at the species scale. This is due to the relatively small size of the proposed development. Because of this, there will likely be only a small number of fish affected, and thus will not affect the population level. This is because the area affected is a very small portion of habitat available to the populations. In addition, monitoring under the NWFP is showing an overall improvement in habitat conditions in the action area. Therefore, the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of LCR Chinook salmon, LCR coho salmon, and LCR steelhead even when combined with a degraded environmental baseline and additional pressure from cumulative effects, and climate change.

Government Camp Parcel to the Pacific Ocean

Increases in contaminants from stormwater input significantly increase the size of the action area from the project site at Camp Creek downstream to the Columbia River, and out to the mouth of the Pacific Ocean. Because this is such a large area, all populations of the 15 species discussed in the Rangewide Status of the Species and Critical Habitat section are included. The status of these populations vary in abundance and productivity, diversity, spatial structure, and overall extinction risk.

The environmental baseline is degraded by the development of hydropower and water storage projects within the Columbia River basin; predation from fish, birds, mammals, and marine mammals; and contaminant inputs from stormwater runoff, agriculture, herbicides and pesticides.

Although species considered in this opinion are affected by these limiting factors, the Corps, BPA, NOAA Restoration Center, and USFWS have also consulted on large restoration programs that consist of actions designed to address species limiting factors or make contributions that would aid in species recovery. Restoration actions may have short-term adverse effects, but generally result in long-term improvements to habitat condition and population abundance, productivity, and spatial structure. After going through consultation, many ongoing actions, such as stormwater facilities, roads, culverts, bridges and utility lines, have less impact on listed salmon and steelhead.

Cumulative adverse effects on species considered in the opinion would be generated by general resource demands, which are likely to continue in the future driven by changes in human population density and standards of living. These effects are likely to continue to a similar or reduced extent in the rural areas. Oregon's land use laws and progressive policies related to long-range planning will help to limit those impacts by ensuring that concern for a healthy economy that generates jobs and business opportunities is balanced by concern for protection of farms, forests, rivers, streams and natural areas (Metro 2000; Metro 2008; Metro 2011). In addition to careful land use planning to minimize adverse environmental impacts, larger population centers may also partly offset the adverse effects of their growing resource demands with more river restoration projects designed to provide ecosystem-based cultural amenities, although the geographic distribution of those actions, and therefore any benefits to ESA-listed species or critical habitats, may occur far from the centers of human populations.

Effects from the development of the Government Camp parcel include increases in stormwater inputs from the construction of new impervious surfaces. Although there will be inputs from stormwater, the proposed treatment methods provide a high level of removing many of the contaminants that affect ESA-listed fish. The effects of the proposed action will be minimized because Meadows will treat stormwater to SLOPES V STU or Clackamas County/WES stormwater standards, whichever element is more stringent. In addition, the effects of the development are small compared to the available habitat of populations considered in this opinion.

The proposed action is likely to cause a slight decrease in the rate of egg and fry survival, and injury in juveniles and adults because of increased contaminants from stormwater inputs. However, these effects are not expected to cause a biologically meaningful effect at the species scale. This is due to the relatively small size of the proposed development. Because of this, there will likely be only a small number of fish affected, and thus will not affect the population level. This is because the area affected is a very small portion of habitat available to any one population. In addition, many ongoing actions, such as stormwater facilities, roads, culverts, bridges and utility lines, have been adjusted to have less impact on listed salmon and steelhead, as described in the Environmental Baseline section. Therefore, the proposed action is not likely to appreciably reduce the likelihood of survival and recovery of species considered in this opinion, even when combined with a degraded environmental baseline and additional pressure from cumulative effects, and climate change.

Effects to Critical Habitat.

