2016 5-Year Review: Summary & Evaluation of Upper Columbia River Steelhead Upper Columbia River Spring-run Chinook Salmon

National Marine Fisheries Service
West Coast Region
Portland, OR

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5-Year Review: Upper Columbia River Species

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

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Contributors
West Coast Region
(alphabetical)

Robert Anderson
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-231-2226
Robert.C.Anderson@noaa.gov

Nora Berwick
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-231-6887
Nora.Berwick@noaa.gov

Craig Busack, PhD
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-230-5412
Craig.Busack@noaa.gov

Scott Carlon
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-231-2379
Scott.Carlon@noaa.gov

Rob Clapp
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-231-2314
Robert.Clapp@noaa.gov

Mitch Dennis
510 Desmond Drive SE, Suite 103
Lacey, WA 98503-1263
360-753-9580
Mitch.Dennis@noaa.gov

Patty Dornbusch
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-230-5430
Patty.Dornbusch@noaa.gov

Shanna Dunn
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-231-2315
Shanna.Dunn@noaa.gov

Gary Fredricks
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-231-6855
Gary.Fredricks@noaa.gov

Ritchie Graves
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-231-6891
Ritchie.Graves@noaa.gov

Charlene Hurst, PhD
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-230-5409
Charlene.N.Hurst@noaa.gov

Jeromy Jording
510 Desmond Drive SE, Suite 103
Lacey, WA 98503-1263
360-753-9576
Jeromy.Jording@noaa.gov

Lynne Krasnow, PhD
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-231-2163
Lynne.Krasnow@noaa.gov

Enrique Patino
7600 Sand Point Way NE
Seattle, WA 98115-0070
206-526-4655
Enrique.Patino@noaa.gov

Rich Turner
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-736-4737
Rich.Turner@noaa.gov

Justin Yeager
304 S. Water, Suite 201
Ellensburg, WA 98926
509-962-8911x224
Justin.Yeager@noaa.gov

Northwest Fisheries Science Center (alphabetical)

Tom Cooney
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232
503-231-6888
Tom.Cooney@noaa.gov

Mike J. Ford, PhD
2725 Montlake Blvd East
East Building
Seattle, WA 98112-2097
206-860-5612
Mike.Ford@noaa.gov

Southwest Fisheries Science Center (alphabetical)

Nate Mantua
110 Shaffer Road
Santa Cruz, CA 95060
831-420-3923
Nate.Mantua@noaa.gov

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1 · General Information

1.1 Introduction

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

The ESA, under section 4(c)(2), directs the Secretary of Commerce to review the listing classification of threatened and endangered species at least once every five years. After completing this review, the Secretary must determine if any species should be: (1) removed from the list; (2) have its status changed from threatened to endangered; or (3) have its status changed from endangered to threatened. The most recent listing determinations for most salmon and steelhead occurred in 2005 and 2006. This document describes the results of the agency's 5-year status review for ESA-listed Upper Columbia River (UCR) salmon and steelhead species. These include: UCR spring-run Chinook salmon and UCR steelhead.

1.1.1 Background on salmonid listing determinations

The ESA defines species to include subspecies and distinct population segments (DPS) of vertebrate species. A species may be listed as threatened or endangered. To identify distinct population segments of salmon species we apply the "Policy on Applying the Definition of Species under the ESA to Pacific Salmon" (56 FR 58612). Under this policy we identify population groups that are "evolutionarily significant units" (ESU) within their species. We consider a group of populations to be an ESU if it is substantially reproductively isolated from other populations, and represents an important component in the evolutionary legacy of the biological species. We consider an ESU as constituting a DPS and therefore a "species" under the ESA.'

To identify DPSs of steelhead, we apply the joint U.S. Fish and Wildlife Service-National Marine Fisheries Service DPS policy (61 FR 4722) rather than the ESU policy. Under this policy, a DPS of steelhead must be discrete from other populations, and it must be significant to its taxon.

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

criteria for including hatchery stocks in ESUs and DPSs. In addition, it (1) provides direction for considering hatchery fish in extinction risk assessments of ESUs and DPSs; (2) requires that hatchery fish determined to be part of an ESU or DPS be included in any listing of the ESU or DPS; (3) affirms our commitment to conserving natural salmon and steelhead populations and the ecosystems upon which they depend; and (4) affirms our commitment to fulfilling trust and treaty obligations with regard to the harvest of some Pacific salmon and steelhead populations, consistent with the conservation and recovery of listed salmon ESUs and steelhead DPSs.

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

Because the new hatchery listing policy changed the way we considered hatchery fish in ESA listing determinations, we completed new status reviews and ESA listing determinations for West Coast salmon ESUs on June 28, 2005 (70 FR 37160), and for steelhead DPSs on January 5, 2006 (71 FR 834). On August 15, 2011, we published our status reviews and listing determinations for 11 ESUs of Pacific salmon and 6 DPSs of steelhead from the Pacific Northwest (76 FR 50448).

1.2 Methodology used to complete the review

On February 6, 2015, we announced the initiation of five-year reviews for 17 ESUs of salmon and 11 DPSs of steelhead in Oregon, California, Idaho, and Washington (80 FR 6695). We requested that the public submit new information on these species that has become available since our original listing determinations or since the species' status was last updated. In response to our request, we received information from Federal and state agencies, Native American Tribes, conservation groups, fishing groups, and individuals. We considered this information, as well as information routinely collected by our agency, to complete these five year reviews.

To complete the reviews, we first asked scientists from our Northwest and Southwest Fisheries Science Centers to collect and analyze new information about ESU and DPS viability. To evaluate viability, our scientists used the Viable Salmonid Population (VSP) concept developed by McElhany et al. (2000). The VSP concept evaluates four criteria – abundance, productivity, spatial structure, and diversity – to assess species viability. Through the application of this concept, the Science Center considered new information on the four salmon and steelhead population viability criteria. They also considered new information on ESU and DPS composition. At the end of this process, the science teams prepared reports detailing the results of their analyses (NWFSC 2015).

To further inform the reviews, we also asked salmon management biologists from our West Coast Region familiar with hatchery programs to consider new information available since the previous listing determinations. Among other things, they considered whether any hatchery

programs have ended or new hatchery programs have started any changes in the operation of existing programs, and scientific data relevant to the degree of divergence of hatchery fish from naturally spawning fish in the same area. They produced a report (Jones 2015) describing their findings. Finally, we consulted salmon management biologists from the West Coast Region who are familiar with hatchery programs, habitat conditions, hydropower operations, and harvest management. In a series of structured meetings, by geographic area, these biologists identified relevant information and provided their insights on the degree to which circumstances have changed for each listed entity.

In preparing this report, we considered the best available scientific information, including the work of the Northwest Fisheries Science Center (NWFSC 2015); the report of the regional biologists regarding hatchery programs (Jones 2015); recovery plans for the species in question; technical reports prepared in support of recovery plans for the species in question; the listing record (including designation of critical habitat and adoption of protective regulations); recent biological opinions issued for UCR steelhead and spring-run Chinook salmon; information submitted by the public and other government agencies; and the information and views provided by the geographically based management teams. The present report describes the agency's findings based on all of the information considered.

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

1.3.1 Federal Register Notice announcing initiation of this review

80 FR 6695; February 6, 2015

1.3.2 Listing history

In 1997, NMFS began listing UCR salmonid species under the ESA. By 1999, NMFS listed two species in this area as endangered, and later reclassified one as threatened (Table 1).

Table 1. Summary of the listing history under the Endangered Species Act for the Upper Columbia River salmonids.

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
Chinook Salmon (*O. tshawytscha*)	Upper Columbia River spring-run Chinook Salmon	**FR Notice:** 64 FR 14308 **Date:** 3/24/1999 **Classification:** Endangered	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 **Classification:** Endangered
Steelhead (*O. mykiss*)	Upper Columbia River Steelhead	**FR Notice:** 62 FR 43937 **Date:** 8/18/1997 **Classification:** Endangered	**FR Notice:** 71 FR 834 **Date:** 1/5/2006 **Re-classification:** Threatened

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
			FR Notice: 74 FR 42605 **Date:** 8/24/2009 **Re-classification:** Threatened

1.3.3 Associated rulemakings

The ESA requires NMFS to designate critical habitat, to the maximum extent prudent and determinable, for species it lists under the ESA. Critical habitat is defined as: (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time of listing if the agency determines that the area itself is essential for conservation. We designated critical habitat for both UCR spring-run Chinook salmon and UCR steelhead in 2005.

Section 9 of the ESA prohibits the take of species listed as endangered. The ESA defines take to mean harass, harm, pursue, hunt, shoot, wound, trap, capture, or collect, or attempt to engage in any such conduct. For threatened species, the ESA does not automatically prohibit take, but instead authorizes the agency to adopt regulations it deems necessary and advisable for species conservation including regulations that prohibit take (ESA section 4(d)). In 2000, NMFS adopted 4(d) regulations for threatened salmonids that prohibit take except in specific circumstances. On February 1, 2006, we applied these 4(d) regulations to UCR steelhead (71 FR 5178).

Table 2. Summary of rulemaking for 4(d) protective regulations and critical habitat for salmon and steelhead in the Upper Columbia River.

Salmonid Species	ESU/DPS Name	4(d) Protective Regulations	Critical Habitat Designations
Chinook Salmon (*O. tshawytscha*)	Upper Columbia River spring-run Chinook Salmon	ESA section 9 applies	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Steelhead (*O. mykiss*)	Upper Columbia River Steelhead	**FR Notice:** 71 FR 5178 **Date:** 2/1/2006	**FR notice:** 70 FR 52630 **Date:** 9/2/2005

1.3.4 Review History

Table 3 lists the numerous scientific assessments of the status of the UCR spring-run Chinook salmon and UCR steelhead DPS. These assessments include status reviews conducted by our Northwest Fisheries Science Center and technical reports prepared in support of recovery planning for these species.

Table 3. Summary of previous scientific assessments for UCR salmon and steelhead.

Salmonid Species	ESU/DPS Name	Document Citation
Chinook Salmon (*O. tshawytscha)*	Upper Columbia River spring-run Chinook Salmon	NWFSC 2015 Ford et al. 2011 ICTRT 2007a ICTRT 2007b ICTRT and Zabel 2007 Good et al. 2005 McClure et al. 2005 ICTRT 2003 NMFS 1999 Myers et al. 1998 NMFS 1998
Steelhead (*O. mykiss*)	Upper Columbia River Steelhead	NWFSC 2015 Ford et al. 2011 ICTRT 2007a ICTRT 2007b ICTRT and Zabel 2007 Good et al. 2005 McClure et al. 2005 ICTRT 2003 NMFS 1997 Busby et al. 1996

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

On June 15, 1990, NMFS issued guidelines (55 FR 24296) for assigning listing and recovery priorities. For recovery plan development, implementation, and resource allocation, we assess three criteria to determine a species' recovery priority number from 1 (high) to 12 (low): (1) magnitude of threat; (2) recovery potential; and (3) conflict with development projects or other economic activity (NMFS 2009). Table 4 lists the recovery priority numbers for the subject species, as reported in NMFS 2015a.

1.3.6 Recovery Plan or Outline

Table 4. Recovery Priority Number and Endangered Species Act Recovery Plan for UCR Spring-run Chinook salmon and UCR steelhead.

Salmonid Species	ESU/DPS Name	Recovery Priority Number	Recovery Plan/Outline
Chinook Salmon (*O. tshawytscha*)	Upper Columbia River spring-run Chinook Salmon	**5**	**Title:** Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan Available at: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/upper_columbia/upper_columbia_spring_chinook_steelhead_recovery_plan.html **Date:** 10/9/2007 **Type:** Final **FR Notice:** 72 FR 57303
Steelhead (*O. mykiss*)	Upper Columbia River Steelhead	**9**	**Title:** Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan Available at: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/upper_columbia/upper_columbia_spring_chinook_steelhead_recovery_plan.html **Date:** 10/9/2007 **Type:** Final **FR Notice:** 72 FR 57303

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2 · Review Analysis

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

2.1 Delineation of Species under the Endangered Species Act

Is the species under review a vertebrate?

ESU/DPS Name	YES	NO
Upper Columbia River spring-run Chinook Salmon	X	
Upper Columbia River Steelhead	X	

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

ESU/DPS Name	YES	NO
Upper Columbia River spring-run Chinook Salmon	X	
Upper Columbia River Steelhead	X	

Was the ESU/DPS listed prior to 1996?

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

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

In 1991, NMFS issued a policy on how the agency would delineate DPSs of Pacific salmon for listing consideration under the Endangered Species Act (ESA) (56 FR 58612). Under this policy a group of Pacific salmon populations is considered an "evolutionarily significant unit" (ESU) if it is substantially reproductively isolated from other con-specific populations, and it represents an important component in the evolutionary legacy of the biological species. The 1996 joint NMFS-Fish and Wildlife Service (FWS) Distinct Population Segment (DPS) policy (61 FR 4722) affirmed that a stock (or stocks) of Pacific salmon is considered a DPS if it represents an ESU of a biological species. Accordingly, in listing the Upper Columbia River steelhead DPS under the DPS policy in 1997, we used the joint DPS policy to delineate the DPS under the ESA.

2.1.1 Summary of relevant new information regarding the delineation of the UCR spring-run Chinook salmon ESU and the UCR steelhead DPS

ESU/DPS Composition

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

We found no new information that would justify a change in the composition of the UCR spring-run Chinook salmon ESU or the UCR steelhead DPS (NWFSC 2015).

Membership of Hatchery Programs

In preparing this report, our management biologists reviewed the available information regarding hatchery membership of this ESU and DPS (Jones 2015). They considered changes in hatchery programs that occurred since the last status review (e.g., some have been terminated while others are new) and made recommendations about the inclusion or exclusion of specific programs. They also noted any errors and omissions in the existing descriptions of hatchery population membership. NMFS intends to address any needed changes and corrections via separate rulemaking subsequent to the completion of these five-year status reviews.

UCR spring-run Chinook Salmon

The UCR spring-run Chinook salmon includes 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 subbasin). Also, spring-run Chinook salmon from six artificial propagation programs: the Twisp River Program; Chewuch River Program; Methow Program; Winthrop National Fish Hatchery Program; Chiwawa River Program; and the White River Program (79 FR 20802). We have determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (70 FR 37160).

In the Methow subbasin, the Winthrop National Fish Hatchery program, operated by the U. S. Fish and Wildlife Service, and the Methow Composite program at Methow State Fish Hatchery, operated by the WDFW, both rely on a high percentage of hatchery-origin fish for broodstock in addition to using a composite stock of natural spawners (i.e., a combination of Methow and Chewuch River fish). These practices reduce genetic differences among groups of Methow River spring-run Chinook salmon, posing a risk to diversity, as well as creating productivity risks through hatchery influenced selection. However, substantive changes have occurred in both programs, reducing risk. In both cases, program size has been reduced, resulting in an overall reduction in release goals of over 50 percent. In addition, the Winthrop program now uses returning adults from the Methow Composite program as broodstock, decreasing its divergence from the natural population. The proportion of hatchery fish on the spawning grounds is likely

to be considerably reduced in future years, both as a result of program reductions and from developing adult management efforts (Jones 2015).

In the Wenatchee Basin, the overall number of spring-run Chinook salmon released has also been reduced, but additional noteworthy changes have occurred. The effort to establish separate supplementation programs for the White River, Chiwawa River, and Nason Creek spawning aggregates has been modified as a result of the inability to collect broodstock for the three areas using a genetic classification scheme. The White River program will be phased out, and a new Nason program has begun. The Chiwawa and Nason programs will be operated according to a sliding-scale broodstock management scheme that decreases the proportion of hatchery-origin fish on the spawning grounds and increases use of natural-origin fish in the broodstock, thereby reducing the impact of the hatchery programs on productivity (Jones 2015).

UCR Steelhead

The UCR steelhead DPS includes naturally spawned anadromous O. mykiss (steelhead) originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream of the Yakima River to the U.S.-Canada border. Also, steelhead from six artificial propagation programs: the Wenatchee River Program; Wells Hatchery Program (in the Methow and Okanogan Rivers); Winthrop National Fish Hatchery Program; Omak Creek Program; and the Ringold Hatchery Program (79 FR 20802). We have determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the DPS (71 FR 834).

The Winthrop National Fish Hatchery (WNFH) program continues to use composite Methow and Okanogan natural-origin and hatchery-origin steelhead for broodstock, but is developing a Methow specific stock as part of its development as a conservation program. Research is also underway at WNFH to determine the feasibility and benefits of a 2-year old smolt program that better mimics the natural life history of Upper Columbia River steelhead. The Okanogan River program (called the Omak Creek program in the 2011 review) is increasing its use of natural-origin fish collected in the Okanogan Basin. Both these efforts should reduce productivity and diversity risk. Continued reliance on hatchery fish collected at Wells Dam could cause the Wells and Ringold programs to diverge from the conservation-oriented programs in the future. The Wenatchee steelhead program has been reduced substantially (from 400,000 to 247,300), and releases have been moved from Turtle Rock Hatchery on the Columbia River to acclimation sites within the Wenatchee Basin. Both these actions should decrease straying from this program into other populations (Jones 2015).

2.2 Recovery Criteria

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

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

ESU/DPS Name	YES	NO
Upper Columbia River spring-run Chinook Salmon	X	
Upper Columbia River Steelhead	X	

2.2.2 Adequacy of recovery criteria.

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

ESU/DPS Name	YES	NO
Upper Columbia River spring-run Chinook Salmon	X	
Upper Columbia River Steelhead	X	

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

ESU/DPS Name	YES	NO
Upper Columbia River spring-run Chinook Salmon	X	
Upper Columbia River Steelhead	X	

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

For the purposes of reproduction, salmon ESUs and steelhead DPSs typically display a metapopulation structure (Schtickzelle and Quinn 2007, McElhany et al. 2000). Rather than interbreeding as one large aggregation, ESUs and DPSs function as a group of largely independent populations separated by areas of unsuitable spawning habitat. For conservation and management purposes, it is important to identify the independent populations that make up an ESU or DPS. For recovery planning and development of recovery criteria, the Interior Columbia Technical Recovery Team (ICTRT) identified independent populations within the UCR spring-run Chinook salmon ESU and the UCR steelhead DPS, and grouped them into genetically similar major population groups (MPGs) (ICTRT 2003). Recovery criteria and strategies outlined in the 2007 Upper Columbia River Recovery Plan are targeted on achieving, at a minimum, the ICTRT (2007b) biological viability criteria for each major population grouping in the ESU/DPS.

UCR spring-run Chinook Salmon ESU

The UCR spring-run Chinook salmon includes 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 subbasin). Also, spring-run Chinook salmon from six artificial propagation programs: the Twisp River Program; Chewuch River Program; Methow Program; Winthrop National Fish Hatchery Program; Chiwawa River Program; and the White River Program (79 FR 20802; Figure 1).

Wenatchee/Methow MPG

For the Wenatchee/Methow MPG, there are three extant populations, Wenatchee River, Entiat River, Methow River, and one functionally extirpated Okanogan River population. Three populations must meet viability criteria, two of which must meet high viability criteria (ICTRT 2007b). An additional recommendation to moderate risk for an ESU with only one MPG was to require at least two populations to meet highly viable status (<1 percent extinction risk for abundance and productivity). The lowest risk scenario for the ESU would be for the two very large populations (Wenatchee and Methow) to meet highly viable status. The Entiat population cannot reach these standards due to its inherent spatial structure (ICTRT 2007b). The 2007 recovery plan requires that all spring-run Chinook salmon populations within the ESU must meet abundance/productivity criteria that represent a 5 percent extinction risk over a 100-year period (UCSRB 2007).

UCR Steelhead DPS

The UCR steelhead DPS includes naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream of the Yakima River to the U.S.-Canada border. Also, steelhead from six artificial propagation programs: the Wenatchee River Program; Wells Hatchery Program (in the Methow and Okanogan Rivers); Winthrop National Fish Hatchery Program; Omak Creek Program; and the Ringold Hatchery Program (79 FR 20802; Figure 2).

Wenatchee/Methow MPG

For the Wenatchee/Methow MPG, there are four extant populations, Wenatchee River, Entiat River, Methow River, Okanogan River, and one functionally extirpated Crab Creek population. Three populations must meet viability criteria, two of which must meet high viability criteria (ICTRT 2007b). An additional recommendation to achieve moderate risk for an ESU with only one MPG was to require at least 2 populations to meet highly viable status (<1 percent extinction risk for abundance and productivity). The lowest risk scenario for the ESU would be for the two large populations (Wenatchee and Methow) to meet highly viable status. The Entiat population and that portion of the Okanogan population below the U.S.-Canada border cannot meet high viability criteria due to their inherent spatial structure (ICTRT 2007b). The 2007 recovery plan requires that all steelhead populations, except the Crab Creek population, must meet abundance/ productivity criteria that represent a 5 percent extinction risk over a 100-year period (UCSRB 2007).

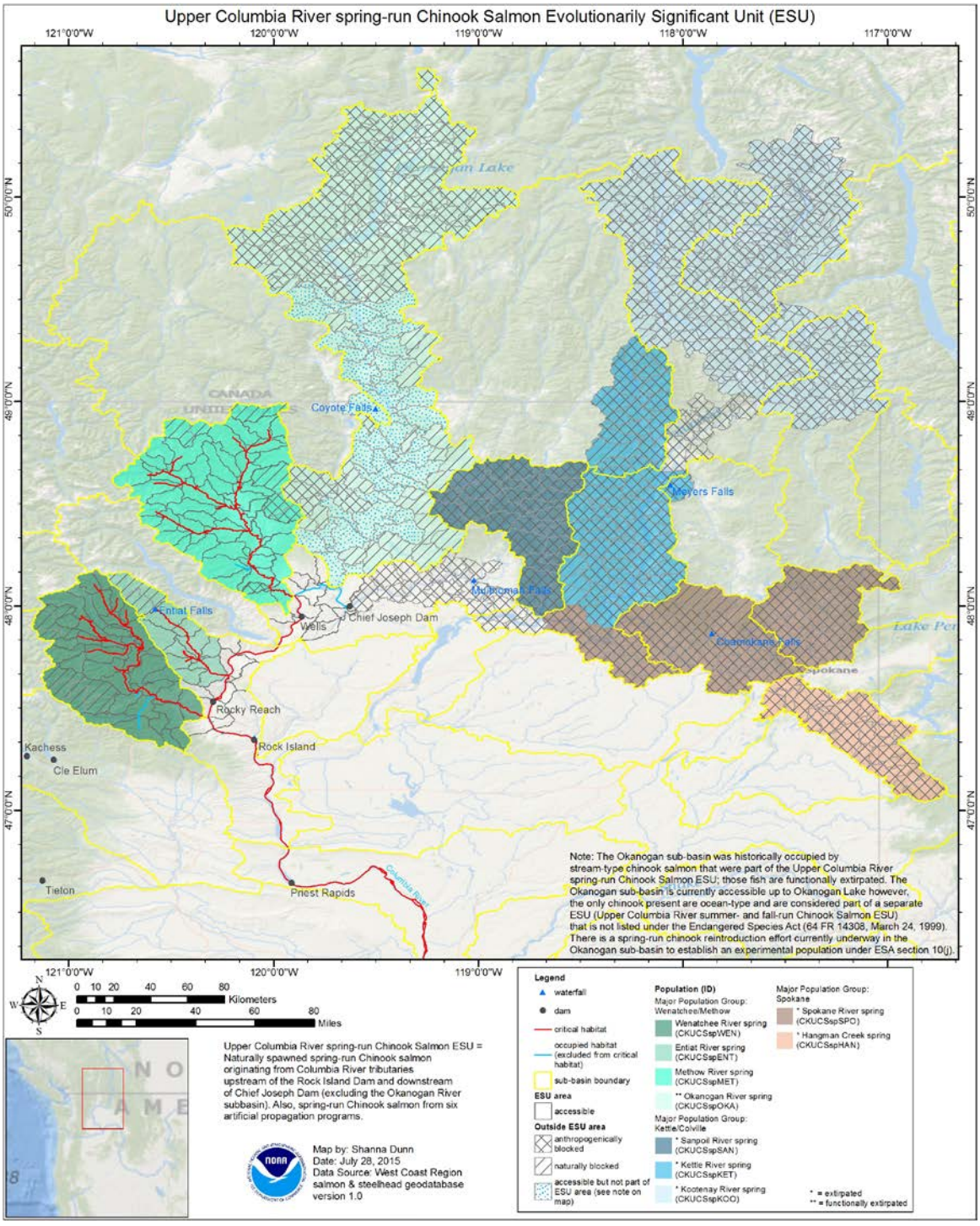

Figure 1. UCR spring-run Chinook salmon population structure[1]

[1] Figure 1 generally shows the accessible and historically accessible areas for the UCR spring-run Chinook salmon ESU. The areas displayed are consistent with the regulatory description of the composition of the UCR spring-run Chinook salmon found at 50 CFR17.11, 223.102, and 224.102. Actions outside the boundaries shown can affect this ESU. Therefore, these boundaries do not delimit the entire area that could warrant consideration in recovery planning or determining if an action may affect this ESU for the purposes of the ESA.