Government Camp Parcel

LCR Chinook Salmon. The Zigzag River, and Mid-Sandy River watersheds are designated as critical habitat, and used by LCR Chinook salmon. The CHART rated the Zigzag River watershed critical habitat PBF conditions as "fair to good", and the Mid-Sandy River watershed critical habitat PBF conditions as "fair to poor" for LCR Chinook salmon

LCR Coho Salmon. The Zigzag River, and Mid-Sandy watersheds are designated as critical habitat, and used by LCR coho salmon. The CHART rated the Zigzag River watershed Conservation Value as "high", and the Mid-Sandy River watershed Conservation value as "medium" for LCR coho salmon.

LCR Steelhead. The Zigzag River watershed is designated as critical habitat, and used by LCR steelhead. The CHART rated the Zigzag River watershed critical habitat PBF conditions as "fair to good".

Climate change is likely to adversely affect the overall conservation value of LCR Chinook salmon, LCR coho salmon, and LCR steelhead designated critical habitats. The adverse effects from development of the Government Camp parcel on freshwater spawning habitat include an increase in substrate embeddedness, a decrease in water quality from suspended sediment, and stormwater inputs, and a temporary increase in water quantity from stormwater inputs. In freshwater rearing sites, there will be a very small, localized decrease in floodplain connectivity, a decrease of water quality from temporary increases in suspended sediment, and stormwater inputs in forage habitat, a small decrease of woody material on natural cover, and a temporary increase in water quantity from stormwater inputs. The adverse effects on freshwater migration corridors include a temporary delay in migration from increased suspended sediment, increased stormwater inputs, a small decrease in woody material on natural cover, and a small increase in peak flow. The magnitude and severity of these effects will be relatively small, compared to the available critical habitat for these species. The effects of decreased water quality will last for years to decades and will overlap with the effects of climate change listed above. However, the proposed action would unlikely exacerbate the effects of climate change in the action area. This is because the proposed Project Design Criteria (PDCs) will minimize the effects of the proposed action to the stream reach scale.

The environmental baseline is degraded by a history of human-caused disturbances, such as logging, road construction, hydro-power development, irrigation and municipal water diversions, and wildfire suppression. Each of these activities has contributed to a myriad of interrelated factors for the decline in quality and function of critical habitat PBFs essential for the conservation of LCR Chinook salmon, LCR coho salmon, and LCR steelhead. Limiting factors for populations of LCR Chinook salmon affected by the proposed action include reduced habitat complexity and water quality. Although we identify a myriad of factors for the reduced quality and function of critical habitat in the action area, Federal lands managed under the NWFP amendment over the last 20 years show an overall improvement in aquatic ecosystems (Reeves et al. 2018). These improvements include an increase in diversity and complexity of watershed features; spatial and temporal connectivity within and between watersheds; physical integrity; water quality; sediment input storage, and transport; instream flows (e.g., both peak and low flows); floodplain inundation; riparian plant species composition and structural diversity; and habitat to support well-distributed populations of native plant, invertebrate, and vertebrate aquatic-and riparian-dependent species (Reeves et al. 2018).

Adverse effects to the quality and function of critical habitat PBFs affected by this action would be minor to moderate intensity in the action area due to the small to moderate magnitude of suspended and depositional sediment, increased contaminants from stormwater input, and minor decrease of in-stream woody material likely to occur. However, at the designation level, the effects to critical habitat PBFs are small. The effects would be spatially and temporally separated throughout the action area such that there is little to no spatial overlap of effects from different projects in the action area. In addition, monitoring under the NWFP amendment is showing an overall improvement in habitat conditions in the action area. Because of this, the effects of the proposed action would not reduce the quality and function of the critical habitat features and their ability to conserve LCR Chinook salmon, LCR coho salmon, and LCR steelhead in the action area.

Cumulative adverse effects on LCR Chinook salmon, LCR coho salmon, and LCR steelhead critical habitat would continue from unmanaged recreation, wildfire suppression, and urbanization. As population continues to grow in and surrounding the action area, so does the overall consumption of local and regional natural resources. The NMFS assumes that future private and state actions would continue within the action area, increasing as population rises.