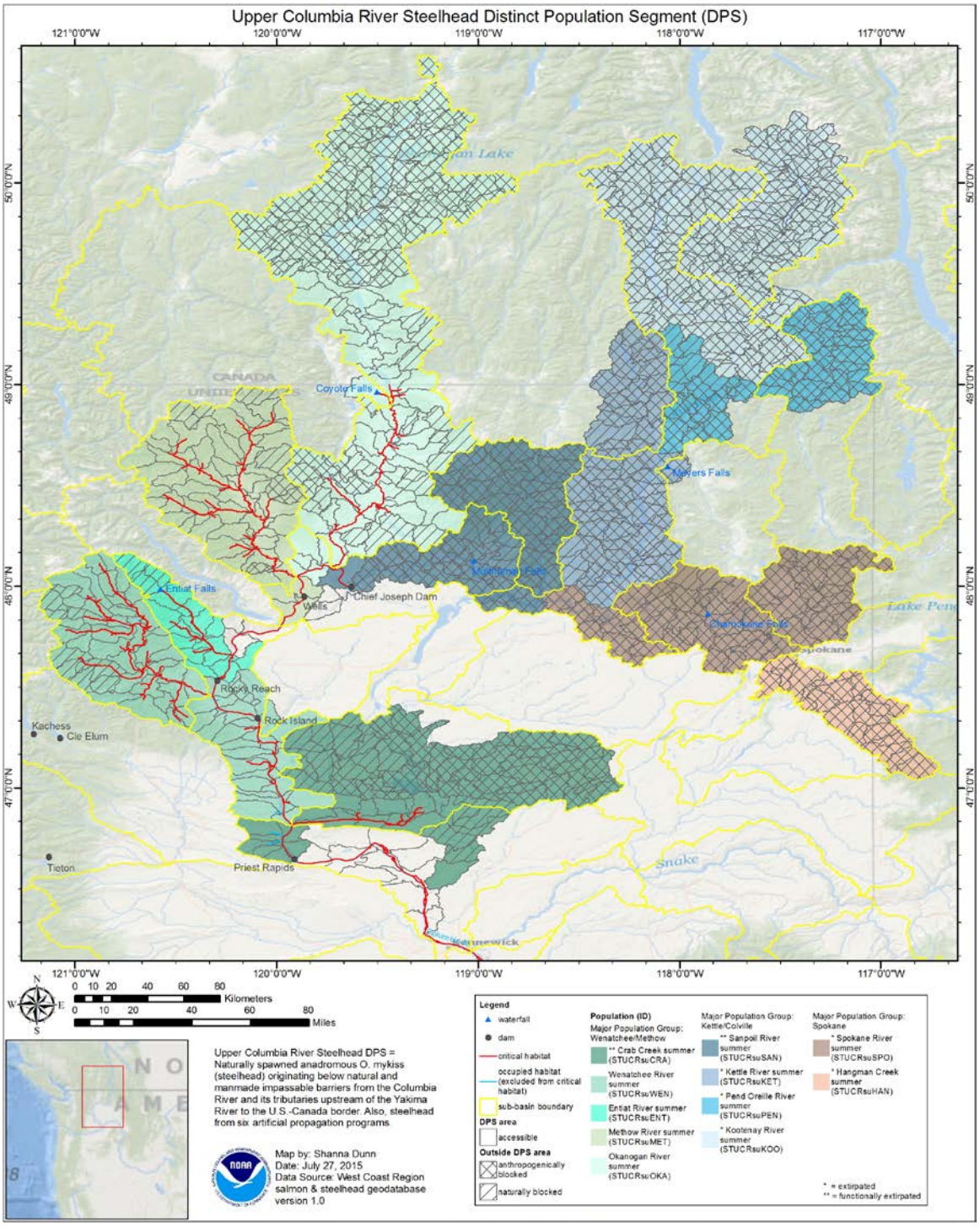

Figure 2. UCR steelhead population structure[2]

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

2.3 Updated Information and Current Species' Status

In addition to recommending the biological recovery or viability criteria adapted in the 2007 Recovery Plan (UCSRB 2007), the ICTRT also assessed the current status of each population ESU/DPS at that time (ICTRT 2007b). Each population was rated against the biological criteria identified in the recovery plan and assigned a current viability rating.

2.3.1 Analysis of Viable Salmonid Population (VSP) Criteria

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

UCR spring-run Chinook Salmon ESU

Updated Biological Risk Summary

Current estimates of natural origin spawner abundance increased relative to the levels observed in the prior review for all three extant populations, and productivities were higher for the Wenatchee and Entiat and unchanged for the Methow (NWFSC 2015). However abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Recovery Plan for all three populations. Short-term patterns in those indicators appear to be largely driven by year-to year fluctuations in survival rates in areas outside of these watersheds. All three populations continued to be rated at low risk for spatial structure but at high risk for diversity criteria. Large-scale supplementation efforts in the Methow and Wenatchee Rivers are ongoing, intended to counter short-term demographic risks given current average survival levels and the associated year-to-year variability. Under the current recovery plan, habitat protection and restoration actions are being implemented that are directed at key limiting factors. Achieving natural origin abundance and productivity levels above the threshold viability curve corresponding to five percent risk in extinction will require substantial improvements in survival and/or natural production capacity. Given the high degree of year-to-year variability in life stage survivals and the time lags resulting from the 5-year life cycle of the populations, it is not possible to detect incremental gains from habitat actions implemented to date in population level measures of adult abundance or productivity. Efforts are underway to develop life stage specific estimates of performance (survival and capacities) and to use a life cycle model framework to evaluate progress. Based on the information available for this review, the risk category for the UCR spring-run Chinook salmon ESU remains unchanged from the prior review (Ford et al. 2011). Although the status of the ESU is improved relative to measures available at the time of listing, all three populations remain at high risk (NWFSC 2015).

UCR Steelhead DPS

Updated Biological Risk Summary

Upper Columbia River steelhead populations have increased relative to the low levels observed in the 1990s, but natural origin abundance and productivity remain well below viability thresholds for three out of the four populations (NWFSC 2015). The status of the Wenatchee

River steelhead population continued to improve based on the additional years information available for this review. The abundance and productivity viability rating for the Wenatchee River exceeds the minimum threshold for five percent extinction risk. However, the overall DPS status remains unchanged from the prior review, remaining at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns. Application of the criteria for abundance/productivity results in relatively coarse scale ratings for each population. Across Interior Columbia DPSs, the populations differ in the relative changes in survival or limiting capacities that could lead to viable ratings. The required improvement to improve the abundance/productivity estimates for UCR steelhead populations is at the high end of the range for all listed Interior populations.

Given the recent changes in hatchery practices in the Wenatchee River and the potential for reduced hatchery contributions or increased spatial separation of hatchery vs. natural origin spawners, it is possible that genetic composition could trend towards patterns consistent with strong natural selection influences in the future. Ongoing genetic sampling and analysis could provide information in the future to determine if the diversity risk is abating. The proportions of hatchery-origin returns in natural spawning areas remain high across the DPS, especially in the Methow and Okanogan river populations. The improvements in natural returns in recent years largely reflect several years of relatively good natural survival in the ocean and tributary habitats. Tributary habitat actions called for in the Upper Columbia River Recovery Plan are anticipated to be implemented over the next 25 years and the benefits of some of those actions will require some time to be realized (NWFSC 2015).

2.3.2 Five-Factor Analysis

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

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

Significant habitat restoration and protection actions at the Federal, state, and local levels have been implemented to improve degraded habitat conditions and restore fish passage. While these efforts have been substantial and are expected to benefit the survival and productivity of the targeted populations, we do not yet have evidence demonstrating that improvements in habitat conditions have led to improvements in population viability. The effectiveness of habitat restoration actions and progress toward meeting the viability criteria should be/continues to be

monitored and evaluated. Generally, it takes one to five decades to demonstrate such increases in viability.

Below, we summarize information for both UCR spring-run Chinook salmon and UCR steelhead populations to evaluate **current status and trends in habitat** conditions for these two species since our last 2011 status review. We specifically address: (1) the **key emergent or ongoing habitat concerns** (threats or limiting factors) focusing on the top concerns that potentially have the biggest impact on viability; (2) **specific areas** where concerns about this ESU/DPS habitat condition remain; (3) **key protective measures and major restoration actions** leading toward achieving the recovery plan viability criteria that substantially address a key concern noted above, or that represent a noteworthy conservation strategy; (4) **key regulatory measures that are inadequate** and contributing substantially to the key concerns summarized above; (5) **recommended future actions**, including: key near-term restoration actions that would address the key concerns summarized above; projects to address monitoring and research gaps; fixes or initiatives to address inadequate regulatory mechanisms, and addressing priority habitat areas when sequencing restoration actions.

The quality and quantity of habitat from freshwater tributaries to the mainstem Columbia River, estuary, and ocean has a profound impact on the status of upper Columbia River salmon and steelhead populations. Within freshwater tributary habitat, numerous stream processes can affect the success of spawning and rearing of salmonids (UCSRB 2014a). For all populations in the upper Columbia River there have been many factors that have contributed to habitat degradation. The historical pattern of land use in the upper Columbia River basin follows a familiar pattern for basins in the Pacific Northwest including beaver trapping, mining, livestock grazing, water diversions, agriculture, and timber harvest to name a few. These factors have reduced habitat diversity, connectivity, water quantity and quality, and riparian function in many assessment units within the basin. However, some of the assessment units contain headwater areas that are in relatively pristine condition and serve as “strongholds” for listed species (UCRTT 2014).

Wenatchee River Populations

The Wenatchee River is unique among subbasins in the Upper Columbia River Region in that it supports the greatest diversity of populations and overall abundance of salmonids. The basin has many major spawning areas for both spring-run Chinook salmon and steelhead (UCRTT 2014). Both spring-run Chinook salmon and steelhead spawn in five major spawning areas. While spring-run Chinook salmon have four minor spawning areas, steelhead have 13 (ICTRT 2005).

1) Key Emergent or Ongoing Habitat Concerns

The primary habitat conditions in the Wenatchee Basin that currently limit abundance, productivity, spatial structure, and diversity of salmon and steelhead include a lack of habitat diversity and quantity, excessive sediment load, obstructions, a lack of channel stability, low flows, and high summer temperatures. Habitat diversity is affected by channel confinement, loss of floodplain connectivity and off-channel habitat, reduced quantities of large wood, and a lack of riparian vegetation. The mainstem and many of its tributaries also lack high-quality pools and

spawning areas associated with pool tail-outs. The lack of pools in many areas is probably directly related to the loss of riparian vegetation, removal of large wood, and channel confinement (UCRTT 2014). Specifically, since the previous 2010-2011 five-year status review, the most widespread ecological concerns in the subbasin (by occurrence in assessment units) are riparian condition, instream structural complexity, side channel and wetland conditions, and anthropogenic barriers (UCSRB 2014b).

2) Specific Areas of Concern

Specific areas of concern include:

- Passage conditions and upstream passage delays for adult Chinook salmon and steelhead in the Wenatchee River at Tumwater Dam and for steelhead in Icicle Creek at both the Leavenworth Fish Hatchery and the boulder field.
- Reduced flow levels and/or elevated water temperatures, particularly in Icicle River, Peshastin Creek, Chumstick Creek, and Mission Creek.
- Juvenile rearing habitat in lower tributaries and in the mainstem Wenatchee River that provide complex channel structure, floodplain connectivity, and forage.
- Impairment of tributary habitat-forming processes and functions from upland actions that influence channel structure, complexity, connectivity, and vegetation. Particularly the U.S. Forest Service (USFS) road network in the Little Wenatchee, Nason, Chiwawa, Icicle, Peshastin, Chumstick, and Mission watersheds.

3) Key Protective Measures and Major Restoration Actions

The highest priority within the Wenatchee subbasin is the protection of habitat that supports salmonid communities so that the populations are robust to environmental disturbances, can increase in abundance, and expand their range to adjacent watersheds. These high priority watersheds within the Wenatchee subbasin include the White River, Chiwawa River, and the upper and middle mainstem Wenatchee River (including Lake Wenatchee) (UCSRB 2014b).

As for major restoration actions within the Wenatchee subbasin, Trout Unlimited completed the Pioneer irrigation efficiency project that removed a side channel dam, changed a point of diversion, and improved irrigation efficiency, which improved flows in the Wenatchee River. Multiple projects have also been completed by the Yakama Nation and others in Nason Creek to remove anthropogenic features and increase juvenile rearing and habitat complexity. In the White River the Cascade Columbia Fisheries Enhancement Group and others have completed the White River wood project placing over 175 pieces of large wood (HWS 2015).

4) Key Regulatory Measures

Various federal, state, county and tribal regulatory mechanisms are in place to minimize or avoid habitat degradation caused by human use and development. Many of these mechanisms have been improved and updated in the past five years. However, the implementation and effectiveness of regulatory mechanisms has not been adequately documented. See Listing Factor

D: Adequacy & Inadequacy of Regulatory Mechanisms, and Protective Efforts in this document for details.

5) Recommended Future Actions

- Improve passage in Icicle Creek for Steelhead past the boulder field and the Leavenworth Fish Hatchery.
- Assess options for improving passage for steelhead and spring-run Chinook salmon at Tumwater Dam.
- Finalize and implement the Okanogan and Wenatchee National Forest Procedures for Watershed and Aquatic Resource Assessment, Analysis and Proposal Development.
- Reduce road and stream interactions to restore aquatic habitat function, in-stream flow and sediment regimes, water quality, and biological functions (spawning, rearing, foraging, and migration) on Federal lands in the Little Wenatchee, Nason, Chiwawa, Icicle, Peshastin, Chumstick, and Mission watersheds.
- Protect and restore floodplain function and reconnection, off-channel habitat, and channel migration processes to increase juvenile rearing habitat.
- Develop a life-cycle model for spring-run Chinook salmon and steelhead to help evaluate effects of habitat restoration, hatchery operations, hydropower management and how they contribute to species recovery.

Entiat River Populations

The Entiat subbasin is considered a relatively small population with a simple spatial structure. Spring-run Chinook salmon are considered to have one major spawning area with no minor spawning areas. Steelhead have two major spawning areas and three minor spawning areas (ICTRT 2005).

1) Key Emergent or Ongoing Habitat Concerns

The primary habitat conditions in the Entiat Basin that currently limit abundance, productivity, spatial structure, and diversity of salmon and steelhead include stream channel configuration and complexity that has been reduced due to logging in the riparian zone, flood control measures that straightened the channel and removed large wood from the river channel. These historic and ongoing activities have led to a condition with low instream habitat diversity including few pools, lack of large wood accumulations, and disconnected side channels, wetlands, and floodplains. The result is a reduction in resting and rearing areas for both adult and juvenile salmon throughout the Entiat River (UCRTT 2014). Since the previous 2010-2011 five-year status review, the most widespread ecological concerns in the subbasin (by occurrence in assessment units) are altered primary productivity, increased sediment conditions, instream structural complexity, bed and channel form, and riparian condition (UCSRB 2014b).

2) Specific Areas of Concern

Specific areas of concern include:

- Juvenile rearing habitat in lower tributaries and in the mainstem Entiat River that provide complex channel structure, floodplain connectivity, and forage.
- Reduced flow levels and/or elevated water temperatures, particularly in Roaring Creek.
- Impairment of tributary habitat-forming processes and functions from upland actions that influence channel structure, complexity, connectivity, and vegetation. Particularly the USFS road network in the Upper Entiat and Mad River watersheds.

3) Key Protective Measures and Major Restoration Actions

The highest priority within the Entiat subbasin is the protection of habitat that supports salmonid communities so that the populations are robust to environmental disturbances, can increase in abundance, and expand their range to adjacent watersheds. These high priority areas for restoration within the Entiat subbasin include the Middle Entiat Sillwaters, Lower Entiat, Mad River, and Upper-Middle Entiat (Gray-Stormy) (UCRTT 2014). One of the key limiting factors that still remains in the Entiat is the limited amount of juvenile rearing habitat (Andonaegui 1999, UCRTT 2014).

Restoration actions in the Entiat include the Chelan-Douglas Land Trust's acquisition and protection of several riverine and floodplain properties. Other organizations including the Cascadia Columbia Fisheries Enhancement Group and the Yakama Nation have completed habitat complexity projects in the Lower Entiat River as well as some side channel work (HWS 2015).

4) Key Regulatory Measures

Various federal, state, county and tribal regulatory mechanisms are in place to minimize or avoid habitat degradation caused by human use and development. Many of these mechanisms have been improved and updated in the past five years. However, the implementation and effectiveness of regulatory mechanisms has not been adequately documented. See Listing Factor D: Adequacy & Inadequacy of Regulatory Mechanisms, and Protective Efforts in this document for details.

5) Recommended Future Actions

- Finalize and implement the Okanogan and Wenatchee National Forest Procedures for Watershed and Aquatic Resource Assessment, Analysis and Proposal Development.
- Reduce road and stream interactions to restore aquatic habitat function, in-stream flow and sediment regimes, water quality, and biological functions (spawning, rearing, foraging and migration) on Federal lands in the Upper Entiat and Mad River watersheds.

- Protect and restore floodplain function and reconnection, off-channel habitat, and channel migration processes to increase juvenile rearing habitat through implementation of the habitat restoration actions in the Gray and Stormy reach and Stillwaters reach projects.
- Develop a life-cycle model for spring-run Chinook salmon and steelhead to help evaluate effects of habitat restoration, hatchery operations, hydropower management and how they contribute to species recovery.

Methow River Populations

The ICTRT classified the Methow River spring-run Chinook salmon population as "very large" in size based on historical habitat potential. The Methow spring Chinook salmon population was classified as a "type B" population (based on historic intrinsic potential) because it has dendritic tributary structure with multiple major spawning areas (ICTRT 2005). The ICTRT identified four major spawning areas and one minor spawning area for the Methow River spring-run Chinook salmon population, and four major and eight minor spawning areas for the Methow summer-run steelhead population (ICTRT 2005).

1) Key Emergent or Ongoing Habitat Concerns

The Methow River has a high proportion of pristine habitat in the upper portions of major tributaries. The primary habitat conditions in the Methow Basin that currently limit abundance, productivity, spatial structure, and diversity of salmon and steelhead are mostly found in the middle and lower mainstem and lower portions of major tributaries that have been affected by state highways, county roads, and residential and agricultural development that have diminished the overall function of the stream channel and floodplain. This has impaired stream complexity, wood and gravel recruitment, floodwater retention, and water quality. Additionally, late summer and winter instream flow conditions often reduce migration, spawning, and rearing habitat for salmonids. This problem is partly natural (a result of watershed-specific weather and geomorphic conditions) but is exacerbated by irrigation withdrawals (UCSRB 2014b). Since the previous 2010-2011 five-year status review, the most widespread ecological concerns in the subbasin (by occurrence in assessment units) are riparian condition, bed and channel form, decreased water quality, and instream structural complexity (UCSRB 2014b).

2) Specific Areas of Concern

Specific areas of concern include:

- Juvenile rearing habitat in lower tributaries and in the mainstem Methow River that provide complex channel structure, floodplain connectivity, and forage.
- Reduced flow levels and/or elevated water temperatures, particularly in theUpper Methow, Chewuch, Beaver Creek, Early Winters Creek, and Lower Twisp River.
- Impairment of tributary habitat-forming processes and functions from upland actions that influence channel structure, complexity, connectivity, and vegetation. Particularly the USFS road network in the Chewuch River, Twisp River, and Beaver Creeks.

- Livestock related impacts to riparian areas and redd trampling of ESA-listed species in the Chewuch and Twisp watersheds.

- The road created passage barrier at river mile 1.7 on Eightmile Creek.

3) Key Protective Measures and Major Restoration Actions

The highest priority within the Methow subbasin is the protection of habitat that supports robust spring-run Chinook salmon and steelhead populations that have the capacity to be resilient to environmental disturbances, can increase in abundance, and expand their range to adjacent watersheds. Priority watersheds to protect within the Methow Subbasin are the Lost, Twisp, Chewuch, Upper and Middle Methow Rivers, and Early Winters Creek (UCSRB 2014b).

Restoration actions in the Methow subbasin have included the Yakama Nation's 1890s Side Channel Project that restored a side channel to the Methow River. They have also worked to improve habitat complexity in the Chewuch River through large wood placement and side channel projects. Also in the Methow, Trout Unlimited and others have worked with two major irrigation diversions to modify and eliminate their need for yearly push-up dams. Other irrigation improvements include changes in the point of diversion, habitat restoration, and significant water efficiency improvements (HWS 2015).

4) Key Regulatory Measures

Various federal, state, county and tribal regulatory mechanisms are in place to minimize or avoid habitat degradation caused by human use and development. Many of these mechanisms have been improved and updated in the past five years. However, the implementation and effectiveness of regulatory mechanisms has not been adequately documented. See Listing Factor D: Adequacy & Inadequacy of Regulatory Mechanisms, and Protective Efforts in this document for details.

5) Recommended Future Actions

- Protect and restore floodplain function and reconnection, off-channel habitat, and channel migration processes to increase juvenile rearing habitat through implementation of habitat restoration actions.

- Finalize and implement the Okanogan and Wenatchee National Forest Procedures for Watershed and Aquatic Resource Assessment, Analysis and Proposal Development.

- Reduce road and stream interactions to restore aquatic habitat function, in-stream flow and sediment regimes, water quality, and biological functions (spawning, rearing, foraging and migration) through significant reductions of the road system network on USFS lands focusing on the Chewuch and Twisp watersheds.

- Manage cattle grazing on federal lands to eliminate riparian related habitat degradation and direct effects to ESA-listed fish, by significantly reducing cattle numbers, abandonment of allotments, or other management strategies particularly in the Chewuch and Twisp watersheds.

- Assess the road related barrier in Eightmile Creek and design and restore fish passage.
- Develop a life-cycle model for spring-run Chinook salmon and steelhead to help evaluate effects of habitat restoration, hatchery operations, hydropower management and how they contribute to species recovery.

Okanogan River Steelhead Population

The Okanogan/Similkameen is the largest and most complex subbasin in the region (UCSRB 2014b). The ICTRT identified 10 major and 24 minor spawning areas for the Okanogan summer-run steelhead population. However, only two major and five minor spawning areas are within the U.S. portion (ICTRT 2005).

1) Key Emergent or Ongoing Habitat Concerns

Barriers, poor water quality and low late-summer instream flows (mainstem and tributary) limit the survival, distribution, and productivity of both anadromous and inland salmonids. Transboundary planning and implementation are ongoing and critical because more than half of the subbasin is within British Columbia (UCSRB 2014b). Disruptions to the hydrologic system have resulted in elevated water temperatures in the mainstem, substantially reducing the suitable migratory period for adult Chinook salmon to access productive habitat. In addition to inhospitable thermal conditions in the mainstem, and lack or loss of stream flow in the tributaries, excessive amounts of fine sediment and migration barriers are other factors limiting salmonid production within the Okanogan River subbasin (UCSRB 2014b). The most widespread ecological concerns in the subbasin are instream structural complexity, riparian condition, increased sediment quality, and decreased water quantity (UCSRB 2014b).

2) Specific Areas of Concern

Specific areas of concern include:

- Reduced flow levels and/or elevated water temperatures, particularly in Salmon Creek, Omak Creek, Johnson Creek, and others.
- Impairment of tributary habitat-forming processes and functions from upland actions that influence channel structure, complexity, connectivity, and vegetation. Particularly the road network in Omak Creek and Salmon Creek watersheds.
- Juvenile rearing habitat in lower tributaries and in the mainstem Okanogan River that provide complex channel structure, floodplain connectivity, and forage.

3) Key Protective Measures and Major Restoration Actions

Restoration actions in the Okanogan have included action both in the United States and Canada. Some major activities included the improvement of passage over Canadian Dams and into tributary habitat. In the United States portion of the Okanogan, the Colville Confederated Tribes have continued improving tributary habitat through culvert replacement and flow enhancement in Salmon Creek through irrigation efficiency improvements and numerous land acquisitions in Salmon Creek and Ninemile Creek (HWS 2015, UCSRB 2014b).

4) Key Regulatory Measures

Various federal, state, county and tribal regulatory mechanisms are in place to minimize or avoid habitat degradation caused by human use and development. Many of these mechanisms have been improved and updated in the past five years. However, the implementation and effectiveness of regulatory mechanisms has not been adequately documented. See Listing Factor D: Adequacy & Inadequacy of Regulatory Mechanisms, and Protective Efforts in this document for details.