The effects of the proposed action, when added to the environmental baseline, cumulative effects, and status of LCR Chinook salmon, LCR coho salmon, and LCR steelhead critical habitat will not appreciably reduce the quality and function of critical habitat in the action area. Therefore, the action will not impair the ability of this critical habitat to play its intended conservation role of supporting populations of LCR Chinook salmon, LCR coho salmon, and LCR steelhead in the action area.

Government Camp Parcel to the Pacific Ocean

Because of stormwater inputs, the designated critical habitats are very large, and diverse for UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, OC coho salmon, SONCC coho salmon, SR sockeye salmon, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead, southern DPS green sturgeon, and southern DPS eulachon. PBFs vary in these watersheds from “poor to excellent”.

Climate change is likely to adversely affect the overall conservation value of designated critical habitats for these species. The only adverse effects on these species from the Government Camp development is stormwater inputs. These effects include a minor, long-term decrease in water quality on freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors. There will also be a minor, long-term reduction in forage in freshwater rearing sites from stormwater inputs. The magnitude and severity of these effects will be relatively small, compared to the available critical habitats for these species. The effects of decreased water quality will last for years to decades and will overlap with the effects of climate change listed above. However, the proposed action would unlikely exacerbate the effects of climate change in the action area. This is because the proposed PDCs will minimize the effects of the proposed action to the stream reach scale.

The environmental baseline in the action area is widely variable, and does not fully meet the biological requirements of individual fish due to the presence of impaired fish passage, floodplain fill, streambank degradation, or degraded riparian conditions. Similarly, it is likely that the environmental baseline is also not meeting the biological requirements of individual fish of ESA-listed species at sites where projects will occur due to one or more impaired aquatic habitat functions. However, the quality of critical habitat at those sites is likely to improve due to completion of the projects.

The cumulative effects of state and private actions that are reasonably certain to occur within the action area are also variable across the action area. In urban areas there will be continued population growth, but improvements in some redevelopment practices will begin to improve negative baseline conditions in those areas. Similarly, some agricultural and forestry practices in rural areas are also less likely to adversely affect ESA-listed fish species compared to past practices. Federal efforts to improve aquatic habitat conditions in the State of Oregon action area are also likely to gradually improve habitat conditions in some areas.

The effects of the proposed action, when added to the environmental baseline, cumulative effects, and status of critical habitats for these species will not appreciably reduce the quality and function of critical habitat in the action area. Therefore, the action will not impair the ability of this critical habitat to play its intended conservation role of supporting populations of UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, OC coho salmon, SONCC coho salmon, SR sockeye salmon, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead, southern DPS green sturgeon, and southern DPS eulachon in the action area.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of LCR Chinook salmon, UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, OC coho salmon, SONCC coho salmon, SR sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead, southern DPS green sturgeon, and southern DPS eulachon, or destroy or adversely modify their designated critical habitat.

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

- Increase in contaminants from stormwater input.
- Increase in suspended sediment from construction of the development.
- Decrease of instream wood recruitment from removal of trees in the riparian area.

The proposed action is likely to result in the following types of incidental take for LCR Chinook salmon, LCR coho salmon, and LCR steelhead

Adults

- Harm (injuries, reduced reproductive success) due to increased suspended sediment, and decreased in-stream wood recruitment.

Juveniles

- Harm (injuries, impairment of essential migration and feeding behaviors) due to increased suspended sediment, and decreased in-stream wood recruitment.

Incubating fry

- Harm (deaths, injuries) due to increased suspended sediment, and decreased in-stream wood recruitment.

The proposed action is also likely to result in the following types of incidental take for LCR Chinook salmon, UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, OC coho salmon, SONCC coho salmon, SR sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead, southern DPS green sturgeon, and southern DPS eulachon:

Adults

- Harm (injuries, reduced reproductive success) due to increased contaminants from stormwater input.

Juveniles

- Harm (injuries, impairment of essential migration and feeding behaviors) due to increased contaminants from stormwater input.

Incubating fry

- Harm (injuries) due to increased contaminants from stormwater input.

Harm due to habitat-related effects

Take caused by the habitat-related effects for this action cannot be accurately quantified as a number of ESA-listed fish because the distribution and abundance of fish that occur within the action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. Additionally, there is no practicable means to measure, or observe harm to the number of fish exposed to stormwater inputs, increased suspended sediment, and decreased in-stream wood recruitment because fish will move in and out of an affected area over the period of time during which these effects will occur (annually) and harm to these fish is not necessarily visible. In such circumstances, NMFS cannot provide an amount of take that would be caused by the proposed action and instead uses indicators of the extent of take that will serve as surrogates for incidental take. Each of these surrogates is proportionally related to the numbers of fish expected to be taken, is quantifiable and measurable, and may be effectively monitored, and thus will serve as a meaningful reinitiation trigger.

Construction-related disturbance of upland and wetland areas. The best available indicator for the extent of take caused due to construction-related disturbance of upland and wetland areas during road, culvert, bridge, and utility line projects, is an increase in visible suspended sediment. This variable is proportional to the water quality impairment those actions will cause, including increased sediment, temperature, and contaminants, and reduced dissolved oxygen. NMFS assumes that an increase in sediment will be visible in the immediate vicinity of the project area and for a distance downstream, and the distance that increased sediment will be visible is proportional both to the size of the disturbance and to the width of the wetted stream (Rosetta 2005). Also, a turbidity flux may be greater at project sites that are subject to tidal or coastal scour.

The extent of take will be exceeded if the turbidity plume generated by construction activities is visible above background levels, about a 10% increase in natural stream turbidity, downstream from the project area source as follows: A visible increase in suspended sediment (as estimated using turbidity measurements, as described below) 50 feet from the project area in streams that are 30 feet wide or less, or 100 feet from the project area for streams between 30 and 100 feet wide. If monitoring or inspections show that the pollution controls are ineffective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary.

Stormwater runoff. The extent of take will be exceeded if the stormwater facility inspection, maintenance, and operation standards are not completed or attained because those variables will determine whether the stormwater treatment system continues to reduce the concentration of pollutants in stormwater runoff as designed, and thus reflects the amount of incidental take analyzed in the opinion (Claytor and Brown 1996; Santa Clara Valley Urban Runoff Pollution Prevention Program 1999; Santa Clara Valley Urban Runoff Pollution Prevention Program 2001).

Removal of Riparian Vegetation. For harm associated with a reduction of in-stream wood recruitment, the best available indicator for the extent of take is the 150-foot riparian buffer on streams. This indicator is causally linked to the incidental take from decreased in-stream wood recruitment because the amount of take is proportional to the width of the riparian stream buffer. As the width of the riparian stream buffer decreases, amount of in-stream wood recruitment decreases, which could significantly affect ESA-listed fish.

2.9.2 Effect of the Take

In the opinion, NMFS determined the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). The proposed action includes conservation measures intended to avoid or minimize adverse effects to listed species. The reasonable and prudent measures set forth below are in addition to those conservation measures, which are anticipated to be carried out as proposed and are not repeated here.

The following measures are necessary and appropriate to minimize the impact of incidental take of listed species due to the proposed action:

1. Minimize incidental take from construction of the Government Camp parcel by ensuring that stormwater is treated with a combination of NMFS and Clackamas County/WES stormwater standards, whichever is more stringent.
2. Minimize incidental take from construction of the Government Camp parcel by maintaining 150-foot stream buffers on Camp Creek.
3. Minimize incidental take from construction of the Government Camp parcel by ensuring that turbidity increases do not exceed acceptable limits.