5) Recommended Future Actions

- Protect and restore floodplain function and reconnection, off-channel habitat, and channel migration processes to increase juvenile rearing habitat through implementation of habitat restoration actions.
- Restore access to steelhead habitat in the Similkameen River above Enloe Dam.[3]
- Restore perennial stream flow in Salmon Creek.
- Reduce road and stream interactions to restore aquatic habitat function, in-stream flow and sediment regimes, water quality, and biological functions (spawning, rearing, foraging and migration) through significant reductions of the road system network on USFS lands focusing on the Salmon and Omak watersheds.
- Develop a life-cycle model for spring-run Chinook salmon and steelhead to help evaluate effects of habitat restoration, hatchery operations, hydropower management and how they contribute to species recovery.

MPG/ESU/DPS Summary

Despite significant efforts to improve habitat conditions, much of the habitat in the range of UCR spring-run Chinook salmon and UCR steelhead remains degraded. Restoring habitat to historic conditions may not be needed to attain viability, but considerable improvement is needed to restore habitat to levels that will support viable populations of both UCR steelhead and spring-run Chinook salmon. In particular, the poor status of the habitat is a major obstacle to achieving UCR spring-run Chinook salmon ESU and steelhead DPS viability. There are significant opportunities to improve habitat conditions in the Okanogan, Methow, Entiat, and Wenatchee basins.

Listing Factor A Conclusion

New information available since the last status review indicates that many restoration and protection actions have been implemented in freshwater and estuary habitat but does not reveal overall trends in habitat quality, quantity, and function. In addition, we remain concerned with habitat conditions throughout the range of the UCR steelhead DPS and spring-run Chinook

[3] Although not necessary for recovery, such an action would help with viability and natural processes.

salmon ESU, particularly in regards to water quality, water quantity, riparian condition, and floodplain function. We therefore conclude that the risk to the species' persistence because of habitat destruction or modification has not changed since the last status review.

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

Harvest

Terminal fisheries targeting hatchery-origin fish in the Hanford Reach, above Priest Rapids Dam, and surrounding tributaries reduce hatchery surplus returns reducing potential impacts to natural-origin fish (Tonseth et al. 2011-15, Tonseth and Jateff 2010-11, Tonseth and Maitland 2012-2013). The current *U.S. v. Oregon* Management Agreement (2008-2017) has, on average, maintained reduced impacts of fisheries on the UCR spring-run Chinook salmon ESU and UCR steelhead DPS over past practices (TAC 2011-14).

UCR spring-run Chinook salmon from the upper Columbia River basin migrate offshore in marine water and where impacts in ocean salmon fisheries are too low to be quantified. The only significant harvest occurs in the mainstem Columbia River in tribal and non-tribal fisheries directed at hatchery spring-run Chinook salmon from the Columbia and Willamette rivers. Exploitation rates have remained relatively low, generally below 10 percent, though they have been increasing in recent years. The increases in recent years have resulted from increased allowable harvest rates under the abundance driven sliding scale harvest rate strategy guiding annual management in response to continued large returns of hatchery spring-run Chinook salmon to the Columbia River basin (NWFSC 2015).

For UCR steelhead, total exploitation rates have been stable at around 5-7 percent range (TAC 2011-14). The majority of impacts on the summer-run occur in tribal gillnet and dip net fisheries targeting the spring-run Chinook salmon.

Research and Monitoring

Much of the scientific research and monitoring being conducted for UCR steelhead and spring-run Chinook salmon is intended to fulfill managers' obligations under the ESA to ascertain the status of the species. For authorized scientific research and monitoring throughout the Pacific Northwest (PNW), authorized mortality rates are capped at no greater than 0.5% of any PNW ESA-listed salmonid ESU/DPS. In 2014, researchers were approved to take up to 89,000 naturally produced juvenile UCR steelhead with a 2.66 percent mortality rate and 68,664 naturally produced juvenile UCR spring-run Chinook salmon with a 2.22 percent mortality rate. For the vast majority of scientific research permits, history has shown that researchers generally take far fewer salmonids than the allotted number of salmonids every year (12.35% of requested take and 11.07% of requested mortalities were used in PNW Section 10a1A permits from 2008 to 2014). The majority of the requested nonlethal take of juvenile steelhead have been and are expected to continue to be captured with screw traps, electrofishing units, beach seines, dip nets, weirs, and hook and line (NMFS APPS database; https://apps.nmfs.noaa.gov/). Our records from

the past nine years indicate that mortality rates for screw traps are typically less than 1 percent and backpack electrofishing typically less than 3 percent. Researchers deploy screw traps from late winter through early summer to capture juvenile salmon and steelhead during their annual outmigration. Managers use the data collected from screw traps to derive estimates of outmigration abundance. Backpack electrofishing is used to capture juvenile fish for abundance estimates, tagging and marking, and tissue samples. However, a small number of the naturally produced adult fish may die as an unintended result of the research.

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

The quantity of permits issued over the past five years has been mostly consistent with the prior five years; however, the overall effect on listed populations has not changed substantially. Therefore, we conclude that the risk to the species' persistence because of utilization related to scientific studies remains essentially unchanged since the Ford et al. 2011 status review.

Listing Factor B Conclusion

New information available since the last status review indicates that the current *U.S. v. Oregon* Management Agreement (2008-2017) has, on average, maintained reduced harvest impacts for UCR spring-run Chinook salmon and UCR steelhead fisheries (TAC 2011-14) over past practices. However, research impacts have increased slightly (NMFS APPS database; https://apps.nmfs.noaa.gov/). The risk to the species' persistence because of overutilization remains essentially unchanged since the 2011 five-year status review with harvest and research/monitoring sources of mortality continuing to impede the rate of recovery for the UCR spring-run Chinook salmon ESU and UCR Steelhead DPS.

Listing Factor C: Disease or predation

Predation

A Columbia River basin-wide assessment of avian predation on juvenile salmonids indicates that the most significant impacts to smolt survival occur in the Columbia River estuary (Collis et al. 2009). Although actions to reduce avian predation in the Columbia River basin have been ongoing with implementation of the 2008 Federal Columbia River Power System (FCRPS) Biological Opinion (Opinion), high levels of avian predation by Caspian terns and double-crested cormorants continue to affect the UCR steelhead DPS. Further, predation remains a concern due to a general increase in pinniped populations along the West Coast. Non-indigenous fish affect salmon and their ecosystems through many mechanisms.

Caspian Terns

The NMFS' 2008 FCRPS Opinion recommended that the Action Agencies implement the Caspian Tern Management Plan (RPA Action 45) to substantially reduce this species' nesting habitat and salmonid predation rates in the Columbia River estuary by 2018. The plan calls for reductions in nesting habitat for Caspian terns at East Sand Island in the lower estuary, concurrent with the development of alternative nesting habitat elsewhere in the interior Northwest and along California coast (i.e., outside the Columbia River basin) (NMFS 2014a). To date, nine alternative nesting habitat islands totaling 8.3 acres have been constructed at interior locations, but no coastal sites have been developed. Tern nesting habitat on East Sand Island has been reduced from 6 acres down to a current 1.58 acres, which has reduced the colony from a pre-management level of about 9,000 pairs to 6,000 to 6,500 pairs. However, this is short of the reduction to 3,500 to 4,000 pairs that was anticipated by the management plan and assessed in the 2008 Opinion's analysis (NMFS 2014a). NMFS also recommended that the Action Agencies reduce predation by Caspian terns nesting in the inland Columbia River basin including those on Goose Island in Potholes Reservoir and Crescent Island in McNary Reservoir. Survival benefits to UCR steelhead and spring-run Chinook salmon began to increase when nesting dissuasion actions began in early 2014. Tern predation on the upper Columbia River species is expected to decrease further when dissuasion begins at Crescent Island in 2015.

Double-crested Cormorants

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

Pinnipeds

Status of Pinnipeds Populations in Oregon and Washington

Pinniped predation continues to remain a concern for listed species in Oregon and Washington due to a general increase in pinniped populations along the West Coast. For example, California sea lions have increased at a rate of 5.4 percent per year between 1975 and 2011 (NMFS 2015b), Steller sea lions have increased at a rate of 4.18 percent per year between 1979 and 2010 (Allen

and Angliss 2014), and harbor seals likely remain at or near carrying capacity in Washington and Oregon (Jefferies et al. 2003, Brown et al. 2005, respectively, as cited in NMFS 2014b).[4]

Columbia River Basin

In the Columbia River Basin, there has been a steady influx of pinnipeds (Figure 3), especially California sea lions, over the past 5 years with sharp increases in California sea lion presence in 2013 of 750 animals, 1,420 animals in 2014,[5] and 2,340 animals in 2015.[5]

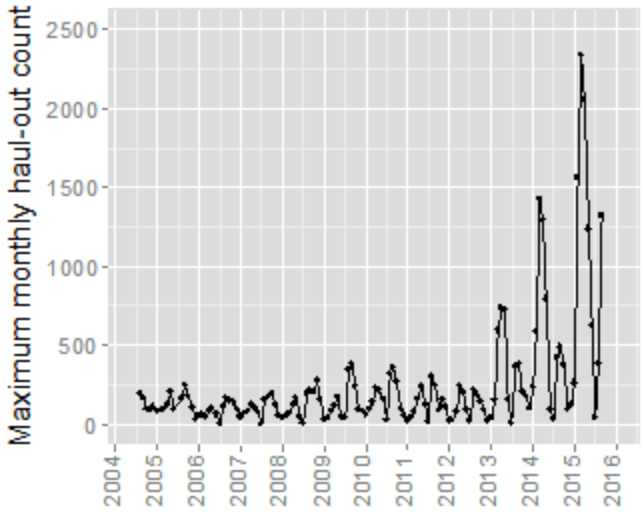

Figure 3. Estimated peak counts (spring and fall) of California sea lions in the East Mooring Basin in Astoria, Oregon, 2004 through 2015.[5]

As pinniped numbers have increased in the Columbia River basin over the past 13 years (2002 through 2014), more than 40,000 fish from listed and non-listed salmon and steelhead stocks (listed stocks: Upper Columbia River spring-run Chinook salmon, Snake River spring/summer-run Chinook salmon, Upper Columbia River steelhead, Snake River Basin steelhead, Middle Columbia River steelhead; non-listed stocks: Middle Columbia River spring-run Chinook salmon, Upper Columbia River summer-run Chinook salmon, Deschutes River summer-run Chinook salmon) have been consumed by California sea lions in the vicinity of Bonneville Dam (Stansell et al. 2014). Most, but not all, California sea lions leave Bonneville Dam by the end of May, and there have been a handful that have taken residence in the area between Bonneville Dam forebay and The Dalles Dam. All up-river stocks are subject to pinniped predation in the vicinity of Bonneville Dam, although it is the spring-run stocks that are at greatest risk because of 'run' timing.

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

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

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

Ongoing research in the Columbia River (Wargo Rub et al. 2014)[6] suggests that 10 to 45 percent of the returning adult salmon are unaccounted for during the 146 mile migration between the Columbia River estuary and the Bonneville Dam, at the time when the California sea lions are present in the Columbia River in large numbers. If California sea lions are in fact responsible for a substantial fraction of this estimated loss, then this additional source of pinniped predation (in addition to documented predation at Bonneville Dam) may represent a significant shift in the severity of pinniped predation to the recovery of listed Columbia River basin salmon and steelhead stocks, in addition to anthropogenic threats (e.g., impacts from habitat loss, dams, etc.).

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

The effect of marine mammal predation on the productivity and abundance of Columbia River basin salmon and steelhead stocks has not been quantitatively assessed at this time. The absolute number of animals preying upon salmon and steelhead throughout the lower Columbia River and Willamette River is not known. In addition to pinniped predation on salmonids, this steady influx of pinnipeds into the Columbia River may also represent a threat to other species, such as eulachon. For example, in 2015 WDFW[7] estimated, based on biomass reconstruction for eulachon consumption, that harbor seals were consuming an estimated 2,700,000 eulachon per day in the Columbia River estuary.

The information available since the last status review clearly indicates that predation by pinnipeds on listed stocks of Columbia River basin salmon and steelhead, as well as eulachon, has increased at an unprecedented rate. So while there are management efforts to reduce pinniped predation in the vicinity of Bonneville Dam, this management effort is insufficient to

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

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

reduce the severity of the threat, especially pinniped predation in the Columbia River estuary (river miles 1 to 145), and at Willamette Falls.

Recommendations

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

Non-indigenous Fish

Non- indigenous fishes affect salmon and their ecosystems. A number of studies have concluded that many established non-indigenous species (in addition to smallmouth bass, channel catfish, and American shad) pose a threat to the recovery of ESA-listed Pacific salmon. Threats are not restricted to direct predation; non-indigenous species compete directly and indirectly for resources, significantly altering food webs and trophic structure, and potentially altering evolutionary trajectories. (Sanderson et al. 2009; NMFS 2010). A sport fishing reward program was implemented in 1990 to reduce the numbers of northern pikeminnow in the Columbia River basin (NMFS 2010). The program continues to meet expected targets, which may reduce predation on smolts in the mainstem Columbia River.

Disease

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

Listing Factor C Conclusion

Disease rates over the past five years are believed to be consistent with the previous review period. Climate change impacts such as increasing temperature may increase susceptibility to diseases. Recent reports indicate the spread of a new strain of IHNV along the Pacific coast may increase disease related concerns for UCR spring-run Chinook salmon and UCR steelhead in the future (Kurath 2012).

New information available since the last status review indicates there is an increase in the level of avian and pinniped predation on UCR steelhead and spring-run Chinook salmon. The avian predation actions that were implemented in 2014-2015 and are ongoing are too recent to have affected the productivity of the Upper Columbia River populations during the period considered in this status review, but should contribute to improved status of the species in the next 5-year review. We therefore conclude that the risk to the species' persistence because of predation has increased by an unquantified amount since the last status review.

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

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

Habitat

Mainstem Columbia River Hydrosystem Improvements (including Upper Columbia River Public Utility Districts)

The Upper Columbia River salmon and steelhead recovery plan (UCSRB 2007) identified the existence and operation of dams in the mainstem migration corridor as threats to the survival and recovery of the spring-run Chinook salmon ESU and steelhead DPS. These include Grand Coulee and Chief Joseph dams, which block passage to some of the species' historical spawning areas, and nine run-of-the-river dams that reduce the survival of juvenile and adult salmonids compared to a free-flowing reach. The mid-Columbia River Public Utility Districts (PUDs) own five of the nine run-of-the-river dams, and the remaining four dams are part of the FCRPS. The configuration at each dam is adjusted to protect listed salmon and steelhead through consultation with the responsible Federal agencies [Corps, Bonneville Power Administration, and the U.S. Bureau of Reclamation in the case of the FCRPS projects, and the Federal Energy Regulatory Commission (FERC), in the case of the projects owned and operated by the PUDs] as described in NMFS' biological opinions. Recent changes at these dams that are likely to have affected the status of the UCR species are described in the following sections.

Improvements in Operations and Fish Passage at FCRPS Hydropower Facilities

The implementation of the Reasonable and Prudent Alternative (RPA) in the 2008 FCRPS Opinion (NMFS 2008), as supplemented in 2010 (NMFS 2010) and 2014 (NMFS 2014a), has provided a number of actions that are improving the survival and condition of salmon and steelhead migrants through the mainstem Columbia River:

- Flow management from storage reservoirs
- Increased spill levels at McNary and John Day dams

- Operations and maintenance activities to maintain biological performance
- Piscivorous fish, avian, and pinniped predation control measures

Changes in the life-cycle productivity of UCR spring-run Chinook salmon and steelhead, as updated in this status review, were affected by alterations to the FCRPS since about 2005. Studies show that the direct survival of juvenile salmonids outmigrating from upper Columbia River populations has increased because of the installation or improvement of juvenile passage structures: surface passage routes and spillway weirs at McNary Dam in 2007, two surface passage weirs at John Day Dam in 2008, spillway wall at The Dalles Dam in 2010, and a new outfall for the Juvenile Bypass System at McNary Dam in 2012. Juvenile and adult passage facilities at mainstem dams are the subject of ongoing testing for passage survival and behavioral responses with the results informing further changes to facility design and project operations under the principle of adaptive management.

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

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

The mid-Columbia River PUDs have improved passage conditions at their projects by installing a new surface bypass at Wanapum Dam (2008) and Priest Rapids Dam (2014). Juvenile passage facilities have continued to perform well at Rocky Reach Dam (where a surface collector was installed in 2003) and at Rock Island and Wells dams (where notched surface spill gates and a surface collector, respectively, were installed more than a decade ago). Other recent improvements include the construction of a new trapping and handling facility at Priest Rapids Dam; new turbine runners at Wanapum Dam; PIT-tag detection arrays in the Rocky Reach Dam juvenile bypass facility; improvements to Northern Pikeminnow removal programs; and enhanced avian predator deterrent programs (hazing, wire arrays, and nesting dissuasion).

As a result of these improvements, performance standards for spring-run Chinook salmon have been met at all five of the mid-Columbia River hydro developments and for steelhead at the Wells, Rocky Reach, and Rock Island projects. The exception is juvenile steelhead survival at the Priest Rapids Project (the Wanapum and Priest Rapids developments). The survival standards are the same for all five mid-Columbia River hydropower developments: 98 percent for adult migrants and 93 percent for juvenile migrants or a combined standard of 91 percent (0.98 x 0.93).

2014 Emergency Operation at Wanapum Dam

On February 27, 2014, a horizontal fracture was discovered in the spillway monolith No. 4 at Wanapum Dam. The fracture opened a crack on the upstream face of the structure about 2 inches high by 65 feet long (Grant PUD 2014). Grant PUD initiated an Emergency Action Plan,

drawing the Wanapum Reservoir down to relieve the pressure behind the dam. Although this dewatered the fish ladder exits, Grant PUD worked with the fisheries co-managers, including NMFS, to design modifications so that adult UCR steelhead and spring-run Chinook salmon were able to pass upstream successfully during 2014.

FCRPS Biological Opinion Tributary Habitat Restoration Program

The RPAs in the 2008 FCRPS Opinion (NMFS 2008) incorporate a process by which the Action Agencies are to identify and implement tributary habitat improvement actions sufficient to meet specific habitat quality—and associated survival—improvements for 56 populations of salmon and steelhead in the Interior Columbia River Basin. The technical foundation of the program is a method for estimating the changes in habitat function that are reasonably certain to result from implementation of habitat improvement actions and the corresponding changes in fish survival that are reasonably certain to occur as the productive capacity of habitat changes.

The Action Agencies have evaluated survival benefits projected for each population from actions implemented under the FCRPS Opinion RPA through 2011, as well as the total benefits projected from past actions and those planned for implementation through 2018. NMFS has determined that it is reasonably certain that benefits for all 56 populations will meet or exceed the Opinion's requirements (NMFS 2014a, pp. 3.16-3.17). For UCR spring-run Chinook salmon populations, benefits projected from actions implemented through 2011 are 3 percent for the Entiat, 2 percent for the Methow, and 1 percent for the Wenatchee populations. Actions implemented through 2018 are projected to result in benefits of 24 percent for the Entiat, 8 percent for the Methow, and 5 percent for the Wenatchee populations. For UCR steelhead populations, survival improvements projected as a result of actions implemented through 2011 are 7 percent for the Okanogan, 3 percent for the Entiat, and 2 percent for both the Methow and Wenatchee populations. Actions planned for implementation through 2018 are projected to result in survival improvements of 17 percent for the Okanogan, 8 percent for the Entiat, 7 percent for the Methow, and 6 percent for the Wenatchee population.

While in some cases these projected survival improvements are significant and will no doubt contribute to long-term recovery of these populations and ESU/DPS, it is important to note that the survival improvements generally are well below the survival improvements needed to achieve the basic criteria for MPG and ESU/DPS viability (Subsection 2.2.3, List the Biological Recovery Criteria as They Appear in the Recovery Plan).

FCRPS Biological Opinion Research, Monitoring, and Evaluation

The FCRPS Action Agencies are implementing a comprehensive fish population and habitat research, monitoring, and evaluation (RME) program under the 2008 FCRPS Opinion and its 2010 Supplement (NMFS 2008; NMFS 2010). Major program components include:

- Monitoring to evaluate fish response to the aggregate effects of multiple habitat actions at the watershed or population scale through the use of intensively monitored watersheds (IMWs). Under the Opinion, IMWs are underway in the Entiat, Methow, John Day, and Lemhi rivers. In addition, IMWs funded by NMFS are underway in Asotin Creek, the Upper Middle Fork John

Day River, and the Potlatch River. IMWs have robust experimental design, including data of sufficient quantity, duration, spatial scale, and resolution, to detect change despite environmental variation.

- Habitat status and trends monitoring (under the Columbia Habitat Monitoring Program, or CHaMP) strategically paired with adult and juvenile fish status and trends monitoring.[8] This monitoring will provide data to calibrate mathematical models simulating the overall effects of habitat improvements on changes in habitat condition and, in turn, the effects of these changes on fish abundance and productivity within each MPG and each ESU or DPS within the interior Columbia River basin. This information will also help detect trends in habitat condition over broader geographic scales, including effects of climate change.

- Development of tributary habitat models that take advantage of advancements in habitat monitoring and fish/habitat relationships to link, both empirically and mechanistically, measures of habitat quality with fish survival. This will allow for improved estimates of the effect of changes in habitat quantity and quality on fish population trajectories as well as improved targeting of habitat restoration efforts.

- Action effectiveness monitoring to determine if actions are meeting their biological objectives and to help identify actions that most effectively address specific limiting factors.

- Implementation and compliance monitoring to verify that habitat improvement actions are completed as planned and are functioning as intended.

- This multifaceted RME approach will inform conclusions regarding habitat status and trends, fish population status and trends, fish-habitat relationships (i.e., how changes in habitat affect fish survival), fish response to various treatment types, and the effectiveness of various types of actions in addressing specific limiting factors. The RME program allows testing and validation of assumptions in a step-by-step process:

    - When an action was implemented, did the habitat condition start changing in the way we thought it would?

    - If we opened up habitat, are fish using it?

    - For major types of actions, is the habitat condition changing in the direction we had anticipated?

    - Are fish populations responding to the habitat change in the way we had anticipated?

- Data, analysis, and understanding regarding one population, location, or type of action can be applied appropriately to other populations and locations.

[8] CHaMP monitoring is underway under the FCRPS Opinion (NMFS 2008; NMFS 2010) in the Asotin, Entiat, John Day, Lemhi, Methow, Minam, South Fork Salmon, Tucannon, Umatilla, Upper Grande Ronde, Wenatchee, and Yankee Fork subbasins.

- Data from the 2008 Opinion RME program (NMFS 2014a; BPA and USBR 2013) are preliminary but appear to be supporting the working hypothesis that implementation of tributary habitat improvement actions under the RPA is contributing to improvements in fish population abundance and productivity. Results are showing the types of changes in habitat that we would expect to see, along with increased fish densities in areas treated with improvement actions (e.g., Entiat River IMW, Methow River IMW, Upper Middle Fork John Day).

- Research is also establishing relationships between habitat quality and fish survival and is identifying the factors that most influence juvenile salmon and steelhead productivity. An understanding of those relationships, combined with detailed watershed and population assessments, is helping biologists and managers target the most critical habitat issues and more accurately estimate the benefits for fish. It is crucial to continue this monitoring, to expand it strategically, and to ensure that mangers use the results in planning and implementing actions.

Below are specific examples of Opinion Research, Monitoring and Evaluation for the upper Columbia River:

- In the Entiat River, an IMW is being used to assess whether engineered log structures added to streams, channels, and other habitat improvements increase habitat complexity and diversity enough to produce a population-level increase in salmon abundance or productivity. Implementation of restoration actions is driven by a statistical design that will detect benefits at the population scale. Preliminary findings include increased numbers of pools and greater densities of juvenile Chinook salmon and steelhead in pools created by the log structures during early summer (NMFS 2014a, p. 240).

- The Methow River IMW design focuses on how actions influence habitat over a watershed scale to increase available food supply to salmonids. The design strategy uses models to guide the planning of field work as well as to support analysis. The effects of habitat actions on fish growth rates and survival will be placed in the context of a full life-cycle model. An analysis of recent smolts-per-redd data indicates that freshwater habitat is limiting juvenile salmon. Two monitoring studies conducted under the RPA have shown positive trends in fish abundance as a result of habitat improvement actions. An extensive monitoring effort in Beaver Creek after a fish barrier was removed has demonstrated recolonization by wild steelhead spawners above the barrier. Monitoring of a levee removal and side channel reconstruction project at Elbow Coulee in the Twisp River shows an increased abundance of listed spring-run Chinook salmon and steelhead. Results of these and other actions will be analyzed for watershed-level effects (NMFS 2014a, pp. 240-241).

Federal Land Management

Within the upper Columbia River basin, Federal lands comprise a large proportion of the land base in the upper Columbia River with approximately 52 percent of lands in some type of Federal ownership mostly in the headwaters. The Okanogan-Wenatchee National Forest (OWNF) is the biggest Federal Land owner with over 4 million acres. Although much of the region remains undeveloped, an extensive forest road network has arisen over the past 100 years.

These forest roads have widespread effects on landscape-scale processes and aquatic habitat in the upper Columbia River. Road densities in the region are some of the highest in the state and many of the issues with roads occur in the core areas for salmon and steelhead production. Other important factors that influence watershed health include fire and forest condition (UCSRB 2014a).

The results of the National Watershed Condition Framework (WCF) assessment on OWNF lands show that the majority of sub-watersheds located outside of Wilderness and Inventoried Roadless Areas are currently degraded and need to be restored (USFS 2012). Chronic and road related hydrologic alterations and periodic storm event interactions with the road system only serve to further degrade floodplains, stream channels, water quality and aquatic habitat. Other land management activities (e.g., mining, timber harvest, vegetation management, fire suppression, grazing, recreation, etc.) can also impair watershed and aquatic function, and most of these management activities are dependent on roads.

The Okanogan-Wenatchee National Forest has over 8,200 miles of system roads, including hundreds of miles of unauthorized roads. Roads are recognized as one of the primary issues affecting the aquatic environment. To address these problems, the Okanogan-Wenatchee National Forest is drafting an aquatic restoration strategy to address road related issues on the Forest.

Over the last 5-years the Okanogan-Wenatchee National Forest has shifted to landscape scale restoration through the inclusion of their 2012 Forests Restoration Strategy and their draft Procedures for Watershed and Aquatic Resource Assessment, Analysis and Proposal Development for Whole Watershed Scale Projects (USFS 2012). In addition to these two documents, the OWNF had some other policy documents that helped pave the way for aquatic restoration, including a roads policy and Emergency Repair of Forest Roads guidance. However, OWNF has had challenges in updating their forest plan and travel management plan, which has delayed the Okanogan-Wenatchee National Forest in implementing modifications to their road system and road management that would provide benefits to ESA listed fish and their habitat. However, NMFS is cautiously hopeful that the Forest will continue their progression towards watershed restoration.

Non-Federal Tributary Land Management

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

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

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

In 1971, the Washington State Legislature passed the Washington Shoreline Management Act, adopted by public referendum in 1972. The purpose of the Act is "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines" by requiring every county and many cities to develop a Shoreline Master Plan (SMP) to govern development in shoreline areas, including all wetlands, river deltas, and riparian areas associated with rivers, streams and lakes. The Washington State Department of Ecology promulgated more protective shoreline requirements in 2003. All counties in Washington State, and the cities within those counties, are subject to these requirements and are updating their shoreline master programs pursuant to the update schedule specified in RCW 90.58.080. The Douglas County shoreline master program update was approved by the state on August 27, 2009. Chelan and Okanogan Counties are in the process of updating their Shoreline master programs. Both counties have developed revised final draft documents over the past 5 years, but have not finalized their updates (http://www.ecy.wa.gov/programs/sea/shorelines/smp/status.html).

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

As with the SMA, GMA also has an update process for city and county critical areas ordinances. Most critical areas ordinances were originally adopted following GMA's enactment in 1990/1991. Okanogan County completed a final draft their Critical Areas Ordinance in 2013 that has not yet been approved (http://okanogancounty.org/planning/). Chelan County's ordinance is also underway (http://www.co.chelan.wa.us/natural-resources/pages/critical-areas-ordinance?parent=planning).

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

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

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

Fish Passage Barrier Removal Board (Revised Code of Washington (RCW) 77.95.160)

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

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

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

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

Instream Flows

On December 11, 2007, amendments to Chapter 173-545 WAC (the Instream Resources Protection Program for the Wenatchee River Basin, WRIA 45) were adopted. The existing water management rule (adopted in 1983) was amended to guide water use planning and decision-making for future human domestic needs while maintaining enough water in streams to protect important fish species and existing water rights. No new instream flows have been set in the upper Columbia River region since the last 5-year status review.

Harvest

Pacific Fisheries Management Council Harvest Management

Since 1977, salmon fisheries in the exclusive economic zone (EEZ) (three to 200 miles offshore) off Washington, Oregon, and California have been managed under salmon Fishery Management Plans (FMPs) of the Pacific Fishery Management Council (PFMC). While all species of salmon fall under the jurisdiction of the current plan (PFMC 2014), it currently contains fishery

management objectives only for Chinook, coho, pink (odd-numbered years only), and any salmon species listed under the ESA that is measurably impacted by PFMC fisheries. The current FMP contains no fishery management objectives for steelhead. The PFMC does not manage fisheries for these species and incidental catches are inconsequential (low hundreds of fish each year) to very rare (PFMC 2014). In the event this situation should change, management objectives for these species could be developed and incorporated by plan amendment. The incidental harvest of these salmon species can be allowed or restricted under existing federal fishery regulations.

The constraints on take of ESA-listed species evaluated under incidental take statements and reasonable, prudent alternatives are collectively referred to as consultation standards. These constraints take a variety of forms including FMP conservation objectives, limits on the time and area during which fisheries may be open, ceilings on fishery impact rates, and reductions from base period impact rates. NMFS may periodically revise consultation standards and annually issues a guidance letter reflecting the most current information (e.g., Stelle 2015). While UCR spring-run Chinook salmon are a stock identified in the FMP, these fish are so rarely caught in PFMC fisheries that management actions designed to limit catch from this ESU beyond what would be provided by harvest constraints for other stocks are not necessary (Stelle 2015). Similarly, although the current FMP does not manage for steelhead harvest because they are rarely caught in ocean fisheries and retention of steelhead in non-Tribal treaty fisheries is currently prohibited, NMFS concluded that ocean fishery management actions beyond those already in place that seek to shape fisheries to minimize impacts to steelhead are not necessary (Stelle 2015).

Columbia River Harvest Management

Pursuant to a September 1, 1983 Order of the U.S. District Court, the allocation of harvest in the Columbia River was established under the "Columbia River Fish Management Plan" and implemented in 1988 by the parties of *U.S. v. Oregon*. In 2008, a new 10-year management agreement was negotiated through the *U.S. v. Oregon* process that included revisions to some in-river objectives. This most recent plan is the 2008-2017 *U.S. v. Oregon* Management Agreement. The plan provides a regulatory framework within which the relevant parties may exercise their sovereign powers in a coordinated and systematic manner in order to protect, rebuild, and enhance upper Columbia River fish runs while providing harvest for both Treaty Tribal and non-Treaty Tribal fisheries. The parties to the agreement are the United States, the states of Oregon, Washington, and Idaho, and, the four Columbia River Treaty Tribes: Warm Springs, Yakama, Nez Perce, and Umatilla. The current *U.S. v. Oregon* Management Agreement (2008-2017) has, on average, maintained reduced impacts of fisheries on both the UCR steelhead DPS and UCR spring-run Chinook salmon ESU (TAC 2011-14), and we expect that to continue with the abundance based framework incorporated into the plan. While there has been an observed slight increase in exploitation rates on the UCR spring-run Chinook salmon ESU (TAC 2011-14), this is a result of recent high numbers of hatchery spring-run Chinook salmon to the Columbia River basin. Existing regulatory mechanisms factor this in through year-specific allowable exploitation

rates which are determined by an abundance-based framework in the current management agreement that constrains fisheries in years of low abundance.

Listing Factor D Conclusion:

Based on the improvements noted above, we conclude that the risk to the species' persistence because of the adequacy of existing regulatory mechanisms has decreased slightly. However, despite improvement in the adequacy of regulatory mechanisms within the UCR ESU/DPS, there remain a number of concerns regarding existing regulatory mechanisms, including:

- Lack of documentation or analysis of the effectiveness of land-use regulatory mechanisms and land-use management plans;
- Contradictory policies and/or implementation of regulations by Federal agencies. For example, one agency may take actions to improve riparian vegetation and instream habitat in one area while a short distance away another Federal authority requires removal of vegetation and instream structures;
- Lack of reporting and enforcement for some regulatory programs.

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

Climate Change (NWFSC 2015)

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

Projected Climate Change

Trends in warming and ocean acidification are highly likely to continue during the next century (IPCC 2013). In winter across the west, the highest elevations (e.g. in the Rocky Mountains) will shift from consistent longer (>5 months) snow-dominated winters to a shorter period (3-4 months) of reliable snowfall (Klos et al. 2014); lower, more coastal or more southerly watersheds will shift from consistent snowfall over winter to alternating periods of snow and rain ("transitional"); lower elevations or warmer watersheds will lose snowfall completely, and rain-dominated watersheds will experience more intense precipitation events and possible shifts in the timing of the most intense rainfall (e.g., Salathe et al. 2014). Warmer summer air temperatures will increase both evaporation and direct radiative heating. When combined with reduced winter water storage, warmer summer air temperatures will lead to lower minimum flows in many watersheds. Higher summer air temperatures will depress minimum flows and raise maximum

stream temperatures even if annual precipitation levels do not change (e.g., Sawaske and Freyberg 2014) (NWFSC 2015).

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

Impacts on Salmon

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

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

Terrestrial and Ocean Conditions and Marine Survival (NWFSC 2015)

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

The Warm Blob

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

Pacific Decadal Oscillation

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

El Niño-Southern Oscillation

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

Freshwater environments

Sea surface temperatures across the Northeast Pacific Ocean are anomalously warm which has contributed to above average terrestrial temperatures in the PNW (Bond et al. 2015). Mean air temperatures for Washington, Oregon, and Idaho were the warmest on record for the 24 month period ending in August 2015 (from a 120 year record starting in 1895). In contrast,

precipitation in the PNW was slightly above average during 2014. Since January 2015, however, precipitation has been below average and the 8 month period from January to August was the 11th driest on record. The exceptionally warm air during the winter of 2014/2015 and below average precipitation from January-April resulted in anomalously low snow pack conditions in the Olympic and Cascade Mountains, with most areas having less than 25% of average snow pack in April 2015 (compared to the 1981-2010 record). The combined effects of low flows and high air temperatures are expected to result in higher than normal stream temperatures and reports of fish kills of salmon and sturgeon in the Willamette and mainstem Columbia rivers in late June and July 2015 (NWFSC 2015).

Marine survival

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

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

Hatchery Effects

Hatchery programs can provide short-term demographic benefits, such as increases in abundance during periods of low natural abundance. They also can help preserve genetic resources until limiting factors can be addressed. However, the long-term use of artificial propagation may pose risks to natural productivity and diversity. The magnitude and type of the risk depends on the status of affected populations and on specific practices in the hatchery program.

UCR spring-run Chinook Salmon

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

- Program size reductions in the Methow and Wenatchee Basins;
- Implementation of a Nason Creek program;
- Release of Methow-Composite stock spring-run Chinook salmon to establish a non-essential experiemental population in the Okanogan Basin;
- Conversion of the Chiwawa and Nason programs to sliding-scale based broodstock management aimed at increasing proportionate natural influence (PNI);
- Marking scheme for Winthrop NFH fish to allow surplus returnees to be identified for removal;
- Conversion of the Winthrop program to a "safety net" operation, in which it uses surplus Methow Hatchery returnees for broodstock; and
- Improved marking for removing differentially marked Leavenworth hatchery fish at Tumwater Dam before escaping upstream to spawn in order to reduce the risk of naturally spawning Leavenworth NFH hatchery strays that originate from outside the ESU to the Wenatchee population.

Although several measures have been implemented to reduce risk, the proportion of hatchery fish on the spawning grounds remains high in the Wenatchee and Methow Basins. Thus we conclude on balance, that the extent to which hatchery effects continue to present risks to the persistence of the UCR spring-run Chinook salmon ESU remains unchanged.

UCR Steelhead

The proportions of hatchery-origin returns in natural spawning areas remain extremely high across the DPS, especially in the Methow and Okanogan river populations (NWFSC 2015).

- Hatchery program sizes in both the Wenatchee and Methow Basin have now been reduced, decreasing risks from them.
- In addition, Wenatchee steelhead are now being released from a different site, which should greatly decrease straying.
- Research is underway at Winthrop NFH to develop a 2-yr steelhead smolt program for the Methow Basin, and the hatchery program continues to develop a Methow-specific broodstock.
- The Okanogan program is increasing incorporation of natural-origin broodstock in an attempt to develop an Okanogan specific program. However, hatchery production in the area is still dominated by the Wells program, which releases fish at Wells Hatchery, in the Methow and Okanogan, and at Ringgold Hatchery. This program is responsible for high abundance of hatchery fish on the spawning grounds in the Okanogan and Methow Basins, posing risks to productivity and diversity.

Listing Factor E Conclusion

Climate Change

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

Terrestrial and Ocean Conditions and Marine Survival

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

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

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

Hatchery Effects

For UCR spring-run Chinook salmon, the proportions of natural origin contributions to spawning in the Wenatchee and Methow populations have trended downwards since 1990, reflecting the large increase in releases and subsequent returns from the directed supplementation programs in those two drainages (Hillman et al. 2015). There is no direct hatchery supplementation program in the Entiat River. Hatchery-origin spawners in the Entiat River system are predominately

strays from Entiat NFH releases. The Entiat NFH spring-run Chinook salmon release program was discontinued in 2007, and the upward trend in proportional natural origin since then can be attributed to that closure. In recent years, hatchery supplementation returns from the adjacent Wenatchee River program have also strayed into the Entiat (NWFSC 2015). The nearby Eastbank Hatchery facility is used for rearing the Wenatchee River supplementation stock prior to transfer to the Chiwawa acclimation pond. It is possible that some of the returns from that program are homing on the Eastbank facility and then straying into the Entiat River, the nearest spawning area (NWFSC 2015).

For UCR steelhead, the high risk ratings for diversity are largely driven by chronic high levels of hatchery spawners within natural spawning areas and lack of genetic diversity among the populations. The basic major life history patterns (summer A-run type, tributary and mainstem spawning/rearing patterns, and the presence of resident populations and subpopulations) appear to be present. All of the populations were rated at high risk for current genetic characteristics by the ICTRT. Genetics samples taken in the 1980s indicate little differentiation within populations in the Upper Columbia River DPS. More recent studies within the Wenatchee River basin have found differences between samples from the Pashastin River, believed to be relatively isolated from hatchery spawning, and those from other reaches within the Wenatchee. This suggests that there may have been a higher level of within and among population diversity prior to the advent of major hatchery releases (Seamons et al. 2012). Genetic studies based on sampling in the Wenatchee as well as other Upper Columbia River steelhead population tributaries are underway and should allow for future analyses of current genetic structure and any impacts of changing hatchery release practices (NWFSC 2015; A. Murdoch, WDFW pers. comm.).

Hatchery-origin returns continue to constitute a high fraction of total spawners in natural spawning areas for this DPS. The estimated proportion of natural-origin spawners has increased consistently since the late 1990s for all four populations. Natural-origin proportions were the highest in the Wenatchee River (58 percent). Although increased, natural origin proportions in the Methow and Okanogan rivers remained at extremely low levels. There are currently direct releases of hatchery origin juveniles in three of the four populations, the exception being the Entiat River. Based on PIT detections, hatchery origin spawners in the Entiat River include stray hatchery returns from releases into the Wenatchee River (NWFSC 2015; Hillman et al. 2015).

Efforts Being Made to Protect the Species

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

In the final listing determinations for salmon (70 FR 37160) and steelhead (71 FR 834), we noted that while many of the ongoing protective efforts are likely to promote the conservation of listed

salmonids, most efforts are relatively recent, have yet to demonstrate their effectiveness, and for the most part address conservation needs at scales sufficient to conserve entire ESUs or DPSs. Therefore, we concluded that existing protective efforts did not preclude listing several ESUs of salmon and several DPSs of steelhead.

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

2.4 Synthesis

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

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

The updated status reviews completed by our Northwest Fisheries Science Center indicate that the viability ratings for UCR spring-run Chinook salmon and UCR steelhead remain at high risk and do not meet the viability criteria recommended by the ICTRT and adapted in the 2007 Recovery Plan. For UCR spring-run Chinook salmon, all four populations remain below viability thresholds; while for UCR steelhead, three of four populations remain below viability thresholds with only the Wenatchee population exceeding the minimum threshold for five percent extinction risk (NWFSC 2015). The Science Center concluded, after reviewing the available new information, that the biological risk category for the UCR spring-run Chinook salmon ESU and the UCR steelhead DPS has not changed since the time of the last status review.

Our analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the persistence of the UCR spring-run Chinook salmon ESU and steelhead DPS has not changed significantly since previous status review. Improvements have been made in operations and fish passage at tributary dams and at the FCRPS dams, and numerous habitat restoration projects have been completed in many Upper Columbia River tributaries. Conversely, habitat problems are still common throughout the region and many more habitat improvements are likely needed to

achieve viability. Harvest rates remain relatively low and stable for both species. Changes in hatchery management are needed for both species to reduce the number of hatchery-origin fish used as broodstock and to reduce the number of hatchery fish allowed to spawn naturally. Many regulatory mechanisms have been improved and updated in the past five years; however, the implementation and effectiveness of existing regulatory mechanisms has not been adequately documented. In addition, predation from an increase in pinniped populations and significant avian impacts remain a concern, as do the impacts that climate change poses to long-term recovery.

After considering the biological viability of the Upper Columbia River ESU/DPS and the current status of their ESA section 4(a)(1) factors, we conclude that the status of the UCR spring-run Chinook salmon ESU and steelhead DPS has not improved significantly since the final listing determinations in 2005 and 2006, respectively. The implementation of sound management actions in hydropower, habitat, hatcheries, and harvest are essential to the recovery of the Upper Columbia River ESU/DPS and must continue. The biological benefits of habitat restoration and protection efforts, in particular habitat restoration, have yet to be fully expressed and will likely take another five to 20 years to result in measurable improvements to population viability. By continuing to implement actions that address the factors limiting population survival and monitoring the effects of the action over time, we will ensure that restoration efforts meet the biological needs of each population and, in turn, contribute to the recovery of these species. The UCR Recovery Plan is the primary guide for identifying future actions to target and address UCR spring-run Chinook salmon and UCR steelhead limiting factors and threats. Over the next five years, it will be important continue to implement these actions and monitor our progress.

2.4.1 Upper Columbia River ESU and DPS Delineation and Hatchery Membership

The Northwest Fisheries Science Center's review (NWFSC 2015) found that no new information has become available that would justify a change in the composition of the Upper Columbia River ESU and DPS.

The West Coast Regional Office's review of new information regarding the ESU/DPS membership status of various hatchery programs (Jones 2015) reports several changes to UCR steelhead and UCR spring-run Chinook salmon hatchery programs since the previous 2011 review. For UCR steelhead, one hatchery program changed its name (Omak Creek was renamed Okanogan River). For UCR spring-run Chinook salmon, the Nason Creek hatchery program has been recommended for ESU inclusion; and the Chewuch River program has been recommended for removal (Jones 2015).

2.4.2 ESU/DPS Viability and Statutory Listing Factors

- The Northwest Fisheries Science Center's review of updated information (NWFSC 2015) does not indicate a change in the biological risk category for either UCR species since the time of the last status review (Ford et al. 2011).

- Our analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the UCR salmon and steelhead's persistence has not changed significantly since our previous status review for the UCR spring-run Chinook salmon ESU and the UCR steelhead DPS.

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3 · Results

3.1 Classification

Listing status:

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

- The UCR spring-run Chinook salmon ESU should remain listed as endangered.
- The UCR steelhead DPS should remain listed as threatened.

ESU/DPS Delineation:

The Northwest Fisheries Science Center's review (NWFSC 2015) found that no new information has become available that would justify a change in the composition of the UCR steelhead DPS or spring-run Chinook salmon ESU.

Hatchery Membership:

Jones 2015 reports several changes to UCR steelhead and UCR spring-run Chinook salmon hatchery programs since the previous 2011 review. For UCR steelhead, one hatchery program changed its name (Omak Creek was renamed Okanogan River). For UCR spring-run Chinook salmon, the Nason Creek hatchery program has been recommended for ESU inclusion; and the Chewuch River program has been recommended for removal.

3.2 New Recovery Priority Number

Since the previous 2011 five-year review, NMFS revised the recovery priority numbers from one (NMFS 2009) to new recovery priority numbers of five for the UCR spring-run Chinook salmon ESU and nine for the UCR steelhead DPS (NMFS 2015a) as listed in Table 4 of this document.

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4 · Recommendations for Future Actions

In our review of the listing factors we identified several actions critical to improving the status of the UCR steelhead DPS and the spring-run Chinook salmon ESU. The most important actions to be taken over the next 5 years include implementation of the high priority strategies and actions identified in the 2007 UCR Recovery Plan, the 2008 Biological Opinion on the *U.S. vs Oregon* (in-river harvest) Management Agreement, the 2008 FCRPS Opinion (i.e., RME measures described as the RPAs to operation of the hydrosystem alone; NMFS 2008) and in the 2010 and 2014 Supplemental FCRPS Opinions NMFS 2010, 2014), and the completion of ESA consultations on the hatchery programs affecting the UCR steelhead DPS and spring-run Chinook salmon ESU. We are currently in the process of identifying actions that address the factors contributing to the existing high risk rating for each population, since such actions have the greatest potential to improve VSP parameters at both the MPG and ESU/DPS levels.

We are directing our efforts at populations that need viability improvements according to ESU/DPS-, MPG-, and population-level recovery criteria, the best available scientific information concerning ESU/DPS status, the role of the independent populations in meeting ESU/DPS and MPG viability, limiting factors and threats, and the likelihood of action effectiveness to guide our recommendations for future actions. NMFS is coordinating with the Federal, state, tribal, and local implementing entities during this prioritization process to ensure that risk factors and actions identified in the recovery plan, and the actions identified in the Harvest Biological Opinion, the FCRPS Opinion, and the ESA consultations on hatchery programs are addressed.

Additional recommended actions include:

- Fisheries co-managers further evaluating the impacts of other hatchery releases (both anadromous and resident) on spring-run Chinook salmon and steelhead.
- Federal and private dam operators further investigating causes of adult losses between hydro facilities by reach (particularly the Columbia River Estuary to Bonneville Dam; Bonneville Dam to McNary Dam; and, McNary Dam to Wells Dam).
- Federal and state management agencies estimating sea lion population (and predation rates on salmonids) in the lower Columbia River.
- Fisheries co-managers improving estimates of catch and release harvest impacts.
- State and Tribal fisheries co-managers using pit tag detection on all harvested fish to better understand the sources of losses in conversion rates and improve the sophistication in harvest management.
- Federal, state, tribal and private entities improving estimates of research, monitoring, and evaluation handling (electrofishing, weirs, catch and release, tagging, marking, trapping, sorting) impacts.

- Federal, state, tribal and private entities identifying contributing factors for lower or greater hatchery fish reproductive success.
- Federal, state, tribal and private entities continuing focus and prioritization of recovery actions on limiting factors.
- Federal, state, tribal and private entities implementing Research Monitoring and Evaluation (RME) actions to address critical uncertainties
- Assess options for restoring access to UCR steelhead in the Similkameen River above Enloe Dam.
- Improve passage in Icicle Creek for UCR steelhead past the boulder field in Icicle Creek and the Leavenworth Fish Hatchery
- Assess options for improving passage for steelhead and spring-run Chinook salmon at Tumwater Dam.
- Finalize and implement the Okanogan and Wenatchee National Forest Procedures for Watershed and Aquatic Resource Assessment, Analysis and Proposal Development.
- Manage the proliferation of overwater structures and alteration of mainstem Columbia River shallow water nearshore habitat.
- Through the HGMP consultation process, continue implementation of actions to reduce productivity and diversity risk from hatchery programs.
- Implement additional RM&E designed to increase understanding of productivity and diversity risk from hatchery programs.

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5.1 Federal Register Notices

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

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

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

August 18, 1997 (62 FR 43937). Final Rule: Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead.

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

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

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

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

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

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

February 1, 2006 (71 FR 5178). Final Listing determination: Endangered and Threatened Species: Final Protective Regulations for Threatened Upper Columbia River Steelhead.

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National Marine Fisheries Service
5-Year Review

Upper Columbia River Spring-run Chinook Salmon
Upper Columbia River Steelhead

Conclusion:

Based on the information identified above, we conclude:

- The Upper Columbia River Spring-run Chinook salmon ESU should remain listed as endangered.
- The Upper Columbia River steelhead DPS should remain listed as threatened.

REGIONAL OFFICE APPROVAL

West Coast Regional Administrator, NOAA Fisheries

Approve: Michael Tehan Date: 05/27/2016

Michael Tehan
Assistant Regional Administrator
Interior Columbia Basin Office
West Coast Region
NOAA Fisheries