2.9.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant or third party complies) with the following terms and conditions. Meadows has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. To implement reasonable and prudent measure #1 (Stormwater Management), the Meadows shall submit a stormwater management plan to NMFS that confirms stormwater will be treated to SLOPES V STU (NMFS 2014)), as outlined in the proposed action "Actions Requiring Stormwater Management" Project Design Criteria (PDC) No. 36; or Clackamas County/Water Environment Services standards, whichever element provides the more stringent level of treatment. The stormwater management plan shall be submitted to NMFS at least 30-days before start of construction. This includes the following elements:

a) Each part of the stormwater system, including the catch basin and flow-through planter, must be inspected and maintained at least quarterly for the first three years, at least twice a year thereafter, and within 48-hours of a major storm event, i.e., a storm event with greater than or equal to 1.0 inch of rain during a 24-hour period (City of Portland 2008a; Valentine 2012).
b) All stormwater must drain out of the catch basin within 24-hours after rainfall ends, and out of the flow-through planter within 48-hours after rainfall ends.
c) All structural components, including inlets and outlets, must freely convey stormwater.
d) Desirable vegetation in the flow-through planter must cover at least 90% of the facility – excluding dead or stressed vegetation, dry grass or other plants, and weeds.

2. To implement reasonable and prudent measure #2 (Riparian Buffers), Meadows shall submit the design plan and as-built report to NMFS that confirms there will be a 150-foot buffers on Camp Creek, and that trails are at least 75 feet from Camp Creek.

3. To implement reasonable and prudent measure #3 (Turbidity Monitoring), Meadows shall:
   a) Take a turbidity sample using an appropriately and regularly calibrated turbidimeter, or a visual turbidity observation, every four hours when ground-disturbing work is being completed, or more often as necessary to ensure that the in-water work area is not contributing visible sediment to water, at a relatively undisturbed area approximately 100 feet upstream from the project area. Record the observation, location, and time before monitoring at the downstream point.
   b) Take a second visual observation, immediately after each upstream observation, approximately 50 feet downstream from the project area in streams that are 30 feet wide or less, or 100 feet from the project area for streams between 30 and 100 feet wide. Record the downstream observation, location, and time.
   c) Compare the upstream and downstream observations. If more turbidity or pollutants are visible downstream than upstream, mobilize work crews to repair, replace, or reinforce erosion and pollution controls as necessary, as described in the EPA Water Quality Standards, Regulation, 40 CFR 130.2). Continue to monitor every four hours.
   d) If the exceedance continues after the second monitoring interval (after 8 hours), the activity must stop until turbidity returns to background levels.

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. Maximize wood loading to Camp Creek by increasing the riparian buffer to 300 feet.

Please notify NMFS if Meadows carries out this recommendation so that we will be kept informed of actions that are intended to improve the conservation of listed species or their designated critical habitats.

2.11. Reinitiation of Consultation

This concludes formal consultation for Government Camp Land Exchange.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)]

This analysis is based, in part, on the EFH assessment provided by the USFS and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for various life-history stages of Chinook salmon as identified in the Fishery Management Plan for Pacific coast salmon (PFMC 2014).

3.2. Adverse Effects on Essential Fish Habitat

Based on information provided by the action agency and the analysis of effects presented in the ESA portion of this document, NMFS concludes that proposed action will have adverse effects on EFH designated for Pacific salmon as outlined in the Pacific Salmon Fishery Management Plan. Adverse effects of the proposed action will include sub-lethal effects from exposure to contaminants, increased suspended sediment, increased stream temperature, and decreased in-stream wood recruitment.

3.3. Essential Fish Habitat Conservation Recommendations

NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH.

1. Follow terms and conditions 1 and 2 as presented in the ESA portion of this document to minimize adverse effects to water quality and monitor/report program effects.
2. Implement the conservation recommendations presented as part of the ESA portion of this document.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, for Pacific Coast salmon.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USFS must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

The USFS must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are U.S. Forest Service. Other interested users could include Meadows. Individual copies of this opinion were provided to the U.S. Forest Service The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation, contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